ICALEPCS2017

Barcelona · Spain, October 8-13

Palau de Congressos de Catalunya

16th International Conference on Accelerator and Large Experimental Physics Control Systems

Organizer

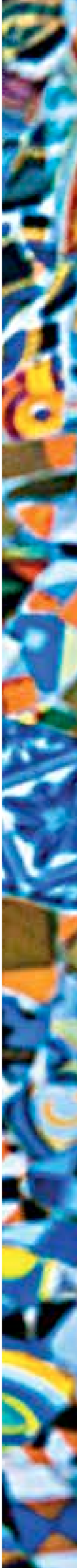
ALBA

Final Program & Abstract Book

ICALEPCS2017

Barcelona · Spain, October 8-13
Palau de Congressos de Catalunya

INDEX



WELCOME

Bienvenidos, Benvinguts, Welcome

On behalf of the local organizing committee we are pleased to welcome you to Barcelona, Spain for the **16th International Conference on Accelerator and Large Experimental Physics Control Systems, ICALEPCS2017**. We are honored to host such an important international conference bringing together the control system specialists from many diverse scientific installations across the world. The ICALEPCS series has and continues to play a significant role promoting collaborations, standards and new technologies in the diverse field of control systems. The commitment of all participants and their contributions and dedication makes the success of this series possible.

This edition is preceded by ten satellite workshops, a record number with a good participation, covering different disciplines related with the control systems. The program includes 5 keynote talks, a total of 111 orals, 36 short oral presentations of posters and 18 speakers' comer live demos.

ICALEPCS2017 is hosted by the ALBA Synchrotron, the Spanish third generation light source in operation since 2012. We would like to thank our colleagues from the local organizing committee as well as all volunteers whose commitment and enthusiasm made the organization of this conference possible. We would also like to thank the international scientific advisory committee and the program committee for their enormous contribution to the success of the conference.

Finally, we would like you enjoy the experience, Barcelona, the program and the networking, and all together make ICALEPCS2017 a memorable event.

We wish you a good stay in this beautiful town, and an excellent conference.

David Fernández
Conference Chair

O Matilla

Óscar Matilla
Program Chair

Organizer ALBA

Endorsed by

EPS APS physics JPS The Physical Society of Japan AAPPS Association of Asia Pacific Physical Societies IEEE NPSS NUCLEAR & PLASMA SCIENCES SOCIETY

PROGRAM AT A GLANCE

Saturday, 7	WORKSHOPS		
08:30	Registration opens		
09:30	EPICS Satellite Meeting (SAW1A) ▼	White Rabbit Tutorial (SAW1C) ▼	TANGO (SAW1D) ▼
10:30			
11:00	Coffee Break		
11:30	EPICS	White Rabbit	TANGO
12:30			
13:30	Lunch		
14:30	EPICS	White Rabbit	TANGO
15:30			
16:00	Coffee Break		
16:30	EPICS	White Rabbit	TANGO
17:30			
18:30			

Sunday, 8	WORKSHOPS		
08:00	Registration opens		
09:00	HDF5 and Data Format (SUW1A) ▼	Control System Cybersecurity (SUW1C) ▼	Motion Control (SUW1D) ▼
10:00			
10:30	Coffee Break		
11:00	HDF5	Cybersecurity	Motion Control
12:00			
13:00	Lunch		
14:00	HDF5	Cybersecurity	Motion Control
15:00			
15:30	Coffee Break		
16:00	HDF5	Cybersecurity	Motion Control
17:00			
18:00			

☐ **Full Day Workshop** ▨ **Half Day Workshop**

PLC Based Control Systems (SAW1E) ▼
PLC
PLC
PLC

Sardana - Scientific SCADA Suite (SUW1E) ▼	User Experience in MicroTCA (SUW1F) ▼
Sardana	MicroTCA
Sardana	MRF Timing Protocol Users (SUY1A) ▼
Sardana	MRF

	Monday, 9	Tuesday, 10		Wednes
	Plenary	Plenary	Parallel	Ple
08:30	**Opening Session** MOOPL	**Keynote Speaker 2** Michel Ossmann TUKPL		**Feedback** **Process** WE
08:45				
09:00	**Keynote Speaker 1** Caterina Biscari & Salvador Ferrer MOKPL			
09:15				
09:30		**Hardware Technology** TUAPL		
09:45				
10:00	**Project Status Report 1** MOAPL			
10:15				Coffee
10:30				
10:45				**Experimen** WE
11:00	Coffee Break	Group Photo		
11:15		Coffee Break		
11:30	**Software Technology Evolution 1** MOBPL	**User Interfaces and User Experience (UX) 1** TUBPL	**Data Management & Processing** TUBPA	
11:45				
12:00				
12:15				
12:30				
12:45				**Keynote** **Carles** WE
13:00	Lunch	Lunch	**Industry Session** TUIPA	
13:15				
13:30				Lu
13:45				
14:00	**Integrating Diverse Systems** MOCPL	**Timing & Synchronization** TUCPL	**Data Analytics** TUCPA	
14:15				
14:30				**Visit** **Sagrada**
14:45				
15:00				
15:15				
15:30		Coffee Break		
15:45	Coffee Break			
16:00		**Software Technology Evolution 2** TUDPL		
16:15	**Control System Upgrades** MODPL			
16:30				
16:45		**Mini-Oral** TUMPL	**Mini-Oral** TUMPA	
17:00				
17:15		**Poster & Speakers' Corner Session** TUPHA - TUSH1 - TUSH2 - TUSH3		
17:30				
17:45				
18:00				
18:15				
18:30				
18:45				
19:00				
20:00				

Sunday, 8

16:00 - 20:00
Registration opens

18:30
Welcome Reception

Conference Key Codes

Day		Sessions	
MO - Monday	TH - Thursday	A, B, C, D - For oral sessions	M - Mini-Oral w
TU - Tuesday	FR - Friday	O - Opening	P - Poster
WE - Wednesday		K - Keynote	S - Speakers' C
		X - Closing	I - Industry Se

sday, 11	Thursday,12		Friday, 13	
nary	Plenary	Parallel	Plenary	
Control and s Tuning APL	**Keynote Speaker 4** Gregorio Ameyugo THKPL		**Keynote Speaker 5** Eugenio Coccia FRKPL	08:30
				08:45
				09:00
			Project Status Report 2 FRAPL	09:15
	User Interfaces and User Experience (UX) 2 THAPL			09:30
				09:45
				10:00
e Break				10:15
				10:30
nt Control 1 BPL	Coffee Break			10:45
			Coffee Break	11:00
	Software Technology Evolution 3 THBPL	**IT Infrastructure for Control Systems** THBPA		11:15
			Workshops Summary FRBPL	11:30
				11:45
				12:00
			Closing Remark FRXPL	12:15
				12:30
Speaker 3 s Gelpí KPL	Lunch			12:45
				13:00
			ALBA Synchrotron Tour	13:15
nch				13:30
	Systems Engineering, Collaborations and Project Management THCPL	**Functional Safety and Machine Protection Systems** THCPA		13:45
				14:00
				14:15
to the a Família				14:30
				14:45
				15:00
				15:15
	Coffee Break			15:30
				15:45
	Experiment Control 2 THDPL			16:00
				16:15
				16:30
	Mini-Oral THMPL	**Mini-Oral** THMPA		16:45
				17:00
	Poster & Speakers' Corner Session THPHA - THSH1 - THSH2 - THSH3			17:15
				17:30
				17:45
				18:00
				18:15
				18:30
				18:45
				19:00
	Conference Dinner			20:00

	Room / Area	
ith Poster	PL - Plenary room	H1 - Speakers' Corner 1
	PA - Parallel room	H2 - Speakers' Corner 2
Corner & Poster	HA - Hall	H3 - Speakers' Corner 3
ssion		

CONFERENCE PROGRAM

Monday, October 9th

08:30 - 09:00 **OPENING SESSION** ▸ Plenary Room
Chair ▸ David Fernandez-Carreiras (ALBA, ES)

08:30 - 08:55 Welcome Address.
David Fernandez-Carreiras - ALBA-CELLS Synchrotron, ES

08:55 - 09:00 Welcome from the Director of ALBA Synchrotron.
Caterina Biscari - ALBA-CELLS Synchrotron, ES

09:00 - 10:00 **MOKPL - KEYNOTE SPEAKER 1** ▸ Plenary Room
Chair ▸ David Fernandez-Carreiras (ALBA, ES)

MOKPL01 - Evolution of Photon Sources.
Caterina Biscari and **Salvador Ferrer** - ALBA-CELLS Synchrotron, ES

10:00 - 11:00 **MOAPL - PROJECTUS STATUS REPORT 1** ▸ Plenary Room
Chairs ▸ Yingbing Yan (SSRF, CN) and John Maclean (ANL, US)

10:00 - 10:15 **MOAPL01** - The Control System for the Linear Accelerator at the European XFEL: Status and First Experiences.
Tim Wilksen - Deutsches Elektronen-Synchrotron

10:15 - 10:30 **MOAPL02** - The First Operation of the MAX IV Laboratory Synchrotron Facilities.
Vincent Hardion - MAX IV Laboratory Lund University

10:30 - 10:45 **MOAPL03** - Status of the National Ignition Facility (NIF) Integrated Computer Control and Information Systems.
Gordon Brunton - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate Photon Science and Applications Program.

10:45 - 11:00 **MOAPL04** - SwissFEL Control System - Overview, Status, and Lessons Learned.
Elke Zimoch - Paul Scherrer Institut

11:00 - 11:30 **COFFEE BREAK** ▸ Exhibition and Poster Area

11:30 - 13:00 **MOBPL - SOFTWARE TECHNOLOGY EVOLUTION 1** ▸ Plenary Room
Chairs ▸ Lize Van den Heever (SKA, ZA) and Gianluca Chiozzi (ESO,GE)

11:30 - 11:45 **MOBPL01** - EPICS 7 Provides Major Enhancements to the EPICS Toolkit.
Leo Bob Dalesio - Osprey DCS LLC

11:45 - 12:00 **MOBPL02** - TANGO Kernel Development Status.
Reynald Bourtembourg - European Synchrotron Radiation Facility

12:00 - 12:15 **MOBPL03** - The SKA Telescope Control System Guidelines and Architecture.
Lorenzo Pivetta - SKA Organisation

12:15 - 12:30 **MOBPL04** - MADOCA II Data Collection Framework for SPring-8.
Takahiro Matsumoto - Japan Synchrotron Radiation Research Institute Controls and Computing Division

12:30 - 12:45	**MOBPL05** - How To Design & Implement a Modern Communication Middleware Based on ZeroMQ. Joel Lauener - European Organization for Nuclear Research Beams Department (BE)
12:45 - 13:00	**MOBPL06** - Facade Devices, a Reactive Approach to Tango. Vincent Michel - MAX IV Laboratory Lund University
13:00 - 14:00	**LUNCH TIME**
14:00 - 15:45	**MOCPL - INTEGRATING DIVERSE SYSTEMS** ▸ Plenary Room Chairs ▸ Gordon Brunton (LLNL, US) and Enrique Blanco (CERN, CH)
14:00 - 14:15	**MOCPL01** - Orchestrating a System. Aaron Lombrozo - Sandia National Laboratories
14:15 - 14:30	**MOCPL02** - Experiences with Laser Survey Instrument Based Approach to National Ignition Facility Diagnostic Alignments. Eric Wilson - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate National Ignition Facility Project
14:30 - 14:45	**MOCPL03** - PROFINET Communication Card for the CERN Cryogenics Crate Electronics Instrumentation. Rafal Krzysztof Mastyna - European Organization for Nuclear Research Technology Department (TE)
14:45 - 15:00	**MOCPL04** - 3G/LTE Based Wireless Communications for Remote Control and Monitoring of PLC Managed Vacuum Mobile Devices. Rodrigo Ferreira - European Organization for Nuclear Research Technology Department (TE)
15:00 - 15:15	**MOCPL05** - ECMC, the Open Source Motion Control Package for EtherCAT Hardware at the ESS. Anders Sandström - European Spallation Source ERIC
15:15 - 15:30	**MOCPL06** - MARWIN: A Mobile Autonomous Robot for Maintenance and Inspection. Andre Dehne - hochschule 21 gGmbH University in Buxtehude
15:30 - 15:45	**MOCPL07** - The Integrated Alarm System of the Alma Observatory. Alessandro Caproni - European Organisation for Astronomical Research in the Southern Hemisphere
15:45 - 16:15	**COFFEE BREAK** ▸ Exhibition and Poster Area
16:15 - 18:00	**MODPL - CONTROL SYSTEM UPGRADES** ▸ Plenary Room Chairs ▸ Nick Hauser (ANSTO, AU) and Tomohiro Matsushita (SPRING8, JP)
16:15 - 16:30	**MODPL01** - Replacing The Engine In Your Car While You Are Still Driving It - Part II. Eric Bjorklund - Los Alamos National Laboratory AOT Division
16:30 - 16:45	**MODPL02** - Virtual Control Commissioning for a Large Critical Ventilation Systems: The CMS Cavern Use Case. William Booth - European Organization for Nuclear Research

16:45 - 17:00	**MODPL03** - Experience Upgrading Telescope Control Systems at the Gemini Telescopes. Arturo Javier Nunez - Gemini Observatory Southern Operations Center
17:00 - 17:15	**MODPL04** - Framework Upgrade of the Detector Control System. Mei Ye - Institute of High Energy Physics Chinese Academy of Sciences Experimental Physics Center
17:15 - 17:30	**MODPL05** - Lightweight Acquisition System for Analogue Signals. Bartosz Przemysław Bielawski - European Organization for Nuclear Research
17:30 - 17:45	**MODPL06** - Recent and Future Upgrades to the Control Systems of LCLS and LCLS-II Scientific Instruments. Daniel Lawrence Flath - SLAC National Accelerator Laboratory
17:45 - 18:00	**MODPL07** - How Low Cost Devices Can Help on the Way to ALICE Upgrade. Ombretta Pinazza - Istituto Nazionale di Fisica Nucleare Sezione di Bologna

Tuesday, October 10th

08:30 - 09:30	**TUKPL - KEYNOTE SPEAKER 2** ▸ Plenary Room Chair ▸ Kevin Brown (BNL, US)
	TUKPL01 - Your Ideas are Worthless. **Michael Ossmann** - Great Scott Gadgets, US
09:30 - 11:00	**TUAPL - HARDWARE TECHNOLOGY ▸ Plenary Room** Chairs ▸ Javier Serrano (CERN, CH) and Timo Korhonen (ESS, SE)
09:30 - 09:45	**TUAPL01** - MicroTCA Generic Data Acquisition Systems at ESS. Simone Farina - European Spallation Source ERIC
09:45 - 10:00	**TUAPL02** - Porting the VME-Based Optical-Link Remote I/O Module to a PLC Platform - an Approach to Maximize Cross-Platform Portability Using SoC. Takemasa Masuda - Japan Synchrotron Radiation Research Institute Controls and Computing Division
10:00 - 10:15	**TUAPL03** - Solving Vendor Lock-in in VME Single Board Computers through Open-sourcing of the PCIe-VME64x Bridge. Grzegorz Daniluk - European Organization for Nuclear Research Beams Department (BE)
10:15 - 10:30	**TUAPL04** - Em# Electrometer Comes to Light. Jose Avila-Abellan - ALBA-CELLS Synchrotron
10:30 - 10:45	**TUAPL05** - PandABox: A Multipurpose Platform For Multi-technique Scanning and Feedback Applications. Shu Zhang - Synchrotron Soleil
10:45 - 11:00	**TUAPL06** - Cryomodule-on-Chip Simulation Engine. Carlos Serrano - Lawrence Berkeley National Laboratory
11:00 - 11:30	**COFFEE BREAK** ▸ Exhibition and Poster Area

11:30 - 13:00	**TUBPL - USER INTERFACES AND USER EXPERIENCE (UX)1** ▸ Plenary Room Chairs ▸ Reinhard Bacher (DESY, GE) and Andy Götz (ESRF, FR)
11:30 - 11:45	**TUBPL01** - CERN Controls Configuration Service: A Challenge in Usability. Lukasz Burdzanowski - European Organization for Nuclear Research Beams Department (BE)
11:45 - 12:00	**TUBPL02** - Taurus Big & Small: From Particle Accelerators to Desktop Labs. Carlos Pascual-Izarra - ALBA-CELLS Synchrotron
12:00 - 12:15	**TUBPL03** - Panic and the Evolution of Tango Alarm Handlers. Sergi Rubio-Manrique - ALBA-CELLS Synchrotron
12:15 - 12:30	**TUBPL04** - Streamlining the Target Fabrication Request at the National Ignition Facility. Carla Manin - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate National Ignition Facility Project
12:30 - 12:45	**TUBPL05** - MXCuBE3 Bringing MX Experiments to the WEB. Marcus Carl Oskarsson - European Synchrotron Radiation Facility
12:45 - 13:00	**TUBPL06** - The Graphical User Interface of the Operator of the Cherenkov Telescope Array. Iftach Sadeh - Deutsches Elektronen-Synchrotron DESY at Zeuthen
11:30 - 13:00	**TUBPA - DATA MANAGEMENT & PROCESSING** ▸ Parallel Room Chairs ▸ Karen White (SNS, US) and Kazuro Furukawa (KEK, JP)
11:30 - 11:45	**TUBPA01** - The Evolution of Component Database for APS Upgrade.* Dariusz Piotr Jarosz - Argonne National Laboratory Advanced Photon Source
11:45 - 12:00	**TUBPA02** - Monitoring the New ALICE Online-Offline Computing System. Wegrzynek Adam - European Organization for Nuclear Research
12:00 - 12:15	**TUBPA03** - Database Scheme for Unified Operation of SACLA / SPring-8. Kensuke Okada - Japan Synchrotron Radiation Research Institute Controls and Computing Division
12:15 - 12:30	**TUBPA04** - The MAX IV Laboratory Scientific Data Management. Vincent Hardion - MAX IV Laboratory Lund University
12:30 - 12:45	**TUBPA05** - High Throughput Data Acquisition with EPICS. Klemen Vodopivec - Oak Ridge National Laboratory Spallation Neutron Source Accelerator Systems Division
12:45 - 13:00	**TUBPA06** - Scalable Time Series Documents Store. Francois Joubert - SKA South Africa National Research Foundation of South Africa Department of Science and Technology
13:00 - 14:00	**TUIPA - INDUSTRY SESSION** ▸ Parallel Room
13:00 - 14:00	**TUIPA01** - Safety is one - main - key to research. Klaus Stark - Pilz GmbH & Co. KG

13:00 - 14:00 **LUNCH TIME**

14:00 - 15:30 **TUCPL - TIMING & SYNCHRONIZATION** ▶ Plenary Room
Chair ▶ Eric Bjorklund (LANL, US) and Nicolas Janvier (ESRF, FR)

14:00 - 14:15 **TUCPL01** - Refurbishment of the ESRF Accelerator Synchronization System Using White Rabbit.
Gerard Goujon - European Synchrotron Radiation Facility

14:15 - 14:30 **TUCPL02** - Synchronized Timing and Control System Construction of SuperKEKB Positron Damping Ring.
Hitoshi Sugimura - High Energy Accelerator Research Organization

14:30 - 14:45 **TUCPL03** - White Rabbit in Radio Astronomy.
Paul Boven - Joint Institute for VLBI ERIC

14:45 - 15:00 **TUCPL04** - SwissFEL Timing System: First Operational Experience.
Babak Kalantari - Paul Scherrer Institut

15:00 - 15:15 **TUCPL05** - Design and Prototyping of a New Synchronization System with Stability at Femtoseconds.
Ming Liu - Shanghai Institute of Applied Physics

15:15 - 15:30 **TUCPL06** - Verification of the FAIR Control System Using Deterministic Network Calculus.
Malte Schütze - Distributed Computer Systems Lab University of Kaiserslautern Department of Computer Science

14:00 - 15:30 **TUCPA - DATA ANALYTICS** ▶ Parallel Room
Chairs ▶ Manuel González Berges (CERN, CH) and Seth Nemesure (BNL, US)

14:00 - 14:15 **TUCPA01** - Data Analysis Support in Karabo at European XFEL.
Hans Fangohr - European XFEL GmbH

14:15 - 14:30 **TUCPA02** - Leveraging Splunk for Control System Monitoring and Management.
Barry Fishler - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate National Ignition Facility Project

14:30 - 14:45 **TUCPA03** - Experience with Machine Learning in Accelerator Controls.
Kevin A. Brown - Brookhaven National Laboratory

14:45 - 15:00 **TUCPA04** - Model Learning Algorithms for Faulty Sensors Detection in CERN Control Systems.
Filippo Maria Tilaro - European Organization for Nuclear Research Beams Department (BE)

15:00 - 15:15 **TUCPA05** - Laser Damage Image Preprocessing Based on Total Variation.
Xiaowei Zhou - Institute of Computer Application China Academy of Engineering Physics

15:15 - 15:30 **TUCPA06** - SwissFEL - Beam Synchronous Data Acquisition - The First Year.
Simon Gregor Ebner - Paul Scherrer Institute Large Research Facilities

15:30 - 16:00	**COFFEE BREAK** ▶ Exhibition and Poster Area
16:00 - 16:45	**TUDPL - SOFTWARE TECHNOLOGY EVOLUTION 2** ▶ Plenary Room Chairs ▶ Gianluca Chiozzi (ESO,GE) and Lize Van den Heever (SKA, ZA)
16:00 - 16:15	**TUDPL01** - Reproduce Anything, Anywhere: A Generic Simulation Suite for Tango Control Systems. Sergi Rubio-Manrique - ALBA-CELLS Synchrotron
16:15 - 16:30	**TUDPL02** - Automatic Formal Verification for EPICS. Jonathan Paul Jacky - University of Washington Medical Center Radiation Oncology
16:30 - 16:45	**TUDPL03** - Control System Simulation Using DSEE High Level Instrument Interface and Behavioural Description. Athanaseus Johannes Tishetso Ramaila - SKA South Africa National Research Foundation of South Africa Department of Science and Technology
16:45 - 17:15	**TUMPL - MINI-ORAL** ▶ Plenary Room Chairs ▶ Richard Farnsworth (ANL, US) and Matthew Bickley (JLAB, US)
16:45 - 16:48	**TUMPL01** - Controls Design and Implementation for Next Beamlines at NSLS-II. Zhijian Yin - Brookhaven National Laboratory National Synchrotron Light Source II
16:48 - 16:51	**TUMPL02** - Streamlining Support and Development Activities Across the Distinct Support Groups of the ALBA Synchrotron With the Implementation of a New Service Management System. Malysa Martin - ALBA-CELLS Synchrotron
16:51 - 16:54	**TUMPL03** - New EPICS/RTEMS IOC Based on Altera SOC at Jefferson Lab. Jianxun Yan - Thomas Jefferson National Accelerator Facility
16:54 - 16:57	**TUMPL04** - LCLS-II Timing Pattern Generator Configuration GUIs. Carolina Bianchini - SLAC National Accelerator Laboratory
16:57 - 17:00	**TUMPL05** - Strategies for Migrating to a New Experiment Setup Tool at the National Ignition Facility. Allan Casey - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate National Ignition Facility Project
17:00 - 17:03	**TUMPL06** - Implementation of Distributed Information Services for Control Systems Framework for Maintenance Domain in a Physical System. Ali Khaleghi - Imam Khomeini International University Engineering
17:03 - 17:06	**TUMPL07** - LeWIS: Let's Write Intricate Simulators. Michael Hart - Science and Technology Facilities Council Rutherford Appleton Laboratory ISIS Department
17:06 - 17:09	**TUMPL08** - MAX IV BioMAX Beamline Control System: From Commissioning Into User Operation. Mikel Eguiraun - MAX IV Laboratory Lund University
17:09 - 17:12	**TUMPL09** - Challenges of the ALICE Detector Control System for the LHC RUN3. Peter Chochula - European Organization for Nuclear Research

16:45 - 17:15	**TUMPA - MINI-ORAL** ▸ Parallel Room Chairs ▸ Seth Nemesure (BNL, US) and Young-Gi Song (KAERI, KR)
16:45 - 16:48	**TUMPA01** - New Visual Alignment Sequencer Tool Improves Efficiency of Shot Operations at the National Ignition Facility (NIF). Mikhail Fedorov - Lawrence Livermore National Laboratory
16:48 - 16:51	**TUMPA02** - Development of a Machine Protection System for KOMAC Facility. Young-Gi Song - Korea Atomic Energy Research Institute (KAERI) Korea Multi-purpose Accelerator Complex (KOMAC)
16:51 - 16:54	**TUMPA03** - The Implementation of KSTAR Fast Interlock System using Compact-RIO. Myungkyu Kim - National Fusion Research Institute
16:54 - 16:57	**TUMPA04** - Operation Status of J-PARC MR Machine Protection System and Future Plan. Takuro Kimura - High Energy Accelerator Research Organization
16:57 - 17:00	**TUMPA05** - OPC UA to DOOCS Bridge: A Tool for Automated Integration of Industrial Devices Into the Accelerator Control Systems at FLASH and European XFEL. Falko Peters - Deutsches Elektronen-Synchrotron
17:00 - 17:03	**TUMPA06** - RF Heat Load Compensation for the European XFEL. Matthias R. Clausen - Deutsches Elektronen-Synchrotron
17:03 - 17:06	**TUMPA07** - Advances in Automatic Performance Optimization at FERMI. Giulio Gaio - Elettra-Sincrotrone Trieste S.C.p.A.
17:06 - 17:09	**TUMPA08** - The Automatic Quench Analysis Software for the High Luminosity LHC Magnets Evaluation at CERN. Maria De Fatima Gomez De La Cruz - European Organization for Nuclear Research
17:15 - 19:00	**TUPHA - POSTER SESSION** ▸ Poster Area
17:15 - 19:00	**TUSH1, TUSH2, TUSH3 - SPEAKERS' CORNER SESSION** ▸ Speakers' Corner Area
	TUSH1 - Screen 1
17:15 - 17:45	**TUSH101** - Creating Interactive Web Pages for Non-Programmers. Ted D'Ottavio - Brookhaven National Laboratory Collider-Accelerator Department
17:45 - 18:15	**TUSH102** - PShell: from SLS beamlines to the SwissFEL control room. Alexandre Gobbo - Paul Scherrer Institut
18:15 - 18:45	**TUSH103** - Web and Multi-Platform Mobile App at Elettra. Lucio Zambon - Elettra-Sincrotrone Trieste S.C.p.A.
	TUSH2 - Screeen 2
17:15 - 17:45	**TUSH201** - Online Luminosity Control and Steering at the LHC. Michael Hostettler - European Organization for Nuclear Research

17:45 - 18:15 **TUSH202** - The Laser Megajoule Facility: Personal Safety System.
Mathieu Gérard Manson - Commissariat à l'énergie atomique et aux énergies alternatives CEA /CESTA

18:15 - 18:45 **TUSH203** - System Identification and Control for the Sirius High Dynamics DCM.
Ricardo Malagodi Caliari - Brazilian Synchrotron Light Laboratory

TUSH3 - Screen 3

17:15 - 17:45 **TUSH301** - Stream Clustering in Hadoop Using Spark Engine on Data Synchrotron.
Ali Khaleghi - Imam Khomeini International University Engineering

17:45 - 18:15 **TUSH302** - uSOP: An Embedded Linux Board for the Belle2 Detector Controls.
Gennaro Tortone - Istituto Nazionale di Fisica Nucleare Sezione Napoli

18:15 - 18:45 **TUSH303** - Managing Your Timing System as a Standard Ethernet Network.
Adam Artur Wujek - European Organization for Nuclear Research Beams Department (BE)

Wednesday, October 11th

08:30 - 10:15 **WEAPL - FEEDBACK CONTROL AND PROCESS TUNING**
▸ Plenary Room
Chairs ▸ Marco Lonza (ELETTRA, IT) and Jean Michel Chaize (ESRF, FR)

08:30 - 08:45 **WEAPL01** - Present and Future of Harmony Bus, a Real-Time High Speed Bus for Data Transfer Between Fpga Cores.
Manuel Broseta - ALBA-CELLS Synchrotron

08:45 - 09:00 **WEAPL02** - Automatic PID Performance Monitoring Applied to LHC Cryogenics.
Benjamin Bradu - European Organization for Nuclear Research Technology Department (TE)

09:00 - 09:15 **WEAPL03** - Simulation of Cryogenic Process and Control of EAST Based on EPICS.
Liangbing Hu - Institute of Plasma Physics Chinese Academy of Sciences

09:15 - 09:30 **WEAPL04** - Nanoprobe Results: Metrology & Control in Stacked Closed-Loop Systems.
Christer Engblom - Synchrotron Soleil

09:30 - 09:45 **WEAPL05** - Parc: A Computational System in Support of Laser Megajoule Facility Operations.
Jean-Philippe Airiau - Commissariat à l'énergie atomique et aux énergies alternatives CEA /CESTA

09:45 - 10:00 **WEAPL06** - Skywalker: Python Suite for Automated Photon Alignment at LCLS.
Alex Wallace - SLAC National Accelerator Laboratory LCLS Department

10:00 - 10:15 **WEAPL07** - On-Line Optimization of XFELs and Light Sources with OCELOT.
Ilya Agapov - Deutsches Elektronen-Synchrotron

10:15 - 10:45	**COFFEE BREAK** ▸ Exhibition and Poster Area
10:45 - 12:30	**WEBPL - EXPERIMENT CONTROL 1** ▸ Plenary Room Chairs ▸ Markus Janousch (PSI, CH) and Guifré Cuní (ALBA, ES)
10:45 - 11:00	**WEBPL01** - EPICS Architecture for Neutron Instrument Control at the European Spallation Source. John Sparger - European Spallation Source ERIC
11:00 - 11:15	**WEBPL02** - On-Axis 3D Microscope for X-Ray Beamlines at NSLS-II.* Kazimierz Gofron - Brookhaven National Laboratory National Synchrotron Light Source
11:15 - 11:30	**WEBPL03** - Beamline and Experiment Automations for the General Medical Sciences and Cancer Institutes Structural Biology Facility at the Advanced Photon Source (GM/CA@APS). Sergey Stepanov - Argonne National Laboratory Advanced Photon Source
11:30 - 11:45	**WEBPL04** - A Software Architecture for Full Beamline Automation - VMXi Use Case. Christopher John Sharpe - Diamond Light Source Ltd
11:45 - 12:00	**WEBPL05** - BLISS - Experiments Control for ESRF EBS Beamlines. Matias Guijarro - European Synchrotron Radiation Facility
12:00 - 12:15	**WEBPL06** - Sardana Based Continuous Scans at ALBA - Current Status. Zbigniew Reszela - ALBA-CELLS Synchrotron
12:15 - 12:30	**WEBPL07** - Optimised Multi-Dimensional Image Scanning With Rascan. Nader Afshar - Australian Nuclear Science and Technology Organisation
12:30 - 13:30	**WEKPL - KEYNOTE SPEAKER 3** ▸ Plenary Room Chair ▸ Oscar Matilla (ALBA, ES) **WEKPL01** - The Sagrada Familia Basilica by Antoni Gaudí. **Carles Gelpí** - Universitat Politécnica de Catalunya

Thursday, October 12th

08:30 - 09:30 **THKPL - KEYNOTE SPEAKER 4** ▸ Plenary Room
Chair ▸ Matthew Bickley (ALBA, ES)

THKPL01 - More Than Particles: How Accelerators Can Speed Up Advanced Manufacturing... and What's Next.
Gregorio Ameyugo - Commissariat à l'énergie atomique et aux énergies alternatives CEA Saclay - Centre NanoInnov CEA LIST - Europe and International, FR

09:30 - 10:45 **THAPL - USER INTERFACES AND USER EXPERIENCE (UX) 2** ▸ Plenary Room
Chairs ▸ Andy Götz (ESRF, FR) and Reinhard Bacher (DESY, GE)

09:30 - 09:45 **THAPL01** - Implementation of Web-based Operational Log System at RIBF.
Akito Uchiyama - RIKEN Nishina Center

09:45 - 10:00 **THAPL02** - Best Practices for Efficient Development of JavaFX Applications.
Grzegorz Kruk - European Organization for Nuclear Research Beams Department (BE)

10:00 - 10:15 **THAPL03** - Usability Recommendations for the SKA Control Room Obtained by a User-Centred Design Approach.
Valentina Alberti - INAF-Osservatorio Astronomico di Trieste

10:15 - 10:30 **THAPL04** - Python for User Interfaces at Sirius.
Douglas Bezerra Beniz - Brazilian Synchrotron Light Laboratory

10:30 - 10:45 **THAPL05** - Nomad 3D: Augmented Reality in Instrument Control.
Yannick Le Goc - Institut Laue-Langevin

10:45 - 11:15 **COFFEE BREAK** ▸ Exhibition and Poster Area

11:15 - 12:45 **THBPL - SOFTWARE TECHNOLOGY EVOLUTION 3** ▸ Plenary Room
Chairs ▸ Gianluca Chiozzi (ESO,GE) and Lize Van den Heever (SKA, ZA)

11:15 - 11:30 **THBPL01** - C2MON SCADA Deployment on CERN Cloud Infrastructure.
Brice Copy - European Organization for Nuclear Research Beams Department (BE)

11:30 - 11:45 **THBPL02** - Behavioural Models for Device Control.
Luigi Andolfato - European Organisation for Astronomical Research in the Southern Hemisphere

11:45 - 12:00 **THBPL03** - A New ACS Bulk Data Transfer Service for CTA.
Mauricio Alejandro Araya - Universidad Técnica Federico Santa María

12:00 - 12:15 **THBPL04** - The Design of Tango Based Centralized Management Platform for Software Devices.
Xiaowei Zhou - Institute of Computer Application China Academy of Engineering Physics

12:15 - 12:30 **THBPL05** - The ELT Linux Development Environment.
Federico Pellegrin - European Organisation for Astronomical Research in the Southern Hemisphere

12:30 - 12:45 **THBPL06** - First implementation of RASHPA, a High-performance RDMA-based Data Acquisition Platform for 2D X-ray Detectors.
Wassim Mansour - European Synchrotron Radiation Facility

11:45 - 12:45 THBPA - IT INFRASTRUCTURE FOR CONTROL SYSTEMS
▸ Parallel Room
Chairs ▸ Roland Müller (BESSY, GE) and Alain Buteau (SOLEIL, FR)

11:15 - 11:30 **THBPA01** - Cyber Threat, the World Is No Longer What We Knew.
Stephane Perez - Commissariat à l'Energie Atomique et aux Energies Alternatives CEA DAM Ile de France

11:30 - 11:45 **THBPA02** - Securing Light Source SCADA Systems.
Leonce Mekinda - European XFEL GmbH

11:45 - 12:00 **THBPA03** - The Back-End Computer System for the Medipix Based PI-MEGA X-Ray Camera.
Marcelo Moraes - Brazilian Synchrotron Light Laboratory

12:00 - 12:15 **THBPA04** - Orchestrating MeerKAT's Distributed Science Data Processing Pipelines.
Anton Joubert - SKA South Africa National Research Foundation of South Africa Department of Science and Technology

12:15 - 12:30 **THBPA05** - Network Traffic Patterns and Performance Improvements for Tango Based Control System and PLC.
Michal Ostoja-Gajewski - Solaris National Synchrotron Radiation Centre Jagiellonian University

12:30 - 12:45 **THBPA06** - Configuration Management for the Integrated Control System Software of ELI-ALP.
Lajos Schrettner - ELI-HU Nonprofit Ltd.

12:45 - 13:45 LUNCH TIME

13:45 - 15:30 THCPL - SYSTEMS ENGINEERING, COLLABORATIONS AND PROJECT MANAGEMENT ▸ Plenary Room
Chairs ▸ Chris Marshall (LNLS, US) and Enzo Carrone (SLAC, US)

13:45 - 14:15 **THCPL01** - Speaking of Diversity.
Karen White - Oak Ridge National Laboratory

14:15 - 14:30 **THCPL02** - Highlights of the European Ground System - Common Core Initiative.
Mauro Pecchioli - European Space Operations Centre European Space Agency

14:30 - 14:45 **THCPL03** - A Success-History Based Learning Procedure to Optimize Server Throughput in Large Distributed Control Systems.
Yuan Gao - Stony Brook University Electrical & Computer Engineering Department

14:45 - 15:00 **THCPL04** - SKA Synchronization and Timing Local Monitor and Control - Software Design Approach.
Ralph Braddock - University of Manchester School of Physics and Astronomy

15:00 - 15:15 **THCPL05** - TANGO Heads for Industry.
Andrew Gotz - European Synchrotron Radiation Facility

15:15 - 15:30 **THCPL06** - Sustaining the National Ignition Facility (NIF) Integrated Computer Control System (ICCS) over its Thirty Year Lifespan.
Barry Fishler - Lawrence Livermore National Laboratory National Ignition Facility Programs Directorate National Ignition Facility Project

13:45 - 15:30 THCPA - FUNCTIONAL SAFETY AND MACHINE PROTECTION SYSTEMS ▸ Parallel Room
Chairs ▸ Mark Heron (DLS, UK) and Alessandro Ercolani (ESA, GE)

13:45 - 14:00 **THCPA01** - Safety Instrumented Systems and the AWAKE Plasma Control as a Use Case.
Enrique Blanco Vinuela - European Organization for Nuclear Research Beams Department (BE)

14:00 - 14:15 **THCPA02** - ESS Accelerator Safety Interlock System.
Denis Paulic - European Spallation Source ERIC

14:15 - 14:30 **THCPA03** - Applying Layer of Protection Analysis (LOPA) to Accelerator Safety Systems Design.
Feng Tao - SLAC National Accelerator Laboratory

14:30 - 14:45 **THCPA04** - Development of a Safety Classified System With LabView and EPICS.
Christophe Haquin - Grand Accélérateur Nat. d'Ions Lourds

14:45 - 15:00 **THCPA05** - Development and Implementation of the Treatment Control System in Shanghai Proton Therapy Facility.
Ming Liu - Shanghai Institute of Applied Physics

15:00 - 15:15 **THCPA06** - A Real-Time Beam Monitoring System for Highly Dynamic Irradiations in Scanned Proton Therapy.
Grischa Klimpki - Paul Scherrer Institut Center for Proton Therapy

15:15 - 15:30 **THCPA07** - Development of an Expert System for the High Intensity Neutrino Beam Facility at J-PARC.
Kazuo Nakayoshi - High Energy Accelerator Research Organization Institute of Particle and Nuclear Studies

15:30 - 16:00 COFFEE BREAK ▸ Exhibition and Poster Area

16:00 - 16:45 THDPL - EXPERIMENT CONTROL 2 ▸ Plenary Room
Chairs ▸ Guifré Cuní (ALBA, ES) and Markus Janousch (PSI, CH)

16:00 - 16:15 **THDPL01** - Configuring and Automating an LHC Experiment for Faster and Better Physics Output.
Clara Gaspar - European Organization for Nuclear Research Physics Department (PH)

16:15 - 16:30 **THDPL02** - GigaFRoST (Gigabyte Fast Read-Out System for Tomography): Control and DAQ System Design.
Tine Celcer - Paul Scherrer Institut

16:30 - 16:45 **THDPL03** - areaDetector: What's New and What's Next?
Mark Lloyd Rivers - Consortium for Advanced Radiation Sources The University of Chicago

16:45 - 17:15	**THMPL - MINI-ORAL** ▸ Plenary Room Chairs ▸ Denis Nicklaus (FERMILAB, US) and Kuo-Tung Hsu (NSRRC, TW)
16:45 - 16:48	**THMPL01** - A Simple Temporal Network for Coordination of a Collaborative System-of-Systems in Research Operations With Large Exogenous Uncertainties. Michael Schaffner - Sandia National Laboratories
16:48 - 16:51	**THMPL02** - Upgrade of KEK Electron/positron Linac Control System for the Both SuperKEKB and Light Sources. Kazuro Furukawa - High Energy Accelerator Research Organization
16:51 - 16:54	**THMPL03** - A New Simulation Architecture for Improving Software Reliability in Collider-Accelerator Control Systems. Yuan Gao - Stony Brook University Electrical & Computer Engineering Department
16:54 - 16:57	**THMPL04** - Telescope Control System of the ASTRI SST-2M prototype for the Cherenkov Telescope Array. Elisa Antolini - Università degli di Perugia Fisica e geologia
16:57 - 17:00	**THMPL05** - Applying Ontological Approach to Storing Configuration Data. Maria Anatolyevna Ilina - Russian Academy of Sciences The Budker Institute of Nuclear Physics
17:00 - 17:03	**THMPL06** - Cameras in ELI Beamlines: A Standardized Approach Birgit Plötzeneder - ELI Beamlines Czech Republic Institute of Physics.
17:03 - 17:06	**THMPL07** - DARUMA: Data Collection And Control Framework For X-Ray Experimental Stations Using MADOCA. Takahiro Matsumoto - Japan Synchrotron Radiation Research Institute Controls and Computing Division
17:06 - 17:09	**THMPL08** - SLAC's Common-Platform Firmware for High-Performance Systems. Till Straumann - SLAC National Accelerator Laboratory
17:09 - 17:12	**THMPL09** - VME Based Digitizers for Waveform Monitoring System of Linear Induction Accelerator (LIA-20). Evgeniy Sergeevitch Kotov - Russian Academy of Sciences The Budker Institute of Nuclear Physics
17:12 - 17:15	**THMPL10** - New VME-Based Hardware for Automation in BINP. George Alexandrovitch Fatkin - Russian Academy of Sciences The Budker Institute of Nuclear Physics
16:45 - 17:15	**THMPA - MINI-ORAL** ▸ **Parallel Room** Chairs ▸ Enrique Blanco (CERN, CH) and Yingbing Yan (SSRF, CN)
16:45 - 16:48	**THMPA01** - The Interlock System of FELiChEM. Ziyu Huang - University of Science and Technology of China National Synchrotron Radiation Laboratory
16:48 - 16:51	**THMPA02** - Investigations of Spatial Process Model for the Closed Orbit Feedback System at the Sis18 Synchrotron at GSI. Sajjad Hussain Mirza - GSI Helmholtzzentrum für Schwerionenforschung GmbH Beam Diagnostics Group

16:51 - 16:54 **THMPA03** - A Simulation System for the European Spallation Source (ESS) Distributed Data Streaming.
Carlos Reis - Elettra-Sincrotrone Trieste S.C.p.A.

16:54 - 16:57 **THMPA04** - RF Energy Management for the European XFEL.
Olaf Hensler - Deutsches Elektronen-Synchrotron

16:57 - 17:00 **THMPA05** - The AFP Detector Control System.
Luís Seabra - Laboratory of Instrumentation and Experimental Particle Physics

17:00 - 17:03 **THMPA06** - Building Controls Applications Using HTTP Services.
Ted D'Ottavio - Brookhaven National Laboratory Collider-Accelerator Department

17:03 - 17:06 **THMPA07** - Improvement of Temperature and Humidity Measurement System for KEK Injector Linac.
Itsuka Satake - High Energy Accelerator Research Organization Accelerator Laboratory

17:06 - 17:09 **THMPA08** - Processing of the Schottky Signals at RHIC.
Andrei Sukhanov - Brookhaven National Laboratory Collider-Accelerator Department

17:09 - 17:12 **THMPA09** - MACUP (Material for data ACquisition - UPgrade): Project Focusing on DAQ Hardware Architecture Upgrade for SOLEIL.
Guillaume Renaud - Synchrotron Soleil

17:15 - 19:00 THPHA - POSTER SESSION ▸ Poster Area

17:15 - 19:00 THSH1, THSH2, THSH3 - SPEAKERS' CORNER SESSION
▸ Speakers' Corner Area

THSH1 - Screen 1

17:15 - 17:45 **THSH101** - Using Control Surfaces to Operate CS-Studio OPIs.
Claudio Rosati - European Spallation Source ERIC

17:45 - 18:15 **THSH102** - PyDM: A Python-Based Framework for Control System Graphical User Interfaces.
Daniel Lawrence Flath - SLAC National Accelerator Laboratory

18:15 - 18:45 **THSH103** - Using Color Blindness Simulator During User Interface Development for Accelerator Control Room Applications.
Sakire Aytac - Deutsches Elektronen-Synchrotron MCS

THSH2 - Screen 2

17:15 - 17:45 **THSH201** - Integration of MeerKAT and SKA telescopes using KATCP <-> Tango Translators.
Athanaseus Johannes Tishetso Ramaila - SKA South Africa National Research Foundation of South Africa Department of Science and Technology

17:45 - 18:15 **THSH202** - Design and Implementation of the LLRF System for LCLS-II.
Carlos Serrano - Lawrence Berkeley National Laboratory

18:15 - 18:45 **THSH203** - Internet of Things (IoT): Wireless Diagnostics Solutions.
Roberto Homs-Puron - ALBA-CELLS Synchrotron

	THSH3 - Screen 3
17:15 - 17:45	**THSH301** - ADStream Module. Bruce Hill - SLAC National Accelerator Laboratory
17:45 - 18:15	**THSH302** - 1000 Things you always want to know about SSO but you never dared to ask! Luis Rodriguez - European Organization for Nuclear Research
18:15 - 18:45	**THSH303** - CS-Studio Display Builder. Kay-Uwe Kasemir (ORNL, Oak Ridge, Tennessee)

Friday, October 13th

08:30 - 09:15	**FRKPL - KEYNOTE SPEAKER 5** ▸ Plenary Room Chair ▸ Kazuro Furukawa (KEK, JP)
	FRKPL01 - The Birth of the Gravitational Wave Astronomy. **Eugenio Coccia** - School of Advanced Studies GSSI, IT
09:15 - 11:00	**FRAPL - PROJECT STATUS REPORT 2** ▸ Plenary Room Chairs ▸ John Maclean (ANL, US) and Darren Spruce (MAXIV, SE)
09:15 - 09:30	**FRAPL01** - Status of the Square Kilometre Array. Lorenzo Pivetta - SKA Organisation
09:30 - 09:45	**FRAPL02** - Commisioning and Calibration of the Daniel K. Inouye Solar Telescope. Chris John Mayer - Advanced Technology Solar Telescope National Solar Observatory
09:45 - 10:00	**FRAPL03** - Status of the Control System for the SACLA/SPring-8 Accelerator Complex. Toru Fukui - RIKEN SPring-8 Center Innovative Light Sources Division
10:00 - 10:15	**FRAPL04** - Diagnostics and Instrumentation Challenges at LCLS-II. Patrick Krejcik - SLAC National Accelerator Laboratory
10:15 - 10:30	**FRAPL05** - Hardware Architecture of the ELI Beamlines Control and DAQ System. Pavel Bastl - Institute of Physics of the ASCR
10:30 - 10:45	**FRAPL06** - The Laser MegaJoule Facility Control System Status Report. Hugues Durandeau - Commissariat à l'énergie atomique et aux énergies alternatives CEA /CESTA
10:45 - 11:00	**FRAPL07** - The ESRF's Extremely Bright Source - a 4th Generation Light Source. Jean-Michel Chaize - European Synchrotron Radiation Facility
11:00 - 11:30	**COFFEE BREAK** ▸ Exhibition and Poster Area
11:30 - 12:15	**FRBPL - WORKSHOPS SUMMARY** ▸ Plenary Room Chair ▸ Oscar Matilla (ALBA, ES)
11:30 - 11:34	**FRBPL01** - EPICS Satellite Meeting. Timo Korhonen - European Spallation Source ERIC

11:34 - 11:38 **FRBPL02** - White Rabbit Tutorial Workshop.
Javier Serrano - European Organization for Nuclear Research Beams Department (BE)

11:38 - 11:42 **FRBPL03** - TANGO Workshop.
Alain Buteau - Synchrotron Soleil

11:42 - 11:46 **FRBPL04** - PLC Based Control Systems.
Enrique Blanco Vinuela - European Organization for Nuclear Research Engineering Department (EN)

11:46 - 11:50 **FRBPL05** - HDF5 and Data Format.
Elena Igorevna Pourmal - The HDF Group

11:50 - 11:54 **FRBPL06** - Control System Cybersecurity Workshop.
Stefan Lueders - European Organization for Nuclear Research

11:54 - 11:58 **FRBPL07** - Motion Control Workshop.
Yves-Marie Abiven - Synchrotron Soleil

11:58 - 12:02 **FRBPL08** - Sardana - Scientific SCADA Suite.
Zbigniew Reszela - ALBA-CELLS Synchrotron

12:02 - 12:06 **FRBPL09** - User Experience in MicroTCA.
Thomas Walter - Deutsches Elektronen-Synchrotron

12:06 - 12:10 **FRBPL10** - MRF Timing Protocol Users Workshop.
Eric Bjorklund - Los Alamos National Laboratory AOT Division

12:15 - 13:00 **FRXPL - CLOSING REMARK** ▸ **Plenary Room**
Chair ▸ David Fernandez-Carreiras (ALBA, ES)

12:15 - 12:30 **FRXPL01** - ICALEPCS 2019.
Kevin A. Brown - Brookhaven National Laboratory

12:30 - 12:45 **FRXPL02** - ICALEPCS 2021.
David Fernandez-Carreiras - ALBA-CELLS Synchrotron

12:45 - 13:00 **FRXPL03** - Final Remarks.
David Fernandez-Carreiras - ALBA-CELLS Synchrotron

KEYNOTE SPEAKERS

Monday, October 9th Keynotes

Caterina Biscari (Modica, Italy, 1957)

Caterina Biscari is the director of the ALBA Synchrotron since 2012. She is an experimental physicist with recognition for key contributions in design, construction, operation in accelerator physics. Graduated in physics at the Universidad Complutense of Madrid (Spain) and Doctor in physics at the Università degli Studi of Naples (Italy). She has spent her scientific career at different research laboratories in Europe, namely CERN, LNF-INF, CNAO, and lately the ALBA Synchrotron, the Spanish 3rd generation light source facility.

Salvador Ferrer

Salvador Ferrer was born in Barcelona (Spain) in 1951 and graduated in physics at the Universitat de Barcelona. He got the PhD in solid state physics at the Universidad Autónoma de Madrid (Spain). He has worked at the European Synchrotron (ESRF) for more than 16 years as principal beamline scientist, and from 2004 at the Synchrotron ALBA as scientific director during the design, construction, commissioning and operation. Today he is scientific advisor to the Director of ALBA combined with his long carrier in materials science research.

Evolution of Photon Sources

The powerful matter probing capacities of photon beams has driven the development of electron accelerator based photon sources, starting from the parasitic usage of particle physics accelerators, to a wide variety of facilities all around the world, including synchrotrons and FELs.

The main characteristics, the evolution of these sources and the expected developments will be presented, with a special highlight on the ALBA synchrotron.

Tuesday, October 10th Keynote

Michael Ossmann

Michael Ossmann is a wireless security researcher who makes hardware for hackers. Best known for the open source HackRF, Ubertooth, and GreatFET projects, he founded Great Scott Gadgets in an effort to put exciting, new tools into the hands of innovative people.

Your ideas are worthless

As the owner of an open source hardware company, I frequently encounter people who tell me why my business cannot possibly succeed. After six years of continuous growth, I would like to share my thoughts about why those people are wrong and how the mythology of invention affects perception. I'll share lessons from my background as a hacker, researcher, open source developer, and business owner and discuss the past, present, and future of science, technology, and the value of ideas.

Wednesday, October 11th Keynote

Carles Gelpí

Carles Gelpí is an architect, professor of Structure Calculations at the Polytechnic University of Catalonia. He is member of several associations, such as the Catalonian Architects, Structure Consultants and the Forensic Expert Architects Association.

Carles manages his own architecture office since 1993 and he is also one of the directors, founding partners and project manager of 2BMFG arquitectes S.L.P, an Architecture Office located in Barcelona with more than 30 years of professional experience counting several notorious renowned projects such as the "Olympic Stadium and Olympic Ring" Barcelona 1992, or the Sagrada Familia's Expiatory Temple, in Barcelona, at the moment under construction.

2BMFGaquitectes counts more than sixty publications and it has received more than twenty national and International awards.

The Sagrada Familia basilica by Antoni Gaudi

From 1882 until 1926, the architect Antoni Gaudí projected the building that is being built and is expected to end in 2026.
How have geometry, materials and tools changed to make it possible?
One of the teams that works there for more than 30 years will explain it to you.

Thursday, October 12th Keynote

Gregorio Ameyugo

Dr. Gregorio Ameyugo (Ferrol, Spain, 1982) is Deputy Director of CEA LIST in charge of European and International development.

An Aerospace Engineer by training (Defence Academy of the United Kingdom), Gregorio received an Engineering Doctorate from Cranfield University, specializing in Aerospace Propulsion and Technology Strategy (diffusion of disruptive innovations).

From Rolls-Royce to Indra, Airbus Helicopters, Airbus R&T and Emerging Technologies and Concepts, and finally the French Atomic Energy and Alternative Energies Commission, Gregorio has found himself working systematically on disruptive projects ranging from propulsion systems to intuitive cockpits, air taxis, rapid prototyping, collaborative robotics and artificial intelligence, giving him a unique perspective on disruptive innovations and technology transfer.

Gregorio joined CEA LIST in 2012 as Head of Industrial R&D Partnerships for Ambient Intelligence and Interactive Systems. In this capacity, he led the launch of collaborative R&D and technology transfer activities in robotics, augmented and virtual reality, IoT and artificial intelligence with French and international partners in a wide range of sectors.

Gregorio is particularly active in the field of Advanced Manufacturing. A member of the Manufuture High-Level Group and EFFRA (European Factories of the Future Research Association), he has been involved in the launch of the platform FactoryLab, by the French "Alliance Industrie du Futur". Gregorio has also led the deployment of an open innovation platform for Flexible Production Systems (FFLOR: Future Factory@Lorraine) located within the PSA factory at Tremery, in the East of France.

Gregorio intervenes as an expert in robotics and automation for Factory of the Future initiatives by French regional governments, he is a member of the Board of ASTech (Paris Region Aerospace cluster), and a co-author of the book "Innovation in Aeronautics" (2012).

More than particles: how accelerators can speed up Advanced Manufacturing… and what's next

Konosuke Matsushita, the founder of Panasonic, once said «We are apt to think that our ideas are the creation of our own wisdom, but the truth is that they are the result of the experience through outside contact".

The ever-accelerating pace of progress in digital technologies is leading to a transformation of the manufacturing industry. With initiatives at regional, national (think Industria Conectada 4.0, Industrie du Futur, Industrie 4.0…) and international level, seizing the opportunity created by these technologies has become a priority for most developed economies.

In France, CEA is one of the leading actors in this 4th industrial revolution, developing new digital and robotics technologies, and working together with industry to accelerate their deployment.

In his talk, Greg Ameyugo will show how progress in Advanced Manufacturing can be and is already being inspired by Accelerator and Large Experimental Physics Control Systems, the current and emerging technology trends in manufacturing, and the changes they can bring about for industry.

Friday, October 13th Keynote

Eugenio Coccia

Prof. Eugenio Coccia (San Benedetto del Tronto, Italy, 1956) is the founder of the School of Advanced Studies GSSI (Gran Sasso Science Institute) and its Rector since 2016. He is a physicist with expertise on astroparticle physics, with a focus on gravitational wave experiments. He is recognized for the development of cryogenic detectors of gravitational waves and is one of the authors of the recent discovery of gravitational waves and of the first observation of Black Holes.

He has been Full Professor at the Università di Roma Tor Vergata (2000-2016), Chair of the INFN Scientific Committee on Astroparticle Physics (2002-2003), Director of the INFN Gran Sasso Laboratory (2003-2009), President of the Italian Society of General Relativity and Gravitational Physics (2000-2004), Chair of the Gravitational Wave International Committee (GWIC) (2011-2015), among other responsibilities.

He has given lectures and seminars in Universities and research centers all over the world and is the author of about 300 scientific articles in international journals and editor of six books in the field of astroparticle physics. He is member of the Academia Europaea, honoris causa, and Fellow of the European Physical Society.

The birth of the gravitational wave astronomy

COMMITTEES

International Scientific Advisory Committee

Reinhard Bacher (DESY, GE)
Matthew Bickley (JLAB, US)
Eric Bjorklund (LANL, US)
Enrique Blanco (CERN, CH)
Kevin Brown (BNL, US)
Gordon Brunton (LLNL, US)
Alain Buteau (SOLEIL, FR)
Enzo Carrone (SLAC, US)
Jean Michel Chaize (ESRF, FR)
Gianluca Chiozzi (ESO, GE)
Lou Corvetti (AS, AU)
Jin Dapeng (IHEP, CN)
Alessandro Ercolani (ESA, GE)
David Fernández (ALBA, ES)
Kazuro Furukawa (KEK, JP)
Andy Götz (ESRF, FR)
Juan Carlos Guzman (CSIRO, AU)
Nick Hauser (ANSTO, AU)
Mark Heron (DLS, UK)
Larry Hoff (FRIB, US)
Kuo-Tung Hsu (NSRRC, TW)
Markus Janousch (PSI, CH)
Timo Korhonen (ESS, SE)
Marco Lonza (ELETTRA, IT)
John Maclean (APS, US)
Christopher Marshall (LNLS, US)
Óscar Matilla (ALBA, ES)
Tomohiro Matsushita (SPRING8, JP)
Roland Müller (BESSY, GE)
Dennis Nicklaus. (Fermilab, USA)
James Piton (LNLS, BR)
Javier Serrano (CERN, CH)
Hamid Shoaee (SLAC, US)
Young-Gi Song (KAERI, KR)
Darren Spruce (MAXIV, SE)
Ryotaro Tanaka (SRPING8, JP)
Lize Van der Heever (SKA, ZA)
Karen White (SNS, US)
Noboru Yamamoto (KEK, JP)
Yingbing Yan (SSRF, CN)

Program Committee

Reinhard Bacher (DESY, GE)
Matthew Bickley (JLAB, US)
Eric Bjorklund (LANL, US)
Enrique Blanco (CERN, CH)
Kevin Brown (BNL, US)
Gordon Brunton (LLNL, US)
Alain Buteau (SOLEIL, FR)
Enzo Carrone (SLAC, US)
Jean Michel Chaize (ESRF, FR)
Gianluca Chiozzi (ESO,GE)
Peter Clout (IEEE, US)
Guifré Cuní (ALBA, ES)
Jin Dapeng (IHEP, CN)
Alessandro Ercolani (ESA, GE)
Richard Farnsworth (BNL, US)
David Fernández (ALBA, ES)
Kazuro Furukawa (KEK, JP)
Manuel González Berges (CERN, CH)
Andy Götz (ESRF, FR)
Juan Carlos Guzman (CSIRO, AU)
Nick Hauser (ANSTO, AU)
Mark Heron (DLS, UK)
Larry Hoff (FRIB, US)
Kuo-Tung Hsu (NSRRC, TW)
Markus Janousch (PSI, CH)
Nicolas Janvier (ESRF, FR)
Timo Korhonen (ESS, SE)
Marco Lonza (ELETTRA, IT)
Chris Marshall (LNLS, US)
Tomohiro Matsushita (SPRING8, JP)
John Maclean (APS, US)
Óscar Matilla (ALBA, ES)
Roland Müller (BESSY, GE)
Seth Nemesure (BNL, US)
Dennis Nicklaus (FERMILAB, US)
James Piton (LNLS,BR)
Javier Serrano (CERN, CH)
Hamid Shoaee (SLAC, US)
Young-Gi Song (KAERI, KR)
Darren Spruce (MAXIV, SE)
Ryotaro Tanaka (SRPING8, JP)
Lize Van der Heever (SKA, ZA)
Karen White (SNS, US)
Noboru Yamamoto (KEK, JP)
Yingbing Yan (SSRF, CN)

Local Organizing Committee (ALBA-CELLS, Spain)

Conference Chair
David Fernández

Secretariat
Concepció Girbau

Program Chair
Óscar Matilla

Editorial Team
Coordinator
Isidre Costa

Industry
Guifré Cuní

International Executive Committee (ISAC)

Andy Götz (ESRF, European Synchrotron, France. Chair)
Nick Hauser (ANSTO, Australia)
Christopher Marshall (LLNL, USA)
David Fernández (ALBA-CELLS, Spain)
Kevin Brown (BNL, USA)

JACoW Editorial Team

Ivan Andrian (ELETTRA, IT)
Harmanpreet Bassan (BNL, US)
Jan Chrin (PSI, CH)
Isidre Costa (ALBA-CELLS, ES)
Michaela Marx (DESY, GE)
Raphael Müller (GSI, DE)
Montse Prieto (ALBA-CELLS, ES)
Kathleen Riches (ANSTO, AU)
Volker RW Schaa (JACOW/GSI, DE)

INFORMATION

GENERAL INFORMATION

Technical Secretariat

Mondial & Cititravel Congresos, S.L.

Salvador Espriu, 77, local 10 ·
08005 Barcelona, Spain
Ph. +34 932 212 955
icalepcs20@mondial-congress.com
www.mondial-congress.com

Conference App

The ICALEPCS 2017 Conference App is available for free download from the Apple App Store, Google Play Store.

Insurance

The ICALEPCS 2017 Local Organizing Committee, or their agents, will not be responsible for any medical expenses, loss, damages or accidents during the Conference.

Internet

Wi-Fi is available to all participants of ICALEPCS 2017 at:

Hotel Fairmont Rey Juan Carlos I ▸ October 7th and 8th
On the -1 level of the Conference Venue ▸ from October 8th to 13th

To connect, please open your device's Wi-Fi settings and select:
Network name ▸ icalepcs Password ▸ icalepcs2017

App: ICALEPCS 2017

https://appsto.re/es/EwGllb.i

https://play.google.com/store/apps/details?id=com.meetmaps.icalepcs

https://meetmaps.com/app/qr.php?p=MzczNQ==

powered by meetmaps

Lost & Fount

A Lost & Found service is available at the registration desk.

Lunches

Lunch is not included in the registration fee. In the area where the Conference venue is located there are not so many restaurants and cafeterias; this is why we offered the option to reserve the lunches in advance.

Unfortunately, the organization of the conference cannot guarantee availability of lunch boxes for those who do not reserve them in advance.

Rate per lunch box: €18.70, VAT included.

Information on restaurants located within 10/15 minutes walking distance is available at the registration desk.

Official Language

The official language of the Conferences is English.

Smoking

Thank you for respecting the smoking ban inside the conference venue.

Transportation to the Venue

If you are planning on using public transportation during the conference, we suggest that you purchase a T-10 card (1 zone €9.95 10 trips). It is valid for bus, subway, tram (except the aerobus) and is available at the metro stations.

Volunteers

There are volunteers available to assist delegates. The volunteers are all wearing polo-shirts or T-shirts with ALBA Synchrotron and ICALEPCS2017 logos.

WORKSHOPS INFORMATION

Workshops Venue

Hotel Fairmont Rey Juan Carlos I
Avinguda Diagonal, 661-667
08028 Barcelona
Metro stop: Zona Universitària (**L3** and **L9 South**)

Registration Desk

The Registration Desk is located in Mare Nostrum Hall and open at the following times:

Saturday, October 7th ▸ 08:30 - 18:00
Sunday, October 8th ▸ 08:00 - 16:00

Registration Fees

The Workshops are not included in the registration fee of ICALEPCS 2017 Conference. Registration fees, VAT included:

Full day workshop ▸ €90 Half day workshop ▸ €60

Badges and Tickets

All workshops documents and tickets should be collected on site at the registration desk.

A name badge will be provided on site. Name badges must be worn at all times to allow access into the workshop.

Workshops badge colors

Saturday Workshops

🟦 EPICS Satellite Meeting: SA1A
🟦 White Rabbit Tutorial: SA1C
🟦 Tango: SA1D
🟦 PLC Based Control Systems: SA1E

Sunday Workshops*

🟩 HDF5 and Data Format: SU1A
🟩 Control System Cybersecurity: SU1C
🟩 Motion Control: SU1D
🟩 Sardana – Scientific SCADA Suite: SU1E
🟪 User Experience in Micro TCA: SU1F
🟫 MRF Timing Protocol Users: SU1F

*with a green band full day workshops

CONFERENCE INFORMATION

Congress Venue

Palau de Congressos de Catalunya
(Catalonia Congress Centre)
Avinguda Diagonal, 661-667
08028 Barcelona
-1 Level
Metro stop: Zona Universitària (**L3** and **L9 South**)

Registration Desk

The Registration Desk is located in the entrance of the -1 level of the Conference Venue and open at the following times:

Sunday, October 8th	16:00 - 20:00	Wednesday, October 11th	07:30 - 15:00
Monday, October 9th	07:30 - 18:00	Thursday, October 12th	07:30 - 18:00
Tuesday, October 10th	07:30 - 18:00	Friday, October 13th	07:30 - 13:00

Exhibition Opening Hours

The Exhibition Area is located on the -1 level of the Conference Venue and open at the following times:

Sunday, October 8th	18:30 - 20:00	Wednesday, October 11th	08:30 - 13:15
Monday, October 9th	08:30 - 17:45	Thursday, October 12th	08:30 - 19:00
Tuesday, October 10th	08:30 - 19:00	Friday, October 13th	08:30 - 13:00

Speakers' Preview Center

All authors should review in the Speakers' Preview Room at least 3 hours prior to the respective session that the presentation has been correctly downloaded and the contents are properly displayed using the Conference computers. The Speakers' Preview Center is located in room K2 on the -1 level of the Conference Venue and open at the following times:

Sunday, October 8th	16:00 - 20:00	Wednesday, October 11th	08:00 - 15:00
Monday, October 9th	08:00 - 18:00	Thursday, October 12th	08:00 - 18:00
Tuesday, October 10th	08:00 - 18:00	Friday, October 13th	08:00 - 12:00

Poster Presentations

The posters will be on display in main Hall at the conference center. During two sessions:

Tuesday, October 10th	16:45 - 19:00
Thursday, October 12th	16:45 - 19:00

The assigned poster program code (e.g. TUPHA001) will be labelled in the correspondent panel.

The day after each poster session, posters must be removed from the panel to be ready for the next poster session. Posters that are not picked up by the authors, will be removed by the Conference staff, and will not be stored nor sent to authors.

Double faced tape is available in every poster board.

Registration Fees

You can register at the registration desk located on the -1 level of the Conference Venue by filling in an on-site registration form. Payments are possible via debit or credit card or in cash.

The following registration fees apply on site:

Full Conference Delegate	€840
Full Conference Student (*)	€425
One Day Delegate	€300
One Day Student (*)	€150
Two Days Delegate	€475
Two Days Student (*)	€300

Registration fees include 21% VAT and are cashed in Euro (€) only.

(*) Students have to provide a certificate/letter from his/her supervisor when registering, otherwise the Delegate fee will be charged.

Full Conference Registration fee includes

Admission to all scientific sessions, exhibition and poster area; conference materials; certificate of attendance; coffee breaks; welcome reception on October 8; conference dinner on October 12th and visit to ALBA Synchrotron on October 13th (registering for the visit is mandatory as seats are limited to 250).

One or Two Days Registration fee include

Admission to the scientific sessions of the day/s for which the registration is formalized, exhibition and poster area; conference materials; certificate of attendance and coffee breaks. Monday registration fee include the welcome reception on October 8th. Friday registration include the visit to ALBA Synchrotron on October 13th (registering for the visit is mandatory as seats are limited to 250).

The registration for ICALEPCS 2017 does not give access to the Workshops on Saturday October 7th and Sunday October 8th. For this, separate registration is required.

Badges and Tickets

All conference documents and tickets should be collected on site at the registration desk.

A name badge will be provided on site with your registration documents. Name badges must be worn at all times to allow access into the venue.

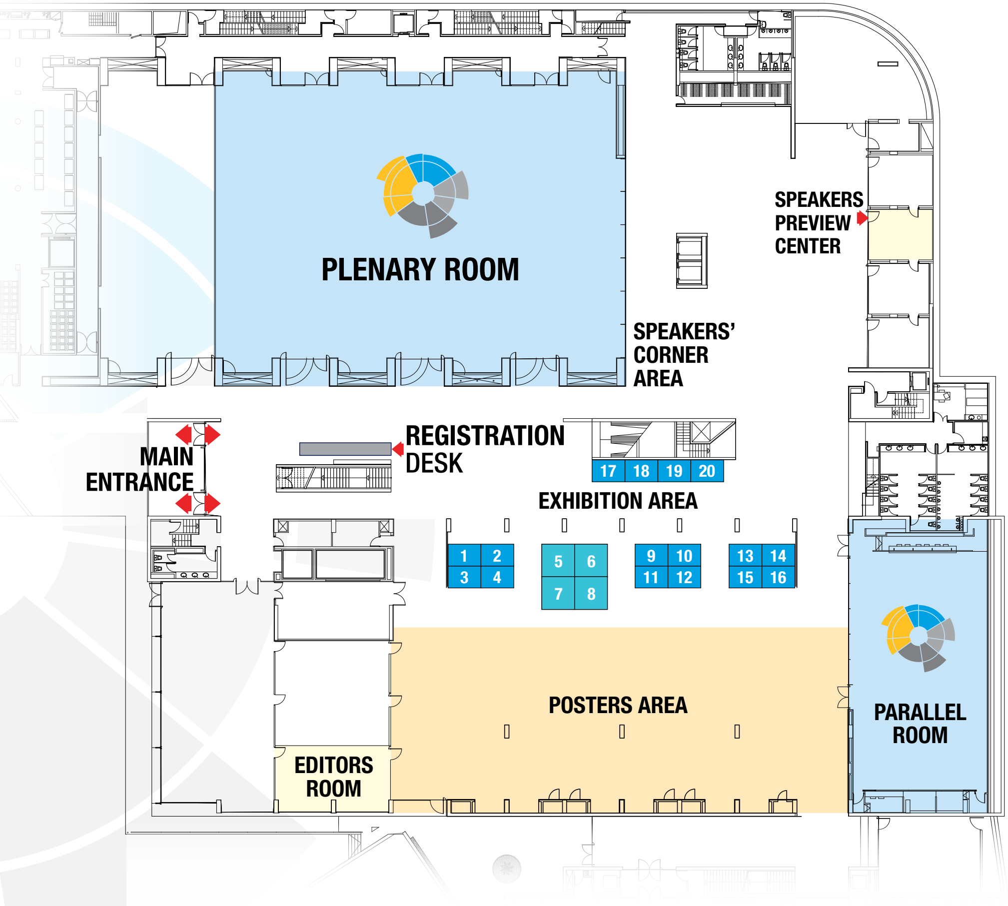
Conference Delegate badge colors:

- ☐ D: Delegates & Keynote speakers
- 🟨 E: Exhibitors
- 🟥 S: Staff
- 🟪 MO: Monday
- ⬜ TU: Tuesday
- 🟩 WE: Wednesday
- 🟦 TH: Thursday
- 🟫 FR: Friday

VENUE MAP

Level -1

PALAU DE CONGRESSOS
DE CATALUNYA
BARCELONA



LOCAL INFORMATION

Barcelona, the capital of Catalonia, is one of the major Mediterranean cities and the second largest city in Spain. There are many reasons which explain why it has attracted visitors from all over the world for many years. There are many 'Barcelonas' to be explored: the old town with Roman walls, the gothic district with palaces and churches from the 16th, 17th and 18th centuries, the well structured Eixample district, the heart of Modernism, and the new Olympic Barcelona.

Banks

Official opening hours of banks in Spain are from 8:30 to 14:00 from Monday to Friday, closed in the afternoon. It is possible to change foreign currency into Euros in the main city hotels.

Climate

Barcelona enjoys a Mediterranean climate with mild, sunny winters, warm summers and relatively low rainfall. The average temperatures in October are 18/22ºC minimum and 24/28ºC maximum. Our sunny summer days are ideal for strolling along the shop lined promenades or sitting out on a restaurant or café terrace.

Credit Cards, Currency and Exchange

All major international credit cards are accepted. Foreign currency and traveler's checks can be exchanged in Spain at banks and foreign exchange offices. Cash-point machines accepting major international credit card and charge cards are available at most banks. The Spanish currency is the Euro.

Electricity

A 2-pin round adapter is necessary for electrical appliances. The electric current used is 220 volts/50 hz.

Restaurants

Barcelona's restaurants range from gourmet-type to informal rand tapas restaurants. There are also many international restaurants in the city, offering almost any kind of cuisine. In Spain, lunch is generally served between 13:30 – 15:30 h, dinner around 20:30 – 23:30 h.

Safety

Barcelona is a safe city, however, as in all touristic cities; pickpockets may be around the Airport, Railway Station and the city centre. Please take the usual precautions and do not leave valuables unattended.

Shopping

Normal trading shopping hours are Monday to Saturday from 9:00 to 13:00 and

16:30 to 20:30. Some shopping malls are also opened on Sundays.

Smoking

In Spain smoking is prohibited in public buildings and public transport (including taxis), at workplaces, railway stations, discotheques, bars and restaurants. Tobacco consumption is also not allowed outside the grounds of hospitals, health centers, schools and kindergartens.

Smoking is permitted on terraces (e.g., restaurants), in one's own home and balcony, in hotel rooms - if not prohibited by the owner - and in the fresh air with the exceptions referred to above.

Taxis

Taxis in Barcelona may be ordered by phone, picked up at authorized taxi stands or flagged down in the street. Taxis must usually be paid in cash through some accept credit cards.

Radio Taxi ▸ +34 933 03 30 33

Taxi for disabled people ▸ +34 035 51 93 68

Taxi ecologic ▸ +34 932 78 30 00

Useful telephone numbers

Emergency ▸ 112

Fire brigade ▸ 088

Local police ▸ 092

RENFE (Spanish railway) ▸ Customer Service +34 902 320 320

Barcelona Airport ▸ +34 902 40 47 04

VAT

There is a variable value added tax (VAT) of 10% to 21% applied to most items and services but in most prices you see will include it. When it is not included, this should be clearly indicated. Neither the Organisation nor Mondial & Cititravel Congresos accepts responsibility for any changes, which may occur due to an official increase of VAT.

AWARDS

The Awards Ceremony will take place on Thursday, October 12th, during the Conference Dinner.

ICALEPCS Lifetime Achievement Award

The ICALEPCS Lifetime Achievement Award is meant to honour an individual (or individuals) who throughout their careers have made invaluable and lasting contributions to the field of control systems for large experimental physics facilities. The scope of this award reaches beyond the successful completion of a single project or even several projects. The aim is to recognize those who through their vision, leadership, technical excellence, and a willingness to think beyond a single laboratory or even a country have influenced the international practice of control system development.

Due to the nature of the award, it will not necessarily be presented at every ICALEPCS. This is meant as a recognition and celebration of exceptional and career-long contribution and as such it should be awarded only when such individuals have been clearly identified.

1. The ICALEPCS Lifetime Achievement Award (LAA) is a special tribute given to a person in recognition of a career with significant highlights in the advancement of the field of Controls in large, experimental physics, facilities.
2. The award is seen as recognizing specific contributions and not just for longevity.
3. The candidate does not have to be active in the field at the time of the award.
4. The LAA may be given at each ICALEPCS conference but if no individuals were identified as qualified candidates then no award would be given.
5. There is no monetary component.
6. Sponsoring and related societies will be notified of the presentation of the award so that an appropriate recognition is received.

ICALEPCS Early Career Award

The ICALEPCS Early Career Award will be granted every two years at the biennial International Conference on Accelerator and Large Experimental Physics Control Systems (ICALEPCS). The ICALEPCS Award is conferred to one early career (defined by university degree awarded within the last ten years) controls systems professionals who made exceptional contributions in the field of Control and data acquisition Systems in large scientific installations.

The prize will consist of a certificate and a potential financial contribution. Only works that are original and published can be considered in the proposals for candidates to the prize.

1. The ICALEPCS Award is given to a person in the advancement of the field of Controls in large, experimental physics facilities.
2. There is no limit in age, but the candidates shall be new (less than 10 years) in the field and in the community at the time of the award.
3. It is awarded every two years at the ICALEPCS conference.
4. There may be a monetary component subjected to the budget and the criteria of the Local Organizing Committee of the conference.

TRACKS

1. Experiment Control

This track focuses on the domain specific control systems and data acquisition for user facility experiments. Experiment control systems must interact with a variety of instrument hardware, sample environment equipment, detectors and data acquisition electronics. These control systems must be flexible and easy to use for experiments with quick turnaround and a heterogeneous user community.

Topics covered in this track include:

- Experiment automation, scanning, sequencing and run control (e.g. SPEC, GDA, CSS, Sardana, ...)
- Sample environment control including robotic sample changers.
- User interfaces and remote monitoring and access.
- Live feedback and online data reduction and visualization.
- Detector and data acquisition (e.g. Lima, areaDetector, ...)
- User information systems and databases.

Keywords ▸ macros, scan, metadata, remote-operation, data-acquisition, macro environment, sequencer, image acquisition, detectors, pixel array detector, CCD.

2. Functional Safety and Machine Protection

This track presents the role and implications of functional safety and machine protection systems in large experimental physics control systems. It will further consider Personnel Safety Systems and Patient Protection Systems where radiation is used in the diagnosis and treatment of patients.

Topics covered in this track include:

- Choice and application of standards: this considers the selection of international standards for functional safety, and their application in the specification, design and life cycle of such systems.
- Aspects of functional safety and machine protection systems: this area discusses topics such as the specification, design, implementation and commissioning processes (e.g. FMEA's) along with interlock considerations, interactions with other facility controls systems, required reliability, machine up-time, availability and maintainability.
- Operational experience and lessons learned: what has gone wrong or can go wrong in safety systems and what can we learn, including incorrect specifications, omitted safety requirements, random hardware failures, systematic hardware failures, software errors, common cause failures and environmental influences?
- Human factors: this area appreciates how the man/machine interface contributes positively to successful, reduced-risk operation and ease of use.

Keywords ▸ PSS, EPS, MPS, PLC, SIL, radiation protection, risk analysis, safety PLCs, relays, interlock, operation permits.

3. Software Technology Evolution

This track covers what is new or innovative in the software technologies to build control systems. Of particular interest is experience gained and lessons learned from applying new approaches in practical software development projects.

Topics covered in this track include:

- Control system evolution: new control system frameworks and evolution of existing control system toolkits (e.g. EPICS, TANGO, DOOCS, ACS ...).
- Middleware technology: reports on performance and scalability of middleware and the usage of web services and service-oriented architecture (SOA) (e.g. ZeroMQ. ActiveMQ, DDS, Kafka, ...)
- Advanced software development techniques: new programming languages, design and code for easy debugging, refactoring in practice, model-driven development, test-driven development, domain-specific languages and code generation, new operating systems or extensions.

Note ▸ GUI toolkits, web tools and integration of low and high-level components are covered in other tracks.

Keywords ▸ middleware, control system frameworks, web-services, SCADA.

4. User Interfaces and User eXperience (UX)

This track focuses on how human beings interact with computer-based systems. This includes what humans expect from their experience, how humans control hardware as well as how humans interact with user interface.

Topics covered in this track include:

- Ease of use.
- UX (User eXperience).
- Style guides, look and feel.
- Data visualization tools.
- Interface building toolkits (e.g. CSS, JDDD, Taurus, ATK, ...)
- Web interfaces and apps.
- Reporting tools.
- Mobile device development to enable remote operation and monitoring.
- Emerging interface trends.

Keywords ▸ GUI (Graphical User Interface), data visualization tools, synoptic, plotting, archive viewers, dashboards, web frameworks, touch screens, CLI (Command Line Interfaces), mobile apps, electronics logbooks, alarm handlers, intelligent data display, virtual displays, augmented reality, voice control.

5. Project Status Reports

This track presents an overview of new or upgraded experimental physics facilities with a control system perspective. Status Reports typically cover the stages of a project from the conceptual proposal through commissioning. Presentations should include descriptions of the most challenging issues facing the facility. Projects that involve novel or unusually complex or demanding control systems are strongly encouraged.

Topics covered in this track include:

- Reports on facilities such as particle accelerators and detectors, fusion devices, light and photon sources, telescopes, gravitational wave detectors, etc.

Keywords ▸ HEP, telescope, satellite, synchrotron, FEL, neutron source, spallation, laser, facility, installation, commissioning, design, tokamak, ion, therapy.

6. Control Systems Upgrades

This track focuses on the extension, modification or enhancements of existing control systems or existing platforms and frameworks, by using new techniques and covering new domains. It also assesses the change control process and the optimization of the transition to the upgraded systems.

Topics covered in this track include:

- Policies and strategies in control systems upgrades transitions (e.g., change management, new operational models, new maintenance paradigms, operator's training).
- Risk analysis and mitigation, strategy for minimizing the downtime in the transition phase.
- Lessons learned in upgrades definition, specification and implementation.
- Return On Investment (ROI) analysis, with considerations on Total Cost of Ownership (TCO) models.
- Approach to selection and/or adoption of new technologies, and negotiations with users and stakeholders.
- Enhancing the flexibility, the evolutivity and the maintainability of the system.

Keywords ▸ Legacy systems, upgrade, obsolete, maintainability, long-term support, shutdown periods, operations, risk analysis and mitigation, strategy, change management.

7. Data Management and Processing

This track focuses on policies and processes implemented for scientific data access and data curation, as well as systems and infrastructures for pipelined data processing and remote data analysis. This includes issues arising from the storage, processing, indexing, search, retrieval and analysis of the scientific datasets as well as the metadata related to samples, experiments, processes and publications.

Topics covered in this track include:

- Distributed database systems.
- Public and private clouds.
- Data policies.
  High performance data storage systems.
- Tools, frameworks and applications for data analysis.
- Hardware and software architectures network and tools implemented for scientific data management.
- Laboratory Information Management Systems.
- Data formats, metadata systems.

Note ▸ Data analytics and data mining, is covered in another specific track. IT infrastructure (not related with data management) is also covered in another track.

Keywords ▸ Cloud computing, Openstack, metadata catalogues, LIMS, ICAT, IsPyB, GPUs, GPFS, Lustre, HPC, HTC.

8. Integrating Diverse Systems

Large-scale experimental control systems are frequently built from the aggregation of many heterogeneous components comprised of in-house and commercial off the shelf systems. Component selection is driven by decisions of technical requirements, industrial standards, institutional policy, community best practices, financial or resource considerations, etc.

This track aims to present the experiences, issues and lessons learned related to the design, construction and evolution of the diverse control systems and their potential integration, covering architectures, technologies and methods.

Topics covered in this track include:

- Design paradigms and technology evolution (e.g. IoT, interoperability...)
- Control system coupling.
- Low-level control component integration.
- Customization levels of commercial off-the-shelf components.
- Scalability and real-time performance.
- Maintainability.

Keywords ▸ Scalability, customization, integration, process control, SCADA, PLC, PAC, IPC, industrial communications, fieldbus, smart sensors, alarms, motion control, robotics, dynamic simulation, virtual commissioning, maintenance, fault detection.

9. IT Infrastructure for Control Systems

This track addresses the IT infrastructure of networks, processing nodes, data storage systems and databases used in Controls Systems. The cyber security aspects and cloud computing solutions are also discussed.

Topics covered in this track include:

- Networks.
- Power usage management.
- Storage systems (If related to data analysis, please check the track on Data Management).
- Configuration management.
- Continuous integration and continuous deliveries including systems such as Travis, Jenkins, and many others.
- Installation methods and tools of control system computers and controllers.
- Design for and addressing off-normal situations.
- IT disaster recovery strategies.
- Interfaces between central IT and control systems-specific infrastructures and devices.
- Virtualization.
- Server and application hosting.
- Service desk management, and tools for managing tickets such as Jira, RT and many others.

Keywords ▸ Backup, storage, Linux, Proprietary Operating Systems, Hypervisors, network, switches, multi-core processor, VPN, LDAP, firewall, NFS, DHCP, RADIUS, DNS, TCP/IP, Nagios, Icinga, Tivoli, Bacula.

10. Feedback Control and Process Tuning

Modern experimental physics facilities are very complex machines that cannot be operated without the use of sophisticated systems automatically executing tasks that are not manageable manually by physicists or operators. Examples are optimization tools for tuning the machines and improving their performance, as well as feedback/feed-forward systems assuring the stability of critical parameters during operation. In some cases these systems require dedicated real-time platforms with deterministic communication capabilities or the usage of FPGAs.

Of particular interest are systems featuring human-like capabilities, able to learn and adapt to different situations. These systems can benefit from the acquired knowledge and gained experience to understand behaviors and recognize phenomena, and eventually support humans in solving complex problems.

Topics covered in this track include:

- Software or FPGA based feedback and feed-forward systems.
- Use of models and simulators.
- Predictive and adaptive correction systems.
- Automatic tuning and optimization techniques, multi objective optimization, genetic algorithms.
- Fuzzy logic, neural networks, artificial intelligence, machine learning.

Keywords ▸ Feedback, feed forward, model, simulation, predictive and adaptive, correction, automatic tuning and optimization, genetic algorithm, fuzzy logic, neural network, artificial intelligence, machine learning.

11. Hardware Technology

This track focuses on hardware design as applied to the operation of large physics facilities, with an emphasis on collaborative efforts among laboratories and companies using Open Source Hardware practices.

Topics covered in this track include:

- Hardware platforms: microTCA.4, xTCA, FMC, VME, VXS, VPX, PCI/PCIe, PXI/PXIe, Network-Attached Devices (NAD)...
- Printed circuit board (PCB) design.
- Programmable logic design, System-on-Chip (SoC) design, including embedded processors in Field Programmable Gate Arrays (FPGA).
- Hardware/software co-design.
- Hardware and gateware simulation, verification and testing.
- Data links for distributed controls and data acquisition.
- Radiation-hardened design.
- Collaborative design tools.
- Reliability and Electromagnetic Compatibility (EMC).
- Availability and redundancy.
- Commercial-Off-The-Shelf (COTS) systems, both open source and proprietary.
- Integrated self-diagnosis.
- Upgrade and maintenance strategies and life cycle management.

Keywords ▸ xTCA, FMC, VME, PCI, PCIe, PCB, FPGA, HDL, SoC, EMC, Open Hardware.

12. Timing and Synchronization

This track focuses on timing and synchronization issues and challenges in particle and light beams, data acquisition, pump-probe configurations, etc. Papers should demonstrate the way issues such as precision, stability, jitter and performance are managed to build custom systems.

Topics covered in this track include:

- Architectures for timing distribution.
- Timing protocols such as NTP, PTP, or IEEE 802.1AS.
- Timing systems such as MRF, Greenfield, and White Rabbit.
- Facility-specific timing systems and protocols.
- Methods for transmission delay compensation.
- Solutions for extremely high precision (sub-picosecond) timing requirements.
- Beam synchronous trigger techniques for Data Acquisition.

Keywords ▸ Timing, Synchronization, NTP, PTP, MRF, White Rabbit, Delay Compensation, Event Systems, Distributed Clock Systems, High Precision Timing, beam synchronous triggering, pump&probe, trigger.

13. Systems Engineering, Collaborations and Project Management

This track focuses on systems engineering techniques and case studies used to manage complex engineering projects over full life cycles and project management and collaboration techniques used to manage diverse projects.

Topics covered in this track include:

- Technology integration and design of complex systems.
- Systems modeling and optimizations.
- Risk management in design, construction and commissioning processes.
- Requirements and interface management.
- Validation and verification techniques.
- Collaborative processes enabling effective interactions between diverse institutes and countries.
- Lessons learned through project lifecycle phases.
- Team building in diverse and/or multicultural environments.
- Human factors such as work-life balance.
- Scope, schedule, budget, and quality assurance management techniques.

Keywords ▸ Risk management, project management, quality assurance, integration, systems modeling.

14. Data Analytics

This track focuses on examining datasets from different data sources with the purpose of uncovering hidden patterns, correlations and other insights. Use cases can cover the plants under control as well as the control systems themselves. Data can be analyzed online, offline or in a combination of both. Analytics also favors data visualization to communicate insights, inferring conclusions and representing the results in a comprehensible form. Note that scientific data processing and analysis is covered by a different track: Data Management and Processing.

Topics covered in this track include:

- Analytics ecosystems (e.g. Hadoop, ...)
- Data analytics frameworks (e.g. Spark, ...)
- Data mining (e.g. ElasticSearch, ...)
- Statistics, and statistical models.
- Dependability.
- Risk analysis.
- Bayes analysis.
- Real time analytics.
- Searching and retrieval.
- Predictive analytics.
- Machine learning.
- NoSQL and time series databases (e.g. Cassandra, MongoDB, ...)

Keywords ▸ Analytics, NoSQL, big data, notebooks.

WORKSHOPS

Saturday, October 7th

09:30 - 18:30 **SAW1A - EPICS SATELLITE MEETING** ▸ Mare Nostrum AB
Chairs ▸ **Timo Korhonen** (ESS, SE) and **Sira Cordón** (ESS-Bilbao, ES)

09:30 - 18:30 **SAW1C - WHITE RABBIT TUTORIAL** ▸ Mare Nostrum C
Chair ▸ **Javier Serrano** (CERN, CH)

09:30 - 18:30 **SAW1D - TANGO** ▸ Mare Nostrum D
Chairs ▸ **Jean Michel Chaize** (ESRF, FR) and **Andy Götz** (ESRF, FR)

09:30 - 18:30 **SAW1E - PLC BASED CONTROLS SYSTEMS** ▸ Mare Nostrum E
Chair ▸ **Enrique Blanco** (CERN, CH)

Sunday, October 8th

09:00 - 18:00 **SUW1A - HDF5 AND DATA FORMAT** ▸ Mare Nostrum AB
Chairs ▸ **Ulrik Pedersen** (DLS, UK), **Andy Götz** (ESRF, FR) and **Elena Pourmal** (The HDF Group, US)

09:00 - 18:00 **SUW1C - CONTROL SYSTEM CYBERSECURITY** ▸ Mare Nostrum C
Chairs ▸ **Stefan Lüders** (CERN, CH)

09:00 - 18:00 **SUW1D - MOTION CONTROL** ▸ Mare Nostrum D
Chairs ▸ **Yves-Marie Abiven** (SOLEIL, FR), **Christer Engblom** (SOLEIL, FR), **Brian Nutter** (DLS, UK), **Nader Afshar** (AS, AU), **Paul Barron** (ESS, SE), **Nicolas Janvier** (ESRF, FR), **Nicola Coppola** (XFEL, GE), and **Guifré Cuní** (ALBA, ES)

09:00 - 18:00 **SUW1E - SARDANA - SCIENTIFIC SCADA SUITE** ▸ Mare Nostrum E
Chairs ▸ **Zbigniew Reszela**, **Carlos Pascual-Izarra**, **Carlos Falcón**, **Marc Rosanes**, **Guifré Cuní**, and **David Fernández-Carreiras** (ALBA, ES)

09:00 - 13:00 **SUW1F - USER EXPERIENCE IN MICROTCA** ▸ Mare Nostrum F
Chair ▸ **Thomas Walter** (DESY, GE)

14:00 - 18:00 **SUY1A - MRF TIMING PROTOCOL USERS** ▸ Mare Nostrum F
Chair ▸ **Eric Bjorklund** (LANL, US)

NETWORKING PROGRAM

WELCOME RECEPTION

Sunday, October 8th at 18:30 h

The Welcome Reception will take place at the Exhibition and Poster area of the Conference Venue

Included in the full conference registration fee and Monday registration fee; it is essential to confirm the attendance when registering.

VISIT TO THE SAGRADA FAMILIA

Wednesday, October 11th from 16:00 h

ICALEPCS 2017 delegates and companions will have the option to visit the Sagrada Familia, one of the most visited buildings in the world. We will visit the astonishing interior of this church, where vaults reach seventy meters. Antoni Gaudí designed a Latin cross plan with five aisles, extremely rich in ornamentation and symbolism

Transportation from the ICALEPCS 2017 Conference venue to the Sagrada Familia will be provided. The Sagrada Familia is in town, very accessible, next to a metro station and in a lively area with bars restaurants. No transportation back to the venue is foreseen after the visit.

Seats are limited to 300 to be assigned in order of registration.

1st visit at 16:00 h ▸ Buses will leave at 15:00 h from the Conference venue.
2nd visit at 16:30 h ▸ Buses will leave at 15:30 h from the Conference venue.
3rd visit at 17:00 h ▸ Buses will leave at 16:00 h from the Conference Venue.
4th visit at 17:30 h ▸ Buses will leave at 16:30 h from the Conference Venue.
Length of the visit ▸ 1 hour approx.

CONFERENCE DINNER

Thursday, October 12th at 20:00 h

The Conference Dinner will take place at:

Marques de Comillas Hall at the Maritime Museum of Barcelona ("Royal Shipyards")
Drassanes Reials (Museu Marítim of Barcelona)
Avinguda de les Drassanes avenue, s/n
08001 Barcelona

Metro stop "Drassanes" (Line L3 - green). Official transportation will not be provided.

Included in the full conference registration fee; it is essential to confirm the attendance when registering.

Additional Conference Dinner Ticket: €95.

VISIT TO ALBA SYNCHROTRON

Friday, October 13th at the end of the Conference sessions

Alba visit

ALBA is a 3rd generation Synchrotron Light Source located in Cerdanyola del Vallès (Barcelona), in operation since 2012.

It is a complex of electron accelerators to produce synchrotron light, which allows the visualization of the atomic structure of matter as well as the study of its properties.

ALBA currently has eight operational state-of-the-art Beamlines, comprising soft and hard X-rays, which are devoted mainly to biosciences, condensed matter and materials science. Additionally, three new Beamlines are in construction.

This large scientific infrastructure provides more than 5,000 hours of beam time per year and is available for academic and industrial users, serving more than 1,000 researchers every year. Since 2012, ALBA has been hosting official users, from Spain, and a significant part from other countries as well.

Managed by the Consortium for the Construction, Equipping and Exploitation of the Synchrotron Light Source (CELLS),

Bring your national ID card or passport for the visit.

Information for Alba visitors

Please take a few minutes to learn about the safety requirements for all individuals present at the Facility.

Safety is everyone's responsibility. You have a duty to behave safely and to encourage and help others around you to do the same.

There are a number of safety hazards present at the Synchrotron including: Radiation, high voltage power supplies, magnetic fields, compressed air systems, water cooling systems, cryogenic cooling systems.

The personnel safety systems and procedures ensure that the employees, visiting scientists and the visitors from the general public are protected from these hazards. When on site everyone is to comply with the instructions and obey all safety and warning signs at the facility. Please do not touch the instrumentation.

Pregnant women, people with **pacemakers** and in general fitted with any o**ther medical device**, and persons **under the age of 16** must inform the designated ALBA staff prior to the visit and on arrival.

Suitable clothes and shoes:

- High heels, sandals and thongs are not permitted.
- No loose garments or accessories that can be easily trapped or caught.

Visitor Escort: You will need to be escorted and follow the instructions given by the designated

ALBA member during the visit. Please follow your group.

Emergency Evacuation of the Building: If the case of an evacuation alarm, please follow the signs to immediately evacuate the building and gather at the meeting point. Follow the ALBA staff members. Do no use the elevators.


The 4-fold safety of automation
COMPONENTS
SYSTEMS
SERVICES
Technical Ecological
Personal Economical
PAS 4000
SafetyNET p

INDUSTRY SESSION

Tuesday, October 10th

13:00 - 14:00 h ▸ Parallel room

Organized by PILZ THE SPIRIT OF SAFETY

Klaus Stark

Senior Manager Innovation Management. Pilz GmbH & Co. KG

Klaus Stark (Dipl.-Ing. FH) was born in Grötzingen in 1955. After completing a degree in electronic engineering/ computer sciences he worked for Pilz as a development engineer for eight years. He then held positions as development manager at Wöhrle Industrieelectronic and at Leuze Elektronik, where he was in charge of product management and application support in the optical sensors division. In 1996 he returned to Pilz as Head of Product Management. In 2008 he became Head of International Sales. Since 2017 Klaus Stark has been responsible for Innovation Management.

He is an active advocate for automation in various committees, including as Chair of ZVEI's Technical Committee "Safety systems in automation" and now also as a board member of the technology initiative SmartFactory KL e.V.

Safety is one - main - key to research

Safety is not an end in itself, but the enabler for functionalities. We as human beings do not recognize the presence of safety, just the absence and the possible, sometimes negative results.

Science research especially, in laser labs or synchrotrons are not possible without a structure around. These structures/activities includes administrative, security, automation and safety issues. In Europe all "machines and facilities" have to fulfil the demands of the Machine directive (MD). These demands are simplified named – "to provide a safe workplace according the state of the art". In order to fulfil that, we apply the norms and standards – in the case of the Synchrotron in Alba the IEC 61508.

The main difference is in the level of danger due to radiation, it´s unvisability and unnoticeability – so any avoidance is (nearly) impossible. Also it´s lab character, the international researcher team and the type of person´s create a special demand.

In Alba the line and the ring and all the individual Labs have to be protected in these way.

Pilz have developed in Alba different projects where safety was the main feature. Among those projects, we can find new radiation labs and the Gateway project that has to ease the technology migration in the Synchrotron of the popular PSS 3000 to the newest and reliable PSS 4000.

The company Pilz was chosen as the supplier and partner, due to their knowledge in safety, their experience, their references in similar projects in Karlsruhe (Germany) and Melbourne (Australia), their quality level but also their competence in service. Pilz Engineers are trained according the BIAC concept and all of them have the CMSE (certified machine safety expert) course successfully passed.

Pilz offered since 1995 one of the first safe plc, called PSS3000. PSS3000 was a centralized concept, which could be expanded with decentral safe I/O via SafetyBUS p. This Safety PLC is used all across the world in various applications and proven by its availability and robustness. Since a couple of years these concept led into the new PSS4000 with it´s Ethernet based backbone called SafetyNET p. The new plc is fully decentral in design, which a central point of view for the programming.

The dual use for automation and safety is based on a unique design in architecture and performance. Availability concepts are possible also ring concepts etc. The symmetrical instruction/command set, together with the approved function blocks, makes it transparent and easy to the application engineers.

The cooperation and the projects management of the synchrotron projects in Alba went well and was validated and confirmed by the TÜV Rheinland approval and the successful operation since years.

Open to all ICALEPCS 2017 attendants

SPONSORS

SILVER SPONSORS

Cosylab integrates control systems for particle therapy and research particle accelerators, either complete, or in part.

Project directors, group leaders and engineers on such projects often face tight deadlines and certification challenges.

They engage Cosylab to achieve better performance, while reducing commissioning time, manpower and cost.

Cosylab has successfully completed more than 200 projects related to development and integration of control systems for scientific research facilities; of these projects, more than 90% are for particle accelerators.

www.cosylab.com

ICEX Spain Trade and Investment, assisted by the network of Spanish Embassy's Economic and Commercial Offices, is the Governmental Agency serving Spanish companies to promote their exports and facilitate their international expansion.

www.icex.es

Pilz operates internationally as a technology leader in automation technology. In addition to the head office in Germany, the family business is represented by subsidiaries and branches on all continents. As an expert for the safety of man, machine and the environment, Pilz offers worldwide customer-oriented solutions for all industries. These include innovative products from the fields of sensor, control and drive technology. Our international team offers professional machinery safety services. Pilz constantly manages to introduce trendsetting innovations and standards to the market. Pilz is actively shaping Industrie 4.0 – from the very beginning, already delivering solutions for Industrie 4.0, and so for the automation of the future.

www.pilz.com/es-ES

SIEMENS
Ingenio para la vida

Siemens AG (Berlin and Munich) is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. The company is active in more than 200 countries, focusing on the areas of electrification, automation and digitalization. In fiscal 2016, which ended on September 30, 2016, Siemens generated revenue of €79.6 billion and net income of €5.6 billion. At the end of September 2016, the company had around 351,000 employees worldwide.

www.siemens.com

Tessella

Tessella, Altran's World Class Center for Analytics, is part of the Altran Group, a global leader in Engineering and R&D Services. Tessella uses data science to accelerate evidence-based decision making, allowing businesses to improve profitability, reduce costs, streamline operations, avoid errors and out-innovate the competition.

Our work includes some of the most exciting and ambitious projects of our time. These projects make the world a better place: increasing productivity in the development of new medicines; designing satellites to observe and understand our universe; harnessing fusion power to provide unlimited, clean energy; and minimizing risk for workers in harsh and dangerous conditions.

www.tessella.com

BRONZE SPONSOR

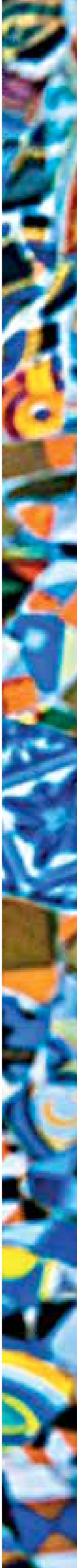
Australian Government | ansto

The **Australian Nuclear Science and Technology Organisation (ANSTO)** is one of Australia's largest public research organisations. The Federal Government has entrusted ANSTO with ownership and operation of over $1 billion worth of our country's landmark and national research infrastructure.

This includes the Open Pool Australian Light-water (OPAL) multi-purpose reactor, the Australian Synchrotron, the Centre for Accelerator Science (CAS), the Australian Centre for Neutron Scattering (ACNS) and the National Deuteration Facility.

More than 500 scientists, engineers and technicians work at ANSTO to answer significant questions relating to the environmental, human health, the nuclear fuel cycle and industry using nuclear techniques.

www.ansto.gov.au



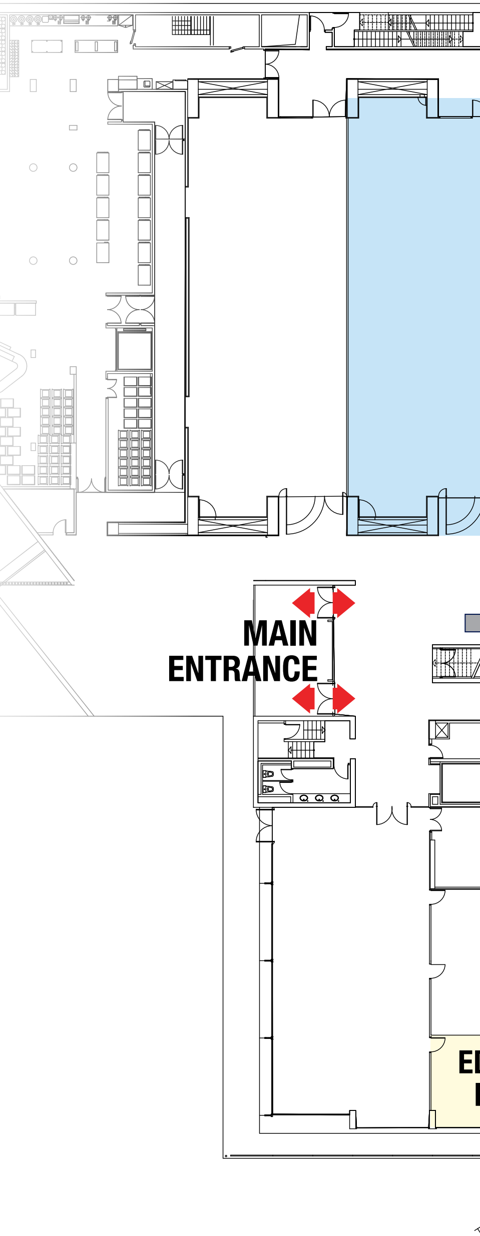
EXHIBITORS

LIST OF EXHIBITORS

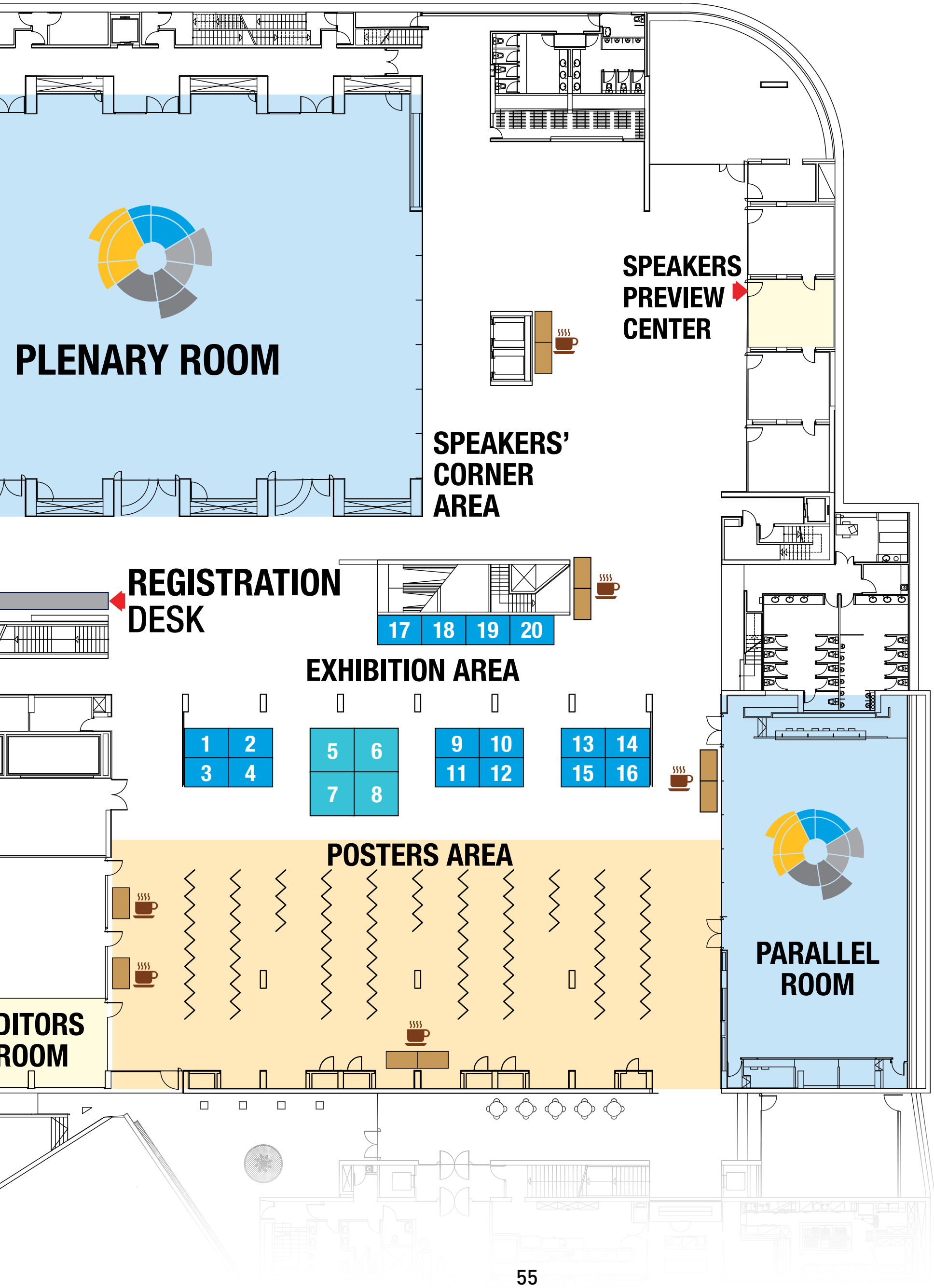
PALAU DE CONGRESSOS
DE CATALUNYA
BARCELONA

Level -1

EXHIBITOR	Booth No.
ADEX	6, 8
BECKHOFF AUTOMATION	13
COSYLAB	1-2
CYCLE	19
D-TACQ SOLUTIONS	14
FAGOR AUTOMATION	6, 8
FARADAY MOTION CONTROLS	17
ICEX	6, 8
INDUCIENCIA	6, 8
INEUSTAR	6, 8
IOXOS TECHNOLOGIES	12
ISEG SPEZIALEKTRONIC – W-IE-NE-R	16
LEYBOLD HISPÁNICA	3
MICROTCA TECHNOLOGY LAB	7
MI-PARTNERS	20
OBSERVATORY SCIENCES	4
PILZ	5
PREVAC | SCIENTEC IBERICA	15
QUANTUM DETECTORS	10
SCIENTIFICA	6, 8
SEVEN SOLUTIONS	6, 8
SIEMENS AG	9,11



EXHIBITION MAP



EXHIBITORS

ADAPTIVE PREDICTIVE EXPERT CONTROL ADEX S.L.

Stands 6 8

ADEX, founded in 2004 as a spin-off from the UNED, is based in Madrid. It holds international patents for ADEX technology, which is the culmination of more than 30 years of research and development, 5 patents, 4 books and more than 100 scientific papers. ADEX has developed and introduced Optimized Adaptive Control systems (ADEX systems) in a wide variety of industrial areas, which guarantees stability and optimal operation due to its unique adaptive self-adjusting capability for processes of a time-varying dynamics and operating context.

www.adexcop.com

BECKHOFF AUTOMATION

Stand 13

Beckhoff implements open automation systems based on PC Control technology. The product range covers Industrial PCs, I/O and Fieldbus Components, Drive Technology and automation software. Products that can be used as separate components or integrated into a complete and seamless control system are available for all industries. The Beckhoff "New Automation Technology" philosophy represents universal and open control and automation solutions that are used worldwide in a wide variety of different applications, ranging from CNC-controlled machine tools to intelligent building automation.

www.beckhoff.com

COSYLAB

Stands 1 2

Cosylab integrates control systems for particle therapy and research particle accelerators, either complete, or in part.

Project directors, group leaders and engineers on such projects often face tight deadlines and certification challenges.

They engage Cosylab to achieve better performance, while reducing commissioning time, manpower and cost.

Cosylab has successfully completed more than 200 projects related to development and integration of control systems for scientific research facilities; of these projects, more than 90% are for particle accelerators.

www.cosylab.com

CYCLE

Stand **19**

Cycle GmbH was founded with the mission of building innovative ultrafast technology for science and industry applications. We are producing world-leading timing equipment that synchronizes RF and optical equipment to each other with sub-femtosecond resolution.

www.cyclelasers.com

D-TACQ SOLUTIONS

Stand **14**

High Performance Simultaneous Data Acquisition: **D-TACQ** designs, manufactures and supports a range of COTS and "COTS" products with uncompromising analog quality and simultaneous sampling. Products feature a high performance FPGA/ microprocessor subsystem and open-source software to provide a flexible networked solution. D-TACQ products are used in large physics sites world-wide, both as complete "DAQ Appliances" and as standard modules working in 3rd party hardware.

D-TACQ is always happy to help with customisation and system integration.

Products on display include low cost, high channel density DAQ Appliances, and integrated solutions on customer platforms, including custom and MicroTCA.

www.d-tacq.com

FAGOR AUTOMATION

Stands **6** **8**

Fagor Automation is a company with great experience in the development and manufacturing of products for machine automation and control. It excels by its capability to develop software and the versatility of its productive process to offer solutions tailored to the needs of their customers. The product range: linear and angular encoders with high accuracy and resolution, numeric control systems (CNC), drives and motors.

www.fagorautomation.com

FARADAY MOTION CONTROLS

Stand **17**

Since 1998 **Faraday Motion Controls**, Formally Delta Tau UK, has been producing high-speed, high precision, open architecture Motion Controllers from single axes to fully coordinated multi axes systems.

With nearly four decades of experience in high performance motion control solutions more than one million axes of motion are controlled by Delta Tau products in just about every industry imaginable.

Delta Tau controllers have excelled in the high energy physics industry where precision, coordination, stability, repeatability and accuracy are paramount.

Delta Tau provides the best application support in the industry with local application engineers strategically located throughout the world to assist whenever and wherever it's needed.

faradaymotioncontrols.co.uk

ICEX ESPAÑA EXPORTACIÓN E INVERSIONES

Stands **6** **8**

ICEX Spain Trade and Investment, assisted by the network of Spanish Embassy's Economic and Commercial Offices, is the Governmental Agency serving Spanish companies to promote their exports and facilitate their international expansion.

www.icex.es

INDUCIENCIA®, THE TECHNOLOGY SCIENCE INDUSTRY PLATFORM

Stands **6** **8**

INDUCIENCIA is a structured forum, led by the industry, in which all the agents interested in Science Industry participate and collaborate to jointly define the objectives of research and technological development in the medium and long term, with a clear orientation to the market.

Its work and activities allow it to orientate and focus all efforts towards a more committed, planned and structured innovation scenario in the Science Industry sector.

www.induciencia.es

INEUSTAR

Stands 6 8

INEUSTAR, the Spanish Science Industry Association is a private, nonprofit organization founded and owned by Spanish industrial companies that devote a relevant part of their activities to design, manufacture and supply special installations, equipment and instruments to Large Scientific Research Facilities (LSRFs). Accelerators and Matter Sciences, Fusion, Astronomy and Space Sciences, Biology and New Energy Sources are but a few of the fields in which our companies are active and highly competitive. INEUSTAR promotes the growth of the Spanish Science Industry by providing special services, fostering new collaborations, disseminating capabilities, promoting R&D and working closely with local and international LSRFs.

www.ineustar.com

IO x OS TECHNOLOGIES

Stand 12

Electronic design company, founded in 2007 in Gland (Switzerland), offering innovative solutions to system integrators in the High Energy Physics, Mil/Aero and Transport industries. It combines its hardware design expertise with engineering, consulting and training services covering both hardware and software with the aim of fulfilling the customer requirements from the initial specification to the final implementation, validation, verification and system integration. IOxOS Technologies has used its know-how and proven experience in the development of long-lasting modular hardware platforms targeting distributed real-time control systems for accelerators and large experimental physics.

www.ioxos.ch

ISEG SPEZIALEKTRONIC
W-IE-NE-R POWER ELECTRONICS

Stand 16

The companies **iseg Spezialelektronik GmbH and W-IE-NE-R Power Electronics GmbH** are specialized in standard and customized equipment for Nuclear Physics Experiments like multi and single channel High- and Low Voltage Power Supplies, NIM-, VME- and CAMAC-Crates as well as Read-Out Electronics such as Preamplifiers, ADC, TDC and Digital Pulse Processors via partner companies. A combined 81 years of experience in small, middle and large scale Physics Experiments worldwide make these two companies the partner of choice for a variety of challenging requirements. The quality and longevity of the products will guarantee a long trouble free runtime of Experiments.

www.iseg-hv.com • www.wiener-d.com

LEYBOLD

Stand **3**

As a pioneer of vacuum technology, **Leybold** offers a wide range of vacuum components, standardized and fully customized vacuum solutions, complemented by vacuum technology accessories and instrumentation.

With a long history in collaboration with major research institutes, national laboratories, universities and scientific instrument manufacturers, Leybold is the right partner to provide the necessary vacuum expertise, experience and equipment.

Leybold offers a broad know-how of processes and applications to their customers, supported by a worldwide sales and after sales network. Leybold Hispánica's office and technical service workshop is located in Cornellá de Llobregat (Barcelona); we are also present in Madrid, Bilbao and Sevilla.

www.leybold.com/es/es

MicroTCA Technology Lab

Stand **7**

DESY designs, builds and operates accelerators and detectors for research with photons. The newly founded "**MicroTCA Technology Lab – A Helmholtz Innovation Lab**" at DESY is focused on components and systems based on the MicroTCA standard and helps customers from research and industry with the development of hardware, firmware and software as well as high-end test and measurement and system integration services. Possible target sectors include industrial automation, laser controls, radar systems and medical technology.

http://mtca.desy.de

MI-PARTNERS

Stand **20**

MI-Partners is a research and development partner for high-end mechatronic products and systems. We offer our expertise in helping our customers in mechatronics related innovations or technological challenges especially in the field of system design, dynamics and control. We are specialized in concept generation and validation for ultra-fast (>10g), extremely accurate (sub-nanometers) or complex positioning systems like stages, manipulators and vibration isolation systems (passive and active).

As we are working for customers in a wide variety of markets, we can benefit from our experience in all these different areas, and as such help our customers with fresh, innovative and cost effective solutions.

www.mi-partners.nl

OBSERVATORY SCIENCES

Stand **4**

Observatory Sciences is a leading developer and supplier of software for the control of 'big science' systems and instruments, including large telescopes and synchrotrons. Meeting the needs of scientific, research and technical clients across the globe, Observatory Sciences is behind some of the world's high-profile astronomy and physics projects.

We use our expertise to provide a range of bespoke systems development, consultancy and project management services tailored to the needs of individual clients. Our customers include Diamond Light Source (UK), the European Southern Observatory (Germany) and the DKIST telescope project (USA).

www.observatorysciences.co.uk

PILZ

Stand **5**

Pilz operates internationally as a technology leader in automation technology. In addition to the head office in Germany, the family business is represented by subsidiaries and branches on all continents. As an expert for the safety of man, machine and the environment, Pilz offers worldwide customer-oriented solutions for all industries. These include innovative products from the fields of sensor, control and drive technology. Our international team offers professional machinery safety services. Pilz constantly manages to introduce trendsetting innovations and standards to the market. Pilz is actively shaping Industrie 4.0 – from the very beginning, already delivering solutions for Industrie 4.0, and so for the automation of the future.

www.pilz.com/es-ES

PREVAC | SCIENTEC IBERICA

Stand **15**

Scientec Ibérica is one of the largest distributors in the field of surface analysis. Our main products are AFM Microscope (Nano-Observer, ResiScope, AFM probes), Nano-indenters, optical and mechanical profilers and analyzers of thin layers. Our application engineers will help you in your research and our service will support you. ScienTec Ibérica recently expanded its range in vacuum field thanks to Prevac products.

Prevac has been one of the world's leading manufacturers of research equipment for analysis of high and ultra high vacuum applications. The range of products includes advanced multi-technique systems for UHV surface science as XPS, UPS, ARPES, FTIR, AFM or deposition systems as MBE, PLD, CVS, Sputter deposition, thermal evaporation. It includes also, Manipulators, goniometer, Chamber, Sample holders, Instruments, Accessories, Electronics and Software...

www.scientec.es • www.prevac.eu

QUANTUM DETECTORS

Stand 10

Quantum Detectors offer detection systems generated out of advanced research and development at globally leading scientific facilities. Many of the systems employ proprietary technology previously unavailable to commercial customers.

Quantum Detectors was founded in September 2007 to promote a wider exploitation of detectors developed for synchrotron radiation, LASER and other large scale facility applications. Since then the company has grown and is now well integrated into the synchrotron community around the globe. The current products are leaders in their respective areas providing users of such equipped facilities with unique capabilities.

www.quantumdetectors.com

SCIENTIFICA

Stands 6 8

Scientifica International is a company based in Elgoibar, in northern Spain. It is devoted to the development, manufacturing and commercialisation of precision equipment for the Science Market.

Scientifica's knowledge base and industrial capabilities extend to three main core technologies:

- Electronics and signal processing: High precision and custom functionality devices, with custom control and signal processing capabilities and algorithms.
- Composite materials: Custom structural and functional materials, with high performance for special purposes.
- Precision mechanics: Ultra high precision mechanics that enables motion control and custom functionality even in hostile working environments as vacuum, radiation, cryogenic and high magnetic fields.

www.scientifica.es

SEVEN SOLUTIONS

Stands 6 8

Seven Solutions is a privately held company leading accurate sub-nanosecond time transfer and frequency distribution for reliable industrial and scientific applications providing deterministic time as a first-order concept. It main lines are two, accelerators control systems with the implementation of a scalable and flexible Digital LLRF for IFMIF/EVEDA linear accelerator in collaboration with CIEMAT, and a wide range of high accuracy timing systems taking advance of the White Rabbit technology, developed in collaboration with CERN. These two lines are merged to provide a high synchronized control systems based on precise and customized digital/analog designs.

www.sevensols.com

SIEMENS AG

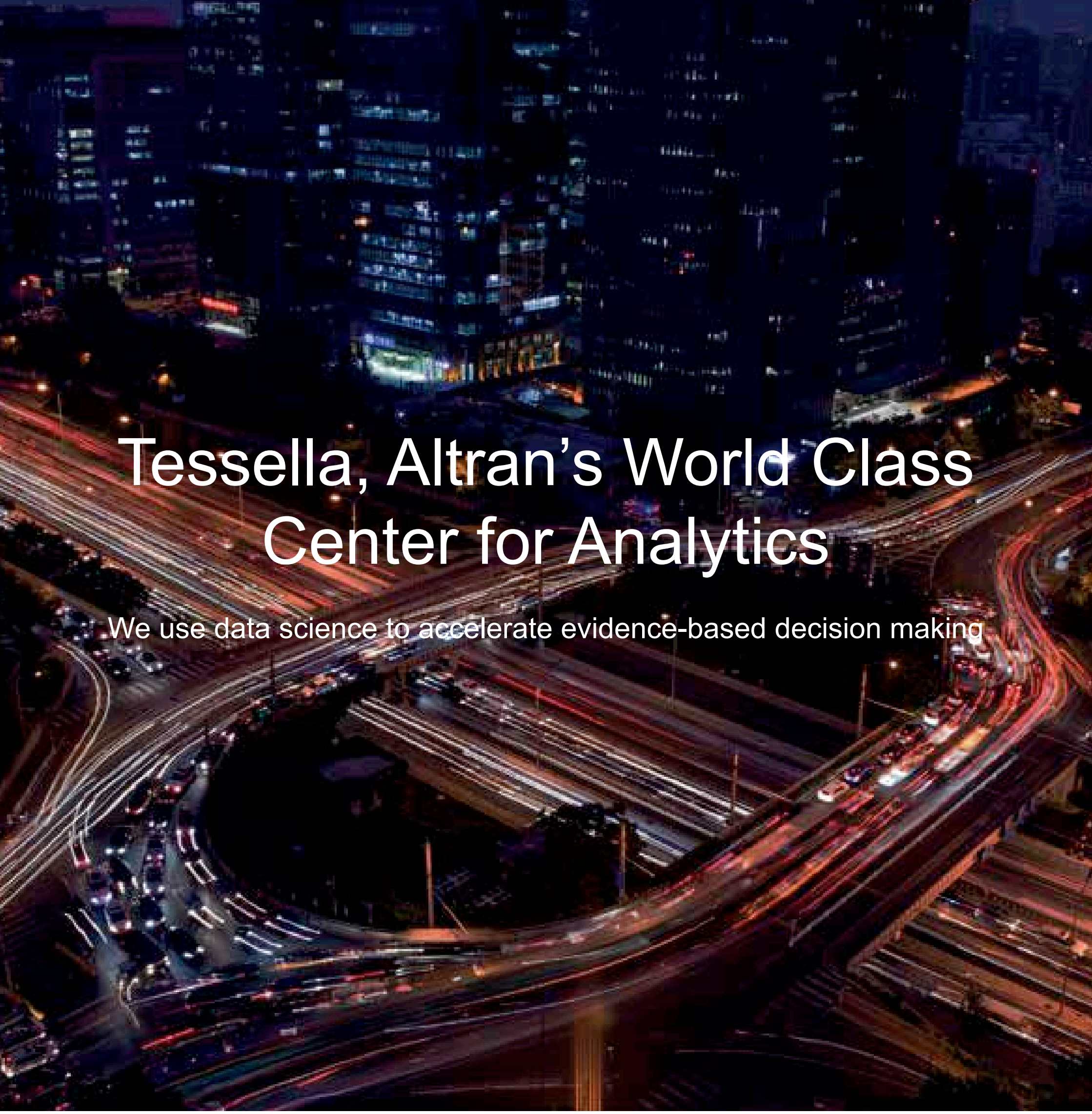
Stands 9 11

SIEMENS

Ingenio para la vida

Siemens AG (Berlin and Munich) is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. The company is active in more than 200 countries, focusing on the areas of electrification, automation and digitalization. In fiscal 2016, which ended on September 30, 2016, Siemens generated revenue of €79.6 billion and net income of €5.6 billion. At the end of September 2016, the company had around 351,000 employees worldwide.

www.siemens.com


Tessella, Altran's World Class Center for Analytics
We use data science to accelerate evidence-based decision making

DETAILED PROGRAM AND BOOK OF ABSTRACTS

07-Oct-17 09:30 – 18:30 Meeting Room A&B

SAW1A — EPICS Satellite Meeting

T. Korhonen (ESS), S. Cordon (ESS Bilbao)

EPICS (Experimental Physics and Industrial Control System) is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes, experiment beam lines and other large scientific experiments. The EPICS collaboration meeting provides an opportunity for developers and managers from the various different sites to come together and discuss their work in progress and make plans for the future. They give a chance to see what is being done at other laboratories, and to review the specifications for new tools or enhancements to existing ones in order to maximize their usefulness to the whole community and avoid duplication of effort.

Topics that will be addressed:

- The upcoming EPICS 7 release
- Project status reports
- User Interface tools
- Technical presentations from EPICS users

07-Oct-17 09:30 – 18:30 Meeting Room C

SAW1C — White Rabbit Tutorial Workshop

J. Serrano (CERN)

White Rabbit (WR) is a multi-laboratory, multi-company collaboration to design open source hardware, gateware and software in the field of distributed hard real-time controls and data acquisition systems. The core of these systems is a WR network, which features sub-ns synchronization with fiber delay compensation and a guaranteed upper bound in message latency. WR is a backwards compatible extension of Ethernet and IEEE 1588 (aka Precise Time Protocol). The WR collaboration typically conducts workshops where users and core developers present their progress and applications.

In this ICALEPCS pre-conference workshop, we would like to take a slightly different approach. We would like to make this a tutorial workshop, meaning that somebody who has never been exposed to WR technology should walk out of the workshop with a very good idea of how to use WR to solve real life problems, having seen real WR gear in action. We would also like to cater for experienced WR users by providing several examples of WR applications in domains they may not have tackled yet, and by including advanced material at the end of the day.
This workshop will cover:

- Basics of WR technology
  - The WR switch and WR nodes
  - The WR PTP core console
  - Demonstration of synchronization and message latency measurement
  - Basic monitoring of a WR network through SNMP
- Applications
  - Event timing system
  - Distributed oscilloscope
  - RF distribution
  - MIMO feedback systems
  - Low-latency deterministic data streaming
- Advanced topics
  - Robustness
  - Advanced monitoring and diagnostics in a WR network
  - Internals of the WR PTP core
  - Remote configuration of switches and nodes
  - Designing and calibrating your own WR node
  - Minimizing the jitter of the recovered clock signal
  - Minimizing the latency variations for data delivery

07-Oct-17 09:30 – 18:30 Meeting Room A&B

SAW1A — EPICS Satellite Meeting

T. Korhonen (ESS), S. Cordon (ESS Bilbao)

EPICS (Experimental Physics and Industrial Control System) is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes, experiment beam lines and other large scientific experiments. The EPICS collaboration meeting provides an opportunity for developers and managers from the various different sites to come together and discuss their work in progress and make plans for the future. They give a chance to see what is being done at other laboratories, and to review the specifications for new tools or enhancements to existing ones in order to maximize their usefulness to the whole community and avoid duplication of effort.

Topics that will be addressed:

- The upcoming EPICS 7 release
- Project status reports
- User Interface tools
- Technical presentations from EPICS users

07-Oct-17 09:30 – 18:30 Meeting Room E

SAW1E — PLC Based Controls Systems

E. Blanco (CERN)

This workshop intends to create a collaborative space where attendees will show their best practices, tools employed and return of experience when engineering PLC based control systems. This time the workshop focuses specifically the management of the control applications.

Precise topics that will be addressed:

- Specifications, requirements trace, documents: analysis, design, implementation
- Software development: standards and/or frameworks, novel paradigms (e.g. automatic code generation, object orientation), language choice and coding conventions, best practices.
- Testing and verification: methodologies and tests (FAT, SAT), simulation, static analysis, verification (e.g. formal methods)
- Application management: versioning, deployment, online changes, upgrades, reverse engineering

08-Oct-17 09:00 – 18:00 Meeting Room A&B

SUW1A — HDF5 and Data Format

U. Pedersen (DLS), A. Götz (ESRF), E.I. Pourmal (The HDF Group)

During ICALEPCS 2015 it became clear that HDF5 is the de facto standard in the controls and acquisition field for storing large datasets. This workshop builds on the success of the last HDF5 workshop at ICALEPCS 2015.

The HDF group will present training tutorials on HDF5 basics including tools, performance tuning and new features.
The workshop will discuss recent developments in HDF5 and the experiences and plans of different sites, using the HDF5 library to record and store data and associated metadata.

Topics to be addressed include:

- HDF5 on multiple-platforms and multiple versions
- Use of additional definition standards like NeXus
- New tools like HDFql, news on h5py, viewers, 3rd party libraries
- Tuning and optimising for High Performance detector systems and HPC
- Experiences and plans for use of new features such as Single Writer Multiple Reader (SWMR), Virtual Dataset (VDS) and Direct Chunk Write

08-Oct-17 09:00 – 18:00 Meeting Room C

SUW1C — Control System Cybersecurity Workshop

S. Lueders (CERN)

Today's accelerator and detector control systems do not differ significantly from the control systems used in industry or devices being part of the "Internet-of-Things" (IoT). Modern Information Technologies (IT) are commonly used, control systems are based more and more on common-of-the-shelf hardware/software (VME crates, PLCs, VxWorks, LynxOS, network switches, networked controls hardware, SCADA, commercial middleware, etc.) or Windows/ Linux PCs. Furthermore, due to the academic freedom in the High Energy Physics community, control systems are produced in a wide, decentralized community, which leads to heterogeneous systems and often necessitates remote access. However, with this adoption of modern IT standards, control systems are also exposed to the inherent vulnerabilities of the corresponding hardware and software. The consequences of a security breach in an accelerator or detector control system might be severe, and attackers won't ignore HEP systems just because it's HEP.

The series of (CS)2/HEP workshops is intended to share and discuss counter-measures, to review configuration and development procedures for secure control systems, and to review the progress since the last (CS)2/HEP workshop.

Potential Keywords and topics are:

- Security, vulnerabilities and protective measures of front end devices (e.g. VME crates, LynxOS, VxWorks, PLCs, power supplies, networked controls hardware)
- Control network security, network architectures, network segregation, firewalling and intrusion detection
- SCADA security, PC installation and management schemes
- Secure ("Kiosk") operation in multi-user environments (e.g. at light-sources, where users change quite frequently)
- Authentication & Authorization on control systems
- Remote operations and expert interventions
- Software development cycle and system configuration management
- Security policies, best practices, security events and lessons learned

08-Oct-17 09:00 – 18:00 Meeting Room D

SUW1D — Motion Control Workshop

Y.-M. Abiven(SOLEIL), C. Engblom (SOLEIL), B. Nutter (DLS), N. Afshar (AS), P. Barron (ESS), N. Janvier (ESRF), N. Coppola (XFEL), G. Cuní (ALBA-CELLS Synchrotron)

The ICALEPCS MOCRAF workshop group has been created on www.MOCRAF.org to discuss about the organization of the ICALEPCS Motion Control pre-conference Workshop. Its purpose is to get feedback from attendees to make the workshop as interesting and as pleasurable as possible. This group will remain alive after the workshop to be the input for the future ICALEPCS MOCRAF meeting.

The aim of the workshop is to be helpful to you the community and so we welcome input (*) on the content and style. After the previous workshop in at ICALEPCS in Melbourne it was suggested that more time should be put aside for interactive group discussions. We are proposing two talks per session each of around 15 to 20 minutes leaving 50 - 60 minutes for relevant discussion topics. We think the current topics of interest could include the following:

- Technical solutions in software and in low level hardware with discusions on: Kinematic transforms, Complex trajectories, Protection including collision avoidance, Multi-axes and Multi-controller synchronization, Embedded and/or hosted motion features.
- Motion control challenges with discussions on: Submicron positioning, Continuous and Synchronous motion control, and Detector's data acquisition.
- Motion Control and Sample Environment Automation:
  - How should motion control fit into the increasing automation demands of high throughput beamlines?
  - How Robotic could contribute to beamline automation?
- Hardware challenges with discussions on: Actuating Technologies, Metrology, Stage Evaluations, Estimations, & Simulations, Methods of Characterization, Stacking vs Parallel Structures, Building a closed-loop control system with different feedback sources.
- Experiences in motion control at the different sites with discussions on: Radiation damage to encoders, in-house development verses industrial product, system performance validation including reliability and obsolescence management.

08-Oct-17 09:00 – 18:00 Meeting Room E

SUW1E — Sardana - Scientific SCADA Suite

Z. Reszela, C. Pascual, C. Falcón, M. Rosanes, G. Cuní, D. Fernández (ALBA-CELLS Synchrotron)

Sardana (www.sardana-controls.org) is an open source, python software suite for Supervision, Control and Data Acquisition in scientific installations. This workshop will demonstrate how to build a complete laboratory control system from scratch. After a quick guide on how to install and configure the Sardana system the workshop participants will start from learning the generic interfaces of the most common laboratory equipment exposed by the device Pool. Afterwards some practical example of how to integrate a new hardware into Sardana will be demonstrated. In continuation a basic course on how to write and execute the user procedures, called macros, will be given. Finally, it will be demonstrated how easy it is to build a modern and flexible graphical interface to the laboratory instruments using Taurus library (www.taurus-scada.org). Furthermore an example on how to mix different data sources in the same GUI will be shown with the how to write a custom Taurus scheme tutorial.

Precise topics that will be addressed:

- Installation and configuration of Sardana system from scratch
- Integration of hardware in the device Pool via controllers
- Programming your own experiments with macros
- Building a graphical user interface using Taurus library
- Accessing different data sources from within Taurus

08-Oct-17 09:00 – 13:00 Meeting Room F

SUW1F — User Experience in MicroTCA

T. Walter (DESY)

This workshop will introduce different applications and uses of MicroTCA standard in accelerators and large experimental physics control systems.

Topics that will be addressed:

- MicroTCA - Introduction to the Standard and latest news on European XFEL - Kay Rehlich (DESY)
- MicroTCA in Real Life - Thomas Holzapfel (Powerbridge, on behalf of N.A.T.)
- Implementation of MicroTCA for Beam Diagnostics and Synchronization (Matthias Felber (DESY)
- Scalability of MicroTCA.4 Systems (Thomas Holzapfel, Powerbridge)

08-Oct-17 14:00 – 18:00 Meeting Room F

SUY1A — MRF Timing Protocol Users Workshop

E. Bjorklund (LANL)

This workshop is for users of event-based timing systems implementing the Micro Research Finland (MRF) protocols and interfaces. This would include (but is not limited to) products from MRF, SINAP, and Instrument Technologies. The content of the workshop will depend on the submissions received, but could include:

- New hardware product announcements
- Report on open FPGA hardware platform
- New software development reports
- User experience and status reports
- New feature requests (hardware and software)

09-Oct-17 08:30 – 09:00 Plenary

MOOPL — Opening Session

Chair: A. Gotz (ESRF)

`MOOPL01` 08:30 25
Welcome Address
D. Fernández-Carreiras *(ALBA-CELLS Synchrotron)*
Welcome from the ICALEPCS 2017 Chair.

`MOOPL02` 08:55 5
Welcome from the Director of ALBA Synchrotron
C. Biscari *(ALBA-CELLS Synchrotron)*

09-Oct-17 09:00 – 10:00 Plenary

MOKPL — Keynote Speaker

Chair: D. Fernandez-Carreiras (ALBA-CELLS Synchrotron)

MOKPL01
09:00 09

Evolution of Photon Sources

C. Biscari*, S. Ferrer (ALBA-CELLS Synchrotron)*

The powerful matter probing capacities of photon beams has driven the development of electron accelerator based photon sources, starting from the parasitic usage of particle physics accelerators, to a wide variety of facilities all around the world, including synchrotrons and FELs. The main characteristics, the evolution of these sources and the expected developments will be presented, with a special highlight on the ALBA synchrotron.

09-Oct-17 10:00 – 11:00 Plenary

MOAPL — Project Status Report 1

Chair: Y.B. Yan (SSRF)
Co-Chair: J.F. Maclean (ANL)

MOAPL01
10:00 15

The Control System for the Linear Accelerator at the European XFEL: Status and First Experiences

T. Wilksen, *A. Aghababyan, S. Aytac, R. Bacher, P.K. Bartkiewicz, C. Behrens, P. Castro, P. Duval, L. Fröhlich, W. Gerhardt, O. Hensler, K. Hinsch, J.M. Jäger, R. Kammering, S. Karstensen, H. Kay, A. Petrosyan, G. Petrosyan, L.P. Petrosyan, V. Petrosyan, K.R. Rehlich, V. Rybnikov, G. Schlesselmann, W. Schütte, E. Sombrowski, M. Staack, J. Szczesny, M. Walla, J. Wilgen, H. Wu (DESY)*

The European XFEL (E-XFEL) is a 3.4 km long X-ray Free-Electron Laser facility and consists of a superconducting, linear accelerator with initially three undulator beam lines. The construction and installation of the E-XFEL is being completed this year and commissioning is well underway. First photon beams are expected to be available for early users in the second half of 2017. This paper will focus on the control system parts for the linear accelerator with its more than 7 million parameters and highlight briefly its design and implementation. Namely the hardware framework based on the MicroTCA.4 standard, testing software concepts and components at real and virtual accelerator facilities and a well-established method for integrating high-level controls into the middle layer through a shot-synchronized data acquisition allowed for a rapid deployment and commissioning of the accelerator. Status and experiences from a technical and an operational point-of-view will be presented.

MOAPL02
10:15 15

The First Operation of the MAX IV Laboratory Synchrotron Facilities

V.H. Hardion, *A. Barsek, P.J. Bell, F. Bolmsten, Y. Cerenius, F. H. Hennies, K. Larsson, J. Lidón-Simon, M. Lindberg, P. Sjöblom, M. Sjöström, D.P. Spruce (MAX IV Laboratory, Lund University)*

On 21st of June 2016 the MAX IV Laboratory was inaugurated in the presence of the officials and has welcome the first external researchers to the new experimental stations. The MAX IV facility is the largest and most ambitious Swedish investment in research infrastructure and designed to be one of the brightest source of X-rays worldwide. The current achievements, progress, collaborations and vision of the facility will be described from the perspective of the control and IT systems.

MOAPL03
10:30 15

Status of the National Ignition Facility (NIF) Integrated Computer Control and Information Systems

G.K. Brunton, *Y.W. Abed, M.A. Fedorov, B.T. Fishler, D.W. Larson, A.P. Ludwigsen, D.G. Mathisen, V.J. Miller Kamm, M. Paul, R.K. Reed, D.E. Speck, E.A. Stout, S.L. Townsend, B.M. Van Wonterghem, S. Weaver, E.F. Wilson (LLNL)*

The National Ignition Facility (NIF) is the world's largest and most energetic laser experimental facility with 192 beams capable of delivering 1.8 megajoules of 500-terawatt ultraviolet laser energy to a target. The energy, temperatures and pressures capable of being generated on the NIF allow scientists the ability to generate conditions similar to the center of the sun and explore the physics of planetary interiors, supernovae, black holes and thermonuclear burn. This year concludes a very successful multi-year plan of optimizations to the control & information systems and operational processes to increase the quantity of experimental target shots conducted in the facility. In addition, many new system control and diagnostic capabilities have been commissioned for operational use to maximize the scientific value produced. With NIF expecting to be operational for greater than 20 years focus has also been placed on optimizing the software processes to improve the sustainability of the control system. This talk will report on the current status of each of these areas in support of the wide variety of experiments being conducted in the facility.

MOAPL04
10:45 15

SwissFEL Control System - Overview, Status, and Lessons Learned

E. Zimoch *(PSI)*

The SwissFEL is a new free electron laser facility at the Paul Scherrer Institute (PSI) in Switzerland. Commissioning started in 2016 and resulted in first lasing in December 2016 (albeit not on the design energy). In 2017, the commissioning will continue and should result in some first pilot experiments by the end of the year. The close interaction of experiment and accelerator components as well as the pulsed electron beam required a well thought out integration of the control system including some new concepts and layouts. This talk presents the status of the control system together with some lessons learned.

09-Oct-17 11:30 – 13:00 Plenary

MOBPL — Software Technology Evolution 1

Chair: L. Van den Heever (SKA South Africa, National Research Foundation of South Africa)

Co-Chair: G. Chiozzi (ESO)

MOBPL01
11:30 15

EPICS 7 Provides Major Enhancements to the EPICS Toolkit

L.R. Dalesio, *M.A. Davidsaver (Osprey DCS LLC) S.M. Hartman, K.-U. Kasemir (ORNL) A.N. Johnson (ANL) H. Junkes (FHI) T. Korhonen (ESS) M.R. Kraimer (Self Employment) R. Lange (ITER Organization) G. Shen (FRIB) K. Shroff (BNL)*

The release of EPICS 7 marks a major enhancement to the EPICS toolkit. EPICS 7 combines the proven functionality, reliability and capability of EPICS V3 with the powerful EPICS V4 extensions enabling high-performance network transfers of structured data. The code bases have been merged and reorganized. EPICS 7 provides a new platform for control system development, suitable for data acquisition and high-level services. This paper presents the current state of the EPICS 7 release, including the pvAccess network protocol, normative data types, and language bindings, along with descriptions of new client and service applications.

MOBPL02
11:45 15

TANGO Kernel Development Status

R. Bourtembourg, *E.T. Taurel, P.V. Verdier (ESRF) G. Abeillé, N. Leclercq (SOLEIL) I.A. Khokhriakov (HZG)*

The TANGO Controls Framework continues to improve. This paper will describe how TANGO kernel development has evolved since the last ICALEPCS conference. TANGO kernel projects source code repositories have been transferred from subversion on Sourceforge.net to git on GitHub.com. Continuous integration with Travis CI and the GitHub pull request mechanism should foster external contributions. Thanks to the TANGO collaboration contract, parts of the kernel development and documentation have been sub-contracted to companies specialized in TANGO. The involvement of the TANGO community helped to define the roadmap which will be presented in this paper and also led to the introduction of Long Term Support versions. The paper will present how the kernel is evolving to support pluggable protocols - the main new feature of the next major version of TANGO.

MOBPL03
12:00 15

The SKA Telescope Control System Guidelines and Architecture

L. Pivetta *(SKA Organisation) A. DeMarco (ISSA) S. Riggi (INAF-OACT) L. Van den Heever (SKA South Africa, National Research Foundation of South Africa) S. Vrcic (NRC-Herzberg)*

The Square Kilometre Array (SKA) project is an international collaboration aimed at building the world's largest radio telescope, with eventually over a square kilometre of collecting area, co-hosted by South Africa, for the mid-frequency arrays, and Australia for the low-frequency array. Since 2015 the SKA Consortia joined in a global effort to identify, investigate and select a single control system framework suitable for providing the functionalities required by the SKA telescope monitoring and control. The TANGO Controls framework has been selected and comprehensive work has started to provide telescope-wide detailed guidelines, design patterns and architectural views to build Element and Central monitoring and control systems exploiting the TANGO Controls framework capabilities.

MOBPL04
12:15 15

MADOCA II Data Collection Framework for SPring-8

T. Matsumoto, *Y. Hamada (JASRI/SPring-8) Y. Furukawa (JASRI)*

MADOCA II (Message and Database Oriented Control Architecture II) is next generation of MADOCA and was developed to fulfill current and future requirements in accelerator and beamline control at SPring-8. In this paper, we report on the recent evolution in MADOCA II for data collection, which was missing in the past reports at ICALEPCS *,**. In MADOCA, the biggest challenge in data collection was to manage signals into Parameter Database smoothly. Users request Signal Registration Table (SRT) for new data collection. However, this costed time and manpower due to typo in SRT and iteration in DB registration. In MADOCA II, we facilitated signal registration scheme with prior test of data collection and validity check in SRT with web-based user interface. Data collection framework itself was also extended to manage various data collection types in SPring-8 with a unified method. All of data collection methods (polling, event type), data format (such as point and waveform data) and platform (Unix, Embedded, Windows including LabVIEW) can be flexibly managed. We started to implement MADOCA II data collection into SPring-8 with 241 hosts and confirmed stable operation since April 2016.

MOBPL05 12:30 15

How To Design & Implement a Modern Communication Middleware Based on ZeroMQ.

***J. Lauener**, W. Sliwinski (CERN) V. Rapp (GSI)*

In 2011, CERN's Controls Middleware (CMW) team started a new project aiming to design and implement a new generation equipment access framework using modern, open-source products. After reviewing several communication libraries [1], ZeroMQ [2] was chosen as the transport layer for the new communication framework. The main design principles were: scalability, flexibility, easy to use and maintain. Several core ZeroMQ patterns were employed in order to provide reliable, asynchronous communication and dispatching of messages. The new product was implemented in Java and C++ for client and server side. It is the core middleware framework to control all CERN accelerators and the future GSI FAIR [3] complex. This paper presents the overall framework architecture; choices and lessons learnt while designing a scalable solution; challenges faced when designing a common API for two languages (Java and C++) and operational experience from using the new solution at CERN for 3 years. The lessons learnt and observations made can be applied to any modern software library responsible for fast, reliable, scalable communication and processing of many concurrent requests.

MOBPL06 12:45 15

Facade Devices, a Reactive Approach to Tango

***V. Michel** (MAX IV Laboratory, Lund University)*

The MAX-IV synchrotron decided to adopt events as the main communication channel in order to increase both the responsiveness and reliability of its TANGO* control system. That means the tango (software) devices do not perform read hardware operation on client request but instead maintain a reliable communication with the hardware while publishing the data through event channels. Reactive programming** is an asynchronous programming paradigm oriented around data streams and the propagation of change. Instead of using the traditional imperative approach of maintaining the integrity of variables, a reactive program expresses the relationship between data streams. High-level tango devices (software devices aggregating data from other tango devices) make very good candidates for reactive programming. More precisely, it is possible to describe the attributes of those devices as relationships, where the input data comes from the event channels of lower-level devices. The facadedevice*** python library is an attempt to implement the reactive machinery within a tango device base class, and provides a descriptive API for defining the relationships in a clear and concise way.

09-Oct-17 14:00 – 15:45 Plenary

MOCPL — Integrating Diverse Systems

Chair: G.K. Brunton (LLNL)
Co-Chair: E. Blanco Vinuela (CERN)

MOCPL01 14:00 15

Orchestrating a System

A.C. Lombrozo *(Sandia National Laboratories)*

Pulsed power facilities require a wide variety of control systems to operate efficiently. Relatively slow distributed control systems that process water are okay taking hundreds of milliseconds to respond to a physical change while small pulsed power lasers may need to respond to a change within hundreds of nanoseconds. Building these control systems requires more than just the ability to write some lines of code and wiring up some embedded controllers. Knowledge of what your hardware is capable of planning appropriately could be the difference between a simple indicator check or an elaborate pre-shot ritual. The software/hardware architecture you choose could be the difference between a true 'lights out' system or paying somebody to babysit a system and restart it when it crashes. Tailoring your choices to the environment in which the system is expected to function, and correctly choosing a solution that will fit your needs will all contribute to the overall success and longevity of your control system. In this presentation, we will cover many of the design decisions that go into 'making things work' while providing some real-world examples of systems that are 'good enough'.

MOCPL02 14:15 15

Experiences with Laser Survey Instrument Based Approach to National Ignition Facility Diagnostic Alignments

E.F. Wilson *(LLNL)*

The National Ignition Facility (NIF) uses powerful lasers to compress targets, to study high energy density physics. Sophisticated diagnostics are placed close to the targets to record the results of each shot. The placement of these diagnostics relative to the target is critical to the mission, with alignment tolerances on the order of 500 microns. The integration of commercial laser-based survey instruments into the NIF control system has improved diagnostic alignment in many ways. The Advanced Tracking Laser Alignment System (ATLAS) project incorporates commercial Faro laser tracker instruments into the diagnostic factory and the target chamber, improving alignment accuracy over prior systems. The system uses multiple retroreflectors mounted on each of the diagnostic positioners to translate to a 6D position in the NIF target chamber volume. This enables a closed loop alignment process to align each diagnostic. This paper provides an overview of how the laser tracker is used in diagnostic alignment, and discusses challenges met by the control system to achieve this integration.

MOCPL03 14:30 15

PROFINET Communication Card for the CERN Cryogenics Crate Electronics Instrumentation

R.K. Mastyna*, J. Casas, N. Trikoupis (CERN)*

The ITER-CERN collaboration agreement initiated the development of a PROFINET communication interface which may replace the WorldFIP interface in non-radiation areas. The main advantage of PROFINET is a simplified integration within the CERN controls infrastructure that is based on Programmable Logic Controllers (PLCs). CERN prepared the requirements and subcontracted the design of a communication card prototype to the Technical University of Bern. The designed PROFINET card prototype uses the NetX Integrated Circuit (IC) for PROFINET communication and a FPGA to collect the electrical signals from the back-panel (electrical signals interface for instrumentation conditioning cards). CERN is implementing new functionalities involving programming, automation engineering and electronics circuit design. The communication between the card and higher layers of control is based on the OPC UA protocol. The configuration files supporting new types of instrumentation cards are being developed and are compatible with the SIEMENS SIMATIC automation environment. The fully operational prototype which will be integrated with the CERN control system is planned to start field tests by mid-2017.

MOCPL04
14:45 15

3G/LTE Based Wireless Communications for Remote Control and Monitoring of PLC Managed Vacuum Mobile Devices

***R. Ferreira**, P. Gomes, G. Pigny (CERN) T.R. Fernandes (ESTGL)*

High and ultra-high vacuum is required in CERN's particle accelerators. Contributing to its production, two types of mobile devices are used: Turbo-Molecular Pumping Groups and Bakeout Racks. During accelerator stops, these PLC-controlled devices are temporarily installed at required locations and integrated into the vacuum SCADA through wired Profibus-DP. This method, though functional, poses certain issues, and a wireless solution would greatly benefit the operations. A CERN private LTE/3G network is permanently available in the accelerators; it uses a leaky-feeder cable antenna, which spans the whole length of the tunnel. This paper describes the conception and implementation of an LTE/3G-based modular communication system for PLC-controlled Mobile Vacuum Devices and lays the foundation of an architecture that can easily be adapted to other situations. The network and control architectures are described in detail, as is the communication protocol specifically developed to allow mobile devices to automatically identify themselves, share their location, and exchange data with the SCADA. Practical considerations such as costs and cyber-security concerns are also addressed.

MOCPL05
15:00 15

ECMC, the Open Source Motion Control Package for EtherCAT Hardware at the ESS

***T. Gahl**, D.P. Brodrick, T. Bögershausen, O. Kirstein, T. Korhonen, D.P. Piso, A. Sandström (ESS)*

In industry the open standard EtherCAT* is well established as a real-time fieldbus for largely distributed and synchronised systems. Open source solutions for the bus master have been first introduced in scientific installations by Diamond Light Source** and PSI using EtherCAT hardware for digital and analog I/Os. The European Spallation Source (ESS) decided to establish open source EtherCAT systems for mid-performance data acquisition and motion control on accelerator applications. In this contribution we present the motion control software package ECMC developed at the ESS using the open source Etherlab*** master to control the EtherCAT bus. The motion control interfaces with a model 3 driver to the EPICS motor record supporting it's functionalities like positioning, jogging, homing and soft/hard limits. Advanced functionalities supported by ECMC are full servo-loop feedback, a scripting language for custom synchronisation of different axes, virtual axes, externally triggered position capture and interlocking. On the example of prototyping a 2-axis wire scanner we show a fully EPICS integrated application of ECMC on different EtherCAT and CPU hardware platforms.

MOCPL06
15:15 15

MARWIN: A Mobile Autonomous Robot for Maintenance and Inspection

***A. Dehne**, T. Hermes, N. Moeller (hs21) R. Bacher (DESY)*

MARWIN is a mobile autonomous robot platform designed for performing maintenance and inspection tasks alongside the European XFEL accelerator installation in operation in Hamburg, Germany. It consists of a 4-wheel drive chassis and a manipulator arm. Due to the unique Mecanum drive technology in combination with the manipulator arm the whole robot provides three degrees of freedom. MARWIN can be operated in a pre-configured autonomous as well as a remotely controlled mode. Its operation can be supervised through various cameras. The primary use case of MARWIN is measuring radiation fields. For this purpose MARWIN is equipped with both a mobile Geiger-Mueller tube mounted at the tip of the manipulator arm and a stationary multi-purpose radiation detector attached to the robot's chassis. This paper describes the mechanical and electrical setup of the existing prototype, the architecture and implementation of the controls routines, the strategy implemented to handle radiation-triggered malfunctions, and the energy management. In addition, it reports on recent operations experiences, envisaged improvements and further use cases.

MOCPL07
15:30 15

The Integrated Alarm System of the Alma Observatory

A. Caproni, *E. Schmid (ESO)*

ALMA is composed of many hardware and software systems each of which must be properly functioning to ensure the maximum efficiency. Operators in the control room, follow the operational state of the observatory by looking at a set of non-homogeneous panels. In case of problems, they have to find the reason by looking at the right panel, interpret the information and implement the counter-action that is time consuming so after an investigation, we started the development of an integrated alarm system that takes monitor point values and alarms from the monitored systems and presents alarms to operators in a coherent, efficient way. A monitored system has a hierarchical structure modeled with an acyclic graph whose nodes represent the components of the system. Each node digests monitor point values and alarms against a provided transfer function and sets its output as working or non nominal, taking into account the operational phase. The model can be mapped in a set of panels to increase operators' situation awareness and improve the efficiency of the facility.

09-Oct-17 16:15 – 18:00 Plenary

MODPL — Control System Upgrades

Chair: N. Hauser (ANSTO)

Co-Chair: T. Matsushita (Spring8)

MODPL01 16:15 15

Replacing The Engine In Your Car While You Are Still Driving It - Part II

E. Björklund *(LANL)*

Two years ago, at the 2015 ICALEPCS conference in Melbourne Australia, we presented a paper entitled 'Replacing The Engine In Your Car While You Are Still Driving It*'. In that paper we described the mid-point of a very ambitious, multi-year, upgrade project involving the complete replacement of the low-level RF system, the timing system, the industrial I/O system, the beam-synchronized data acquisition system, the fast-protect reporting system, and much of the diagnostic equipment. That paper focused mostly on the timing system upgrade and presented several observations and recommendations from the perspective of the timing system and its interactions with the other systems. In this paper, now nearly three quarters of the way through our upgrade schedule, we will report on additional observations, challenges, recommendations, and lessons learned from some of the other involved systems.

MODPL02 16:30 15

Virtual Control Commissioning for a Large Critical Ventilation Systems: The CMS Cavern Use Case

W. Booth*, E. Blanco Viñuela, B. Bradu, S. Sourisseau (CERN)*

The current cavern ventilation control system of the CMS experiment at CERN is based on components which are already obsolete: the SCADA system, or close to the end of life: the PLCs. The control system is going to be upgraded during the CERN Long Shutdown 2 (2019-2020) and will be based on the CERN industrial control standard: UNICOS employing WinCC OA as SCADA and Schneider PLCs. Due to the critical nature of the CMS ventilation installation and the short allowed downtime, the approach was to design an environment based on the virtual commissioning of the new control. This solution uses a first principles model of the ventilation system to simulate the real process. The model was developed with the modelling and simulation software EcosimPro. In addition, the current control application of the cavern ventilation will also be re-engineered as it is not completely satisfactory in some transients where many sequences are performed manually and some pressure fluctuations observed could potentially cause issues to the CMS detector. The plant model will also be used to validate new regulation schemes and transient sequences offline in order to ensure a smooth operation in production.

MODPL03 16:45 15

Experience Upgrading Telescope Control Systems at the Gemini Telescopes

A.J. Nunez*, I. Arriagada, P.E. Gigoux, R. Rojas (Gemini Observatory, Southern Operations Center) M.J. Rippa (Gemini Observatory, Northern Operations Center)*

The real-time control systems for the Gemini Telescopes were designed and built in the 1990s using state-of-the-art software tools and operating systems of that time. Since these systems are in use every night they have not been kept up-to-date and are now obsolete and very labor intensive to support. Gemini is currently engaged in a major upgrade of the software on our telescope control systems. We are in the process to deploy these systems to operations, and in this paper we review the experience and lessons learned through this process and provide an update on future work on other obsolescence management issues.

MODPL04
17:00 15

Framework Upgrade of the Detector Control System

Ms. Ye *(IHEP)*

The Jiangmen Underground Neutrino Observatory (JUNO) is the second phase of the Daya Bay reactor neutrino experiment. The detector of the experiment was designed as a 20k ton LS with a inner diameter of 34.5 meters casting material acrylic ball shape. Due to the gigantic shape of the detector there are approximate 40k monitoring point including 20k channels of high voltage of array PMT, temperature and humidity, electric crates as well as the power monitoring points. Since most of the DCS of the DayaBay was developed on the framework based on LabVIEW, which is limited by the operation system upgrade and running license, the framework migration and upgrade are needed for DCS of JUNO. The paper will introduce the new framework of DCS based on EPICS (Experimental Physics and Industrial Control System). The implementation of the IOCs of the high-voltage crate and modules, stream device drivers, and the embedded temperature firmware will be presented. The software and hardware realization and the remote control method will be presented. The upgrade framework can be widely used in devices with the same hardware and software interfaces.

MODPL05
17:15 15

Lightweight Acquisition System for Analogue Signals

B.P. Bielawski *(CERN)*

In a complex machine such as a particle accelerator there are thousands of analogue signals that need monitoring and even more signals that could be used for debugging or as a tool for detecting symptoms of potentially avoidable problems. Usually it is not feasible to acquire and monitor all of these signals not only because of the cost but also because of cabling and space required. The RF system in the Large Hadron Collider is protected by multiple hardware interlocks that ensure safe operation of klystrons, superconducting cavities and all the other equipment. In parallel, a diagnostic system has been deployed to monitor the health of the klystrons. Due to the limited amount of space and the moderate number of signals to be monitored, a standard approach with a full VME or Compact PCI crate has not been selected. Instead, small embedded industrial computers with USB oscilloscopes chosen for the specific application have been installed. This cost effective, rapidly deployable solution will be presented, including existing and possible future installations as well as the software used to collect the data and integrate it with existing CERN infrastructure.

MODPL06
17:30 15

Recent and Future Upgrades to the Control Systems of LCLS and LCLS-II Scientific Instruments

D.L. Flath*, M.C. Browne, M.L. Gibbs, K. Gumerlock, B.L. Hill, A. Perazzo, M.V. Shankar, T.A. Wallace, D.H. Zhang (SLAC)*

The Linac Coherent Light Source (LCLS), a US Department of Energy Office of Science user facility, achieved first light in 2009; a total of seven scientific instruments were commissioned through 2015. The EPICS-based control system, in terms of both hardware and software has evolved significantly over eight years of operation as the rate of experiment delivery has increased through means such as photon-beam multiplexing. A description of the upgrades and improvements to hardware, software, tools, and procedures will be presented. Additional discussion points will focus on: (1) the positive effect of upgrades regarding reduction of staffing levels and required skill-level required to support operations; (2) enabling highly skilled staff to focus on further improvements; and (3) current and future upgrades required to support the LCLS-II which will further expand experiment output when it achieves first light in 2020. LCLS-II topics include requirements for automation of routine tasks such as x-ray and optical-laser beam alignment, and focusing as well as improvements to user-interfaces and user-experience which will allow users and non-expert staff to execute experiments.

MODPL07
17:45 15

How Low Cost Devices Can Help on the Way to ALICE Upgrade

O. Pinazza *(INFN-Bologna) A. Augustinus, P.M. Bond, P.Ch. Chochula, A.N. Kurepin, M. Lechman, J.L. LÃ¥ng (CERN) A.N. Kurepin (RAS/INR)*

The ambitious upgrade plan of the ALICE experiment expects a complete redesign of its data flow after the LHC shutdown scheduled for 2019, for which new electronics modules are being developed in the collaborating institutes. Access to prototypes is at present very limited and full scale prototypes are expected only close to the installation date. To overcome the lack of realistic HW, the ALICE DCS team built small-scale prototypes based on low-cost commercial components (Arduino, Raspberry PI), equipped with environmental sensors, and installed in the experiment areas around and inside the ALICE detector. Communication and control software was developed, based on the architecture proposed for the future detectors, including CERN JCOP FW and ETM WINCC OA. Data provided by the prototypes has been recorded for several months, in presence of beam and magnetic field. The challenge of the harsh environment revealed some insurmountable weaknesses, thus excluding this class of devices from usage in a production setup. They did prove, however, to be robust enough for test purposes, and are still a realistic test-bed for developers while the production of final electronics is continuing.

10-Oct-17 08:30 – 09:30 Plenary

TUKPL — Keynote Speaker

Chair: K.A. Brown (BNL)

TUKPL01 08:30 60

Your Ideas are Worthless

M. Ossmann *(GSG)*

As the owner of an open source hardware company, I frequently encounter people who tell me why my business cannot possibly succeed. After six years of continuous growth, I would like to share my thoughts about why those people are wrong and how the mythology of invention affects perception. I'll share lessons from my background as a hacker, researcher, open source developer, and business owner and discuss the past, present, and future of science, technology, and the value of ideas.

10-Oct-17 09:30 – 11:00 Plenary

TUAPL — Hardware Technology

Chair: J. Serrano (CERN)
Co-Chair: T. Korhonen (ESS)

TUAPL01
09:30 15

MicroTCA Generic Data Acquisition Systems at ESS

***S. Farina**, J.H. Lee, J.P.S. Martins, D.P. Piso (ESS)*

The European Spallation Source (ESS) is a Partnership of 17 European Nations committed to the goal of collectively building and operating the world's leading facility for research by use of neutrons by the second quarter of the 21st Century. The strive for innovation and the challenges that need to be overcome in order to achieve the requested performances pushed towards the adoption of one of the newest standards available on the market. ESS has decided to use MicroTCA as standard platform for the systems that require high data throughput and high uptime. The implications of this choice on the architecture of the systems will be described with emphasis on the data acquisition electronics.

TUAPL02
09:45 15

Porting the VME-Based Optical-Link Remote I/O Module to a PLC Platform - an Approach to Maximize Cross-Platform Portability Using SoC

***T. Masuda**, A. Kiyomichi (JASRI/SPring-8)*

The optical-link remote I/O system OPT-VME that consists of a VME master and several kinds of slave boards is widely used in SPring-8 and SACLA. As the next generation low-end platform instead of the outdated VMEbus, a Linux PLC such as Yokogawa e-RT3 has been considered. We have developed an e-RT3-based master module OPT-PLC to fully utilize a large number of existing remote boards. In the original system, low-level communication is performed by FPGA and high-level communication procedures are handled in the Solaris device driver on a VME CPU board. This driver becomes a barrier to port the system to e-RT3 platform. OPT-PLC should be handled by the e-RT3 standard driver in the same manner as other e-RT3 I/O modules. To solve the difficulty, OPT-PLC was equipped with Xilinx SoC and the high-level communication procedures were implemented as application software on ARM Linux in the SoC. As the result, OPT-PLC can be controlled through the standard e-RT3 driver. Furthermore, the system will be ported to other platform like PCI Express by replacing bus interface block in the PL part. This paper reports on our development as an approach to maximize cross-platform portability using SoC.

TUAPL03
10:00 15

Solving Vendor Lock-in in VME Single Board Computers through Open-sourcing of the PCIe-VME64x Bridge

***G. Daniluk**, J.D. Gonzalez Cobas, M. Suminski, A. Wujek (CERN) G. Gräbner, M. Miehling, T. Schnürer (MEN)*

VME is a standard for modular electronics widely used in research institutes. Slave cards in a VME crate are controlled from a VME master, typically part of a Single Board Computer (SBC). The SBC typically runs an operating system and communicates with the VME bus through a PCI or PCIe-to-VME bridge chip. The de-facto standard bridge, TSI148, has recently been discontinued, and therefore the question arises about what bridging solution to use in new commercial SBC designs. This paper describes our effort to solve the VME bridge availability problem. Together with a commercial company, MEN, we have open-sourced their VHDL implementation of the PCIe-VME64x interface. We have created a new commodity which is free to be used in any SBC having an FPGA, thus avoiding vendor lock-in and providing a fertile ground for collaboration among institutes and companies around the VME platform. The article also describes the internals of the MEN PCIe-VME64x HDL core as well as the software package that comes with it.

TUAPL04
10:15 15

Em# Electrometer Comes to Light

***J.A. Avila-Abellan**, M. Broseta, G. Cuní, O. Matilla, M. Rodriguez, A. Ruz, J. Salabert, X. Serra-Gallifa (ALBA-CELLS Synchrotron) A. Milan-Otero, P. Sjöblom (MAX IV Laboratory, Lund University)*

Em# project is a collaboration project between MAX IV Laboratory and ALBA Synchrotron to obtain a high performant four-channel electrometer. Besides the objective of accurate current measurements down to the pico-ampere range, the project pursues to establish a reusable instrumentation platform with time stamped data collection able to perform real time calculations for flexible feedback implementations. The platform is based on a FPGA responsible of acquisition and synchronization where a real-time protocol between the modules has been implemented (Harmony) [*]. The data acquired is transmitted via PCIe to a Single Board Computer with an embedded Linux distribution where high level processing and synchronization with upper levels of Control System is executed. In this proceeding, the reasons that lead to start a complex instrument development instead of using a Commercial On the Shelf (COTS) solution will be discussed. The results of the produced units will be analyzed in terms of accuracy and processing capabilities. Finally, different Em# applications in particle accelerators will be described, further widening the functionality of the current state-of-the-art instrumentation.

TUAPL05
10:30 15

PandABox: A Multipurpose Platform For Multi-technique Scanning and Feedback Applications

***S. Zhang**, Y.-M. Abiven, J. Bisou, G. Renaud, G. Thibaux (SOLEIL) M.G. Abbott, T.M. Cobb, C.J. Turner, I.S. Uzun (DLS)*

PandABox is a development project resulting from a collaboration between Synchrotron SOLEIL and Diamond Light Source started in October 2015. The initial objective driving the project was to provide multi-channel encoder processing for synchronizing data acquisitions with motion systems in experimental continuous scans. The resulting system is a multipurpose platform well adapted for multi-technique scanning and feedback applications. This flexible and modular platform embeds an industrial electronics board with a powerful Xilinx Zynq 7030 SoC (Avnet Picozed), FMC slot, SFP module, TTL and LDVS I/Os and removable Encoder peripheral modules. In the same manner, the firmware and software framework has been developed in a modular way to be easily configurable and adaptable. The whole system is open and extensible from the hardware level up to integration with control systems like "Tango" or "EPICS". This paper details the hardware capabilities and performance of the platform, the framework adaptability and the project status at both sites.

TUAPL06
10:45 15

Cryomodule-on-Chip Simulation Engine

***C. Serrano**, L.R. Doolittle (LBNL)*

The Cryomodule-On-Chip (CMOC) simulation engine is a Verilog implementation of a cryomodule model used for Low-Level RF development for superconducting cavities. The model includes a state-space model of the accelerating fields inside a cavity, the mechanical resonances inside a cryomodule as well as their interactions. The implementation of the model along with the LLRF controller in the same FPGA allows for live simulations of an RF system. This allows for an interactive simulation framework, where emulated cavity signals are produced at the same rate as in a real system and therefore providing the opportunity to observe longer time-scale effects than in software simulations as well as a platform for software development and operator training.

10-Oct-17 11:30 – 13:00 Plenary

TUBPL — User Interfaces and User eXperience (UX) 1

Chair: R. Bacher (DESY)
Co-Chair: A. Götz (ESRF)

TUBPL01
11:30 15

CERN Controls Configuration Service: A Challenge in Usability

***L. Burdzanowski**, A. Asko, A. Lameiro, K. Penar, C. Roderick, B. Urbaniec, V.I. Vasiloudis (CERN)*

Complex control systems often require complex tools to facilitate daily operations in a way that assures the highest possible availability. Such a situation poses an engineering challenge, for which system complexity needs to be tamed in a way that everyday use becomes intuitive and efficient. The sensation of comfort and ease of use are matters of ergonomics and usability - very relevant not only to equipment but especially software applications, products and graphical user interfaces. The Controls Configuration Service (CCS) is a key component in CERN's data driven accelerator Control System. Based around a central database, the service provides a range of user interfaces enabling configuration of all different aspects of controls for CERN's accelerator complex. This paper describes the ongoing renovation of the service with a focus on the evolution of the provided user interfaces, design choices and architectural decisions paving the way towards a single configuration platform for CERN's control systems in the near future.

TUBPL02
11:45 15

Taurus Big & Small: From Particle Accelerators to Desktop Labs

***C. Pascual-Izarra**, G. Cuní, C. Falcon-Torres, D. Fernández-Carreiras, Z. Reszela, M. Rosanes Siscart (ALBA-CELLS Synchrotron) O. Prades-Palacios (ETSE-UAB)*

Taurus is a popular solution for rapid creation of Graphical User Interfaces (GUIs) for experiment control and data acquisition (even by non-programmers) *. Taurus is best known for its ability to interact with the Tango and Epics control systems, and thus it is mainly used in large facilities. However, Taurus also provides mechanisms to interact with other sources of data, and it is well suited for creating GUIs for even the smallest labs where the overhead of a distributed control system is not desired. This scalability together with its ease-of-use and the uncontested popularity of Python among the scientific users, make Taurus an attractive framework for a wide range of applications. In this work we discuss some practical examples of usage of Taurus ranging from a very small experimental setup controlled by a single Raspberry Pi, to large facilities synchronising an heterogeneous set of hundreds of machines running a variety of operating systems.

TUBPL03
12:00 15

Panic and the Evolution of Tango Alarm Handlers

***S. Rubio-Manrique**, G. Cuní, D. Fernández-Carreiras (ALBA-CELLS Synchrotron) G. Scalamera (Elettra-Sincrotrone Trieste S.C.p.A.)*

The PANIC Alarm System is a python based suite to manage the configuration, triggering and acknowledge of alarms and automated actions in a Tango control system. The suite was developed at Alba in 2007 and since then it has been adopted by several other facilities and installations such as Synchrotrons and large telescopes, integrating in the process a large set of community-requested features. Its scalability is based on the stand-alone PyAlarm engines, that operate distributed across the control system; and the PANIC python API and user interfaces, that centralize the operation and configuration of the system. Each PyAlarm engine performs polled or event-triggered evaluation of alarm rules, complex logical operations and regular expression searches. The activation, recovery or reset of any alarm in the system can trigger actions like email, SMS, audible messages, local/remote logging, database insertion or execution of tango commands. This paper describes the evolution of the suite, its compatibility with other alarm handlers in Tango, the current state-of-the-art features, the compliance with Alarm Management standards and the future needs.

TUBPL04
12:15 15

Streamlining the Target Fabrication Request at the National Ignition Facility

***C.P. Manin**, E.J. Bond, A.D. Casey, R.D. Clark, G.W. Norman (LLNL)*

At the National Ignition Facility (NIF), targets used in experiments are assembled on site by the target fabrication team. Most of these targets do not have the same features and need to be customized. The target feature definition is usually managed by Shot Engineers based on hundreds of existing and/or new parameters, making the task time consuming. The life cycle of a target request requires a series of states before final approval, and keeping track of these states is critical for the fabrication process. The Shot Data Systems team provides a Target Request Tool (TRT) application for facilitating the management of target requests, from creation to approval. TRT provides a simple and user-friendly interface that allows the user to obtain a list of current target requests and filter them by relevant parameters. When the user creates a new request, he/she is prompted to a multi-panel, interactive web page that shows and hides components per the user's selection, never making the user leave the page. The underlying design uses the latest web technologies such as NodeJs, JQuery and JavaScript. The overall software architecture and functionality will be presented.

TUBPL05
12:30 15

MXCuBE3 Bringing MX Experiments to the WEB

***M. Oskarsson**, A. Beteva, D.D.S. De Sanctis, M. Guijarro, G. Leonard (ESRF) F. Bolmsten, M. Eguiraun, A. Milan-Otero, J. Nan, M. Thunnissen (MAX IV Laboratory, Lund University)*

Originally conceived at ESRF and first deployed in 2005 MXCuBE (Macromolecular Xtallography Customized Beamline Environment) has with its successor MXCuBE2, become a successful international collaboration the aim of which is to develop a beamline control application independent of underlying instrument control and thus deployable at MX beamlines of any synchrotron source. The continued evolution of the functionality of MX beamlines is, to a large extent, facilitated by active software development. New demands and advances in technology have led to the development of a new version of MXCuBE, MXCuBE3, designed with the results of a technical pre-study and a user survey in mind. MXCuBE3 takes advantage of the recent development in web technologies such as React and Redux to create a intuitive and user friendly application. The ability to access the application from any web browser further simplifies beamline operation and natively facilitates the execution of remote experiments. This talk will present the software architecture of MXCuBE3 and the application as a whole.

TUBPL06
12:45 15

The Graphical User Interface of the Operator of the Cherenkov Telescope Array

***I. Sadeh**, I. Oya (DESY Zeuthen) D. Dezman (Cosylab) E. Pietriga (INRIA) J. Schwarz (INAF-Osservatorio Astronomico di Brera)*

The Cherenkov Telescope Array (CTA) is the next generation gamma-ray observatory. CTA will incorporate about 100 imaging atmospheric Cherenkov telescopes (IACTs) at a southern site, and about 20 in the north. Previous IACT experiments have used up to five telescopes. Subsequently, the design of a graphical user interface (GUI) for the operator of CTA poses an interesting challenge. In order to create an effective interface, the CTA team is collaborating with experts from the field of Human-Computer Interaction. We present here our GUI prototype. The backend of the prototype is a Python web server. It is integrated with the array control and data acquisition system of CTA, which is based on the Alma Common Software (ACS). The backend incorporates a redis database, which facilitates synchronization of GUI panels. Redis is also used to buffer information collected from various software components and databases. The frontend of the prototype is based on Web technology. Communication between web server and clients is performed using WebSockets, where graphics are generated with the d3.js Javascript library.

10-Oct-17 11:30 – 13:00 Parallel

TUBPA — Data Management and Processing

Chair: K.S. White (ORNL)
Co-Chair: K. Furukawa (KEK)

TUBPA01 11:30 15

The Evolution of Component Database for APS Upgrade*

***D.P. Jarosz**, N.D. Arnold, J. Carwardine, G. Decker, N. Schwarz, S. Veseli (ANL)*

The purpose of the Advanced Photon Source Upgrade (APS-U) project is to update the facility to take advantage of the multi-bend achromat (MBA) magnet lattices, which will result in narrowly focused x-ray beams of much higher brightness. The APS-U implementation has a short schedule of one-year. In order to plan and execute a task of such complexity, a collaboration between many individuals of very diverse backgrounds must exist. The Component Database (CDB) has been created to aid in documenting & managing all the parts that will go into the upgraded facility. After initial deployment and use, it became clear that the system must become more flexible as the engineers started requesting new features; such as tracking inventory assemblies, supporting relationships between components, and several usability requests. Recently, a more generic database schema has been implemented. This allows for the addition of more functionality without needing to refactor the database often. The topics discussed in this paper include advantages and challenges of a more generic schema, the usage of CDB at the APS, changes to promote an open source collaboration, and various new functionalities.

TUBPA02 11:45 15

Monitoring the New ALICE Online-Offline Computing System

***A. Adam**, V. Chibante Barroso (CERN)*

ALICE (A Large Ion Collider Experiment) particle detector has been successfully collecting physics data since 2010. Currently, it is in preparations for a major upgrade of the computing system, called O2 (Online-Offline). The O2 system will consist of 268 FLPs (First Level Processors) equipped with readout cards and 1500 EPNs (Event Processing Node) performing data aggregation, calibration, reconstruction and event building. The system will readout 27 Tb/s of raw data and record tens of PBs of reconstructed data per year. To allow an efficient operation of the upgraded experiment, a new Monitoring subsystem will provide a complete overview of the O2 computing system status. The O2 Monitoring subsystem will collect up to 600 kHz of metrics. It will consist of a custom monitoring library and a toolset to cover four main functional tasks: collection, processing, storage and visualization. This paper describes the Monitoring subsystem architecture and the feature set of the monitoring library. It also shows the results of multiple benchmarks, essential to ensure performance requirements. In addition, it presents the evaluation of pre-selected tools for each of the functional tasks.

TUBPA03 12:00 15

Database Scheme for Unified Operation of SACLA / SPring-8

***K. Okada**, N. Hosoda, M. Ishii, T. Sugimoto, M. Yamaga (JASRI/SPring-8) T. Fujiwara, T. Fukui, T. Maruyama, K. Watanabe (RIKEN SPring-8 Center)*

For reliable accelerator operation, it is essential to have a centralized data handling scheme, for such as unique equipment ID's, archive and online data from sensors, and operation points and calibration parameters those are to be restored upon a change in operation mode. Since 1996, when SPring-8 got in operation, a database system has been utilized for this role. However, as time passes the original design got shorthanded and new features equipped upon requests pushed up maintenance costs. For example, as SACLA started in 2010, we introduced a new data format for the shot by shot synchronized data. Also number of tables storing operation points and calibrations increased with various formats. Facing onto the upgrade project at the site*, it is the time to overhaul the whole scheme. In the plan, SACLA will be the high quality injector to a new storage ring while in operation as the XFEL user machine. To handle shot by shot multiple operation patterns, we plan to introduce a new scheme where multiple tables inherits a common parent table information. In this paper, we report the database design for the upgrade project and status of transition.

TUBPA04
12:15 15

The MAX IV Laboratory Scientific Data Management

***V.H. Hardion**, A. Barsek, F. Bolmsten, K. Larsson, Z. Matej, D.P. Spruce, M. Thunnissen (MAX IV Laboratory, Lund University)*

The Scientific Data Management (SDM) is a key component of the IT system of a user research facility like the MAX IV Laboratory. By definition this system handles the data produced by the User of such facility. It sounds as easy as using an external hard drive to store the experimental data to carry back to the home institute for analysis. But on the other side the "data" can be seen as more than a file in a directory and the "management" not only a copy operation. Simplicity and good User Experience (UX) vs security/authentication and reliability are the among main challenges of this project with all the mindset changes. This article will explain all the concepts and the basic roll-out of the system at the MAX IV Laboratory for the first Users and the features anticipated in the future.

TUBPA05
12:30 15

High Throughput Data Acquisition with EPICS

***K. Vodopivec** (ORNL)*

In addition to its use for control systems and slow device control, EPICS provides a strong infrastructure for developing high throughput applications for continuous data acquisition. Integrating data acquisition into an EPICS environment provides many advantages. The EPICS network protocols provide for tight control and monitoring of operation through an extensive set of tools. As part of a facility-wide initiative at the Spallation Neutron Source, EPICS-based data acquisition and detector controls software has been developed and deployed to most neutron scattering instruments. The software interfaces to the in-house built detector electronics over fast optical channels for bi-directional communication and data acquisition. The software is built around asynPortDriver and allows the passing of arbitrary data structures between plugins. The completely modular design allows the setup of versatile configurations of data pre-processing plugins depending on neutron detector type and instrument requirements. After 3 years of experience and average data rates of 1.5 TB per day, it shows exemplary results of efficiency and reliability.

TUBPA06
12:45 15

Scalable Time Series Documents Store

***M.J. Slabber**, F. Joubert, M.T. Ockards (SKA South Africa, National Research Foundation of South Africa)*

Data indexed by time is continuously collected from instruments, environment and users. Samples are recorded from sensors or software components at specific times, starting as simple numbers and increasing in complexity as associated values accrue e.g. status and acquisition times. A sample is more than a triple and evolves into a document. Besides variance, volume and veracity also increase and the time series database (TSDB) has to process hundreds of GB/day. Also, users performing analyses have ever increasing demands e.g. in <10s plot all target coordinates over 24h of 64 radio telescope dishes, recorded at 1Hz. Besides the many short-term queries, trend analyses over long periods and in-depth enquiries by specialists around past events e.g. critical hardware failure or scientific discovery, are performed. This paper discusses the solution used for the MeerKAT radio telescope under construction by SKA-SA in South Africa. System architecture and performance characteristics of the developed TSDB are explained. We demonstrate how we broke the mould of using general-purpose database technologies to build a TSDB by rather utilising technologies employed in distributed file storage.

10-Oct-17 13:00 – 14:00 Parallel

TUIPA — Industry Session

Chair: D. Fernandez-Carreiras (ALBA-CELLS Synchrotron)

TUIPA01 13:00 60

Safety Is One-Main-Key to Research

K. Stark *(PILZ)*

Safety is not an end in itself, but the enabler for functionalities. We as human beings do not recognize the presence of safety, just the absence and the possible, sometimes negative results. Science research especially in laser labs or synchrotrons is not possible without a structure around. These structures/activities include administrative, security, automation and safety issues. In Europe all "machines and facilities" have to fulfill the demands of the Machine Directive (MD). These demands are simplified named to provide a safe workplace according the state of the art. In order to fulfill that, we apply the norms and standards, in the case of the Synchrotron in Alba the IEC 61508. Pilz offered since 1995 one of the first safe PLC, called PSS3000. PSS3000 was a centralized concept, which could be expanded with decentral safe I/O via SafetyBUS p. This Safety PLC is used all across the world in various applications and proven by its availability and robustness. Since a couple of years these concept led into the new PSS4000 with it’s Ethernet based backbone called SafetyNET p. The new PLC is fully decentral in design, which a central point of view for the programming.

10-Oct-17 14:00 – 15:30 Plenary

TUCPL — Timing and Synchronization

Chair: E. Bjorklund (LANL)
Co-Chair: N. Janvier (ESRF)

TUCPL01 14:00 15

Refurbishment of the ESRF Accelerator Synchronization System Using White Rabbit

***G. Goujon**, A. Broquet, N. Janvier (ESRF)*

The ESRF timing system, dating from the early 90's and still in operation, is built around a centralized RF driven sequencer distributing synchronization signals along copper cables. The RF clock is broadcasted over a separate copper network. White Rabbit, offers many attractive features for the refurbishment of a synchrotron timing system, the key one being the possibility to carry RF over the White Rabbit optical fiber network. CERN having improved the feature to provide network-wide phase together with frequency control over the distributed RF, the whole technology is now mature enough to propose a White Rabbit based solution for the replacement of the ESRF system, providing flexibility and accurate time stamping of events. We describe here the main features and first performance results of the WHIST module, an ESRF development based on the White Rabbit standalone SPEC board embedding the White Rabbit protocol and a custom mezzanine (DDSIO) extending the FMC-DDS hardware to provide up to 12 programmable output signals. All WHIST modules in the network run in phase duplicates of a common RF driven sequencer. A master module broadcasts the RF and the injection trigger.

TUCPL02 14:15 15

Synchronized Timing and Control System Construction of SuperKEKB Positron Damping Ring

***K. Furukawa**, F. Miyahara, T.T. Nakamura, M. Satoh, H. Sugimura (KEK)*

The KEK electron/positron injector chain delivers beams for particle physics and photon science experiments. A damping ring has been constructed at the middle of the linac to generate a positron beam with sufficiently low emittance to support a 40-fold higher luminosity in the SuperKEKB asymmetric collider over the previous project of KEKB, in order to increase our understanding of flavour physics. A timing and control system for the damping ring is under construction to enable the timing synchronization and beam bucket selection between the linac, the positron damping ring and the SuperKEKB main ring. It should manage precise timing down to several picoseconds for the beam energy and bunch compression systems. Besides precise timing controls to receive and transmit positron beams, it has to meet local analysis requirements in order to measure beam properties precisely with changing the RF frequency. It is incorporating the event timing control modules from MRF and SINAP.

TUCPL03 14:30 15

White Rabbit in Radio Astronomy

***E.P. Boven** (JIVE)*

The Square Kilometre Array (SKA) is a new radio telescope that is currently being designed. It will consist of two interferometric antenna arrays, one in South Africa and one in Australia, which together will cover a frequency span of 50 MHz to 13.8 GHz. Our design for the timing synchronization of all the receivers in these arrays uses White Rabbit to distribute absolute time. This talk will discuss how we will provide synchronization on these long distances, in the rather challenging climatic conditions of the semi-desert sites chosen for the SKA telescopes, and the improvements to WR we implemented for that. Very Long Baseline Interferometry (VLBI) is an instrumental method in radio astronomy where radio telescopes distributed all over the globe carry out observations simultaneously, and through aperture synthesis operate as a single radio telescope. As the resolution of such an instrument scales with the longest baseline between stations, global VLBI provides unsurpassed resolution in astronomy. In the ASTERICS project, we are demonstrating how White Rabbit can be used to distribute a coherent frequency reference for VLBI on public, shared fiber.

TUCPL04 14:45 15

SwissFEL Timing System: First Operational Experience

B. Kalantari, *R. Biffiger (PSI)*

The SwissFEL timing system builds on MRF's event system products. Performance and functional requirements have pushed MRF timing components to its newest generation (300 series) providing active delay compensation, conditional sequence events, and topology identification among others. However, employing available hardware functionalities to implement complex and varying operational demands and provide them in the control system has its own challenges. After a brief introduction to the new MRF hardware this paper describes operational aspects of the SwissFEL timing and related control system applications. We describe a new technique for beam rate control and how this scheme is used for the machine protection system (MPS). We show how a well thought modular software-side design enables us to maintain various rep rates across the facility and allows us to implement complex triggering patterns with minimum development effort. We also discuss our timestamping method and its interface to the beam synchronous data acquisition system. Further we share our experience in timing network installation, monitoring and maintenance issues during commissioning phase of the facility.

TUCPL05 15:00 15

Design and Prototyping of a New Synchronization System with Stability at Femtoseconds

M. Liu, *X.L. Dai, C.X. Yin (SINAP)*

We present the design and prototyping of a new synchronization system with high stability. Based on a continuous-wave laser, the RF reference and the timing events are transmitted along the same optical fiber at femtoseconds. Therefore, the system could reutilize the existing fiber optic network of the event timing system around large accelerator facilities. The phase drift of the signal is detected based on Michelson interference and is then compensated with optical methods. The dispersion drift is corrected by appropriative dispersion compensating fiber. The system design and the test results in the lab are demonstrated in the paper.

TUCPL06 15:15 15

Verification of the FAIR Control System Using Deterministic Network Calculus

M. Schütze, *S. Bondorf (DISCO) M. Kreider (GSI) M. Kreider (Glyndŵr University)*

The FAIR control system (CS) is an alarm-based design and employs White Rabbit time synchronization over a GbE network to issue commands executed accurate to 1 ns. In such a network based CS, graphs of possible machine command sequences are specified in advance by physics frameworks. The actual traffic pattern, however, is determined at runtime, depending on interlocks and beam requests from experiments and accelerators. In 'unlucky' combinations, large packet bursts can delay commands beyond their deadline, potentially causing emergency shutdowns. Thus, prior verification if any possible combination of given command sequences can be delivered on time is vital to guarantee deterministic behavior of the CS. Deterministic network calculus (DNC) can derive upper bounds on message delivery latencies. This paper presents an approach for calculating worst-case descriptors of runtime traffic patterns. These so-called arrival curves are deduced from specified partial traffic sequences and are used to calculate end-to-end traffic properties. With the arrival curves and a DNC model of the FAIR CS network, a worst-case latency for specific packet flows or the whole CS can be obtained.

10-Oct-17 14:00 – 15:30 Parallel

TUCPA — Data Analytics

Chair: M. Gonzalez Berges (CERN)
Co-Chair: S. Nemesure (BNL)

TUCPA01
14:00 15

Data Analysis Support in Karabo at European XFEL

***H. Fangohr**, V. Bondar, D. Boukhelef, S. Brockhauser, W. Ehsan, S.G. Esenov, G. Flucke, G. Giovanetti, S. Hauf, B.C. Heisen, D.G. Hickin, A. Klimovskaia, L.G. Maia, L. Mekinda, T. Michelat, A. Parenti, G. Previtali, H. Santos, A. Silenzi, J. Szuba, M. Teichmann, K. Weger, K. Wrona (XFEL. EU)*

We describe the data analysis structure that is integrated into the Karabo framework [1] to support scientific experiments and data analysis at European XFEL GmbH. The photon science experiments have a range of data analysis requirements, including online (i.e. near real-time during the actual measurement) and offline data analysis. The Karabo data analysis framework supports execution of automatic data analysis for routine tasks, supports complex experiment protocols including data analysis feedback integration to instrument control, and supports integration of external applications. The online data analysis is carried out using distributed and accelerator hardware (such as GPUs) where required to balance load and achieve near real-time data analysis throughput. Analysis routines provided by Karabo are implemented in C++ and Python, and make use of established scientific libraries. The XFEL control and analysis software team collaborates with users to integrate experiment specific analysis codes, protocols and requirements into this framework, and to make it available for the experiments and subsequent offline data analysis.

TUCPA02
14:15 15

Leveraging Splunk for Control System Monitoring and Management

***B.T. Fishler**, G.K. Brunton, M.A. Fedorov, M.S. Flegel, K.C. Wilhelmsen, E.F. Wilson (LLNL)*

The National Ignition Facility (NIF) is the world's largest and most energetic laser experimental facility with 192 beams capable of delivering 1.8 megajoules and 500-terawatts of ultraviolet light to a target. To aid in NIF control system troubleshooting, the commercial product Splunk was introduced to collate and view system log files collected from 2,600 processes running on 1,800 servers, front-end processors, and embedded controllers. We have since extended Splunk's access into current and historical control system configuration data, as well as experiment setup and results. Leveraging Splunk's built-in data visualization and analytical features, we have built custom tools to gain insight into the operation of the control system and to increase its reliability and integrity. Use cases include predictive analytics for alerting on pending failures, analyzing shot operations critical path to improve operational efficiency, performance monitoring, project management, and in analyzing and monitoring system availability. This talk will cover the various ways we've leveraged Splunk to improve and maintain NIF's integrated control system.

TUCPA03
14:30 15

Experience with Machine Learning in Accelerator Controls

***K.A. Brown**, S. Binello, T. D'Ottavio, P.S. Dyer, S. Nemesure, D.J. Thomas (BNL)*

The repository of data for the Relativistic Heavy Ion Collider and associated preinjector accelerators consists of well over half a petabyte of uncompressed data. By todays standard, this is not a large amount of data. However, a large fraction of that data has never been analyzed and likely contains useful information. We will describe in this paper our efforts to use machine learning techniques to pull out new information from existing data. Our focus has been to look at simple problems, such as associating basic statistics on certain data sets and doing predictive analysis on single array data. The tools we have tested include unsupervised learning using Tensorflow, multimode neural networks, hierarchical temporal memory techniques using NuPic, as well as deep learning techniques using Theano and Keras.

TUCPA04 14:45 15

Model Learning Algorithms for Anomaly Detection in CERN Control Systems

F.M. Tilaro*, B. Bradu, M. Gonzalez-Berges, F. Varela (CERN) M. Roshchin (Siemens AG, Corporate Technology)*

At CERN there are over 600 different industrial control systems with millions of deployed sensors and actuators and their monitoring represents a challenging and complex task. This paper describes three different mathematical approaches that have been designed and developed to detect anomalies in CERN control systems. Specifically, one of these algorithms is purely based on expert knowledge while the other two mine historical data to create a simple model of the system, which is then used to detect anomalies. The methods presented can be categorized as dynamic unsupervised anomaly detection; "dynamic" since the behaviour of the system is changing in time, "unsupervised" because they predict faults without reference to prior events. Consistent deviations from the historical evolution can be seen as warning signs of a possible future anomaly that system experts or operators need to check. The paper also presents some results, obtained from the analysis of the LHC Cryogenic system. Finally the paper briefly describes the deployment of Spark and Hadoop into the CERN environment to deal with huge datasets and to spread the computational load of the analysis across multiple nodes.

TUCPA05 15:00 15

Laser Damage Image Preprocessing Based on Total Variation

J. Luo*, Z. Ni, X. Xie, X. Zhou (CAEP)*

The inspection and tracking of laser-induced damages of optics play a significant role in high-power laser systems. Laser-induced defects or flaws on the surfaces of optics are presented in images acquired by specific CCDs, hence the identification of defects from laser damage images is essential. Despite a great effort we have made to improve the imaging results, the defect identification is a challenging task. The proposed research focuses on the preprocessing of laser damage images, which assists identifying optic defects. We formulate the image preprocessing as a total variation (VA) based image reconstruction problem, and further develop an alternating direction method of multipliers (ADMM) algorithm to solve it. The use of TV regularization makes the preprocessed image sharper by preserving the edges or boundaries more accurately. Experimental results demonstrate the effectiveness of this method.

TUCPA06 15:15 15

SwissFEL - Beam Synchronous Data Acquisition - The First Year

S.G. Ebner*, H. Brands, B. Kalantari, R. Kapeller, F. Märki, L. Sala, C. Zellweger (PSI)*

The SwissFEL beam-synchronous data-acquisition system is based on several novel concepts and technologies. It is targeted on immediate data availability and online processing and is capable of assembling an overall data view of the whole machine, thanks to its distributed and scalable back-end. Load on data sources is reduced by immediately streaming data as soon as it becomes available. The streaming technology used provides load balancing and fail-over by design. Data channels from various sources can be efficiently aggregated and combined into new data streams for immediate online monitoring, data analysis and processing. The system is dynamically configurable, various acquisition frequencies can be enabled, and data can be kept for a defined time window. All data is available and accessible enabling advanced pattern detection and correlation during acquisition time. Accessing the data in a code-agnostic way is also possible through the same REST API that is used by the web-frontend. We will give an overview of the design and specialities of the system as well as talk about the findings and problems we faced during machine commissioning.

10-Oct-17 16:00 – 16:45 Plenary

TUDPL — Software Technology Evolution 2

Chair: G. Chiozzi (ESO)

Co-Chair: L. Van den Heever (SKA South Africa, National Research Foundation of South Africa)

TUDPL01 16:00 15

Reproduce Anything, Anywhere: A Generic Simulation Suite for Tango Control Systems

***S. Rubio-Manrique**, S. Blanch-Torné, M. Broseta, G. Cuní, D. Fernández-Carreiras, J. Moldes (ALBA-CELLS Synchrotron) A. Götz (ESRF)*

Synchrotron Light Sources are required to operate on 24/7 schedules, while at the same time must be continuously upgraded to cover scientists needs of improving its efficiency and performance. These operation conditions impose rigid calendars to control system engineers, reducing to few hours per month the maintenance and testing time available. The SimulatorDS project has been developed to cope with these restrictions and enable test-driven development, replicating in a virtual environment the conditions in which a piece of software has to be developed or debugged. This software provides devices and scripts to easily duplicate or prototype the structure and behavior of any Tango Control System, using the Fandango python library* to export the control system status and create simulated devices dynamically. This paper will also present first large scale tests using multiple SimulatorDS instances running on a commercial cloud.

TUDPL02 16:15 15

Automatic Formal Verification for EPICS

***J.P. Jacky**, S.P. Banerian (University of Washington Medical Center) M.D. Ernst, C.A. Loncaric, S. Pernsteiner, Z.L. Tatlock, E. Torlak (University of Washington)*

We built an EPICS-based radiation therapy machine control system, and are using it to treat patients at our hospital. To help ensure safety, we use a restricted subset of EPICS constructs and programming techniques, and developed several new automated formal verification tools for them. The Symbolic Evaluator checks properties of EPICS database programs (applications), using symbolic evaluation and satisfiability checking. It found serious errors in our control program that were missed by reviews and testing. Other tools are based on a formal semantics for database records, derived from EPICS documentation and expressed in the specification language of an automated theorem prover. The Verified Interpreter is a re-implementation of the parts of the database engine we use, which is proved correct against the formal semantics. We used it to check those parts of EPICS core by differential testing. It found no significant errors (differences between EPICS behavior and the formal semantics). A Verified Compiler is in development. It will compile a database to a standalone program that does not use EPICS core, where the machine code is verified to conform to the formal semantics.

TUDPL03 16:30 15

Control System Simulation Using DSEE High Level Instrument Interface and Behavioural Description

***N. Marais**, K. Madisa, A.J.T. Ramaila (SKA South Africa, National Research Foundation of South Africa) A.S. Banerjee, P. Patwari, S. Roy Chaudhuri (Tata Research Development and Design Centre) Y. Gupta (National Centre for Radio Astrophysics, Tata Institute of Fundamental Research)*

Development of KATCP based control systems for the KAT-7 and MeerKAT radio telescopes proved the value of a fully simulated telescope system. Control interface simulators of all telescope subsystems were developed or sourced from the subsystems. SKA SA created libraries to ease creation of simulated KATCP devices. The planned SKA radio telescope chose the TANGO controls framework. To benefit from simulation-driven development tango-simlib, an OSS Python library for data-driven development of TANGO device simulators, is presented. Interface simulation with randomly varying attributes only requires a POGO XMI file; more complex behaviour requires a simple JSON SIMDD (Simulator Description Datafile). Arbitrary behaviour is implemented selectively using Python code. A simulation-control interface for back-channel manipulation of the simulator for e.g. failure conditions is also generated. For the SKA Telescope Manager system an Eclipse DSEE (Domain Specific Engineering Environment) capturing the behaviour and interfaces of all Telescope subsystems is being developed. The DSEE produces tango-simlib SIMDD files, ensuring that the generated simulators match their formal specification.

10-Oct-17 16:45 – 17:15 Plenary

TUMPL — Mini-Oral

Chair: R.I. Farnsworth (ANL)
Co-Chair: M. Bickley (JLab)

TUMPL01
16:45

Controls Design and Implementation for Next Beamlines at NSLS-II

***Z. Yin**, B.V. Luvizotto, J. Ma, S. So (BNL)*

The NEXT (NSLS-II EXperimental Tools) Project is a US Department of Energy funded MIE (Major Items of Equipment) project to deliver five state of the art beamlines at NSLS-II by 2017: ESM (Electron Spectro-Microscopy), ISR (Integrated In-Situ and Resonant scattering), ISS (Inner Shell Spectroscopy), SIX (Soft Inelastic X-ray Scattering) and SMI (Soft Matter Interfaces). We describe the challenges and opportunities in the design and implementation of beamline controls for these five beamlines. In particular, working closely with project managers, beamline scientists and engineers, we enforce standardization to mitigate resource and schedule risks, so as to focus design and development efforts to areas which are specific to each beamline's requirements. With closing of this projects, the five beamlines are currently in commissioning or serving user science - successful implementation of controls play a critical role in achieving the respective beamline performance parameters.

TUMPL02
16:48

Streamlining Support and Development Activities Across the Distinct Support Groups of the ALBA Synchrotron With the Implementation of a New Service Management System

***M. Martin**, A. Burgos, G. Cuní, E. Edmundo, D. Fernández-Carreiras, O. Matilla, A. Pérez Font, D. Salvat (ALBA-CELLS Synchrotron)*

The MIS section in the Computing division at ALBA Synchrotron designs and supports management information systems. This paper describes the streamlining of the work of 12 support groups into a single customer portal and issue management system. Prior to the change, ALBA was using five different ticket systems. To improve coordination, we searched tools able to support ITIL Service Management, as well as PRINCE2 and Agile Project Management. Within market solutions, JIRA, with its agile boards, calendars, SLAs and service desks, was the only solution with a seamless integration of both. Support teams took the opportunity to redesign their service portfolio and management processes. Through the UX design, JIRA has proved to be a flexible solution to customize forms, workflows, permissions and notifications on the fly, creating a virtuous cycle of rapid improvements, a rewarding co-design experience which results in highly fitting solutions and fast adoption. Team, project and service managers now use a single system to track requests in a timely manner, view trends, and get a consolidated view of efforts invested in the different beamlines and accelerators.

TUMPL03
16:51

New EPICS/RTEMS IOC Based on Altera SOC at Jefferson Lab

***J. Yan**, T.L. Allison, B. Bevins, A. Cuffe, C. Seaton (JLab)*

A new EPICS/RTEMS IOC based on the Altera System-on-Chip (SoC) FPGA was designed at Jefferson Lab. The Altera SoC FPGA integrates a dual ARM Cortex-A9 hard processor system (HPS) consisting of processor, peripherals and memory interfaces tied seamlessly with the FPGA fabric using a high-bandwidth interconnect backbone. The embedded Altera SoC IOC has features of remote network boot via u-boot from SD card or QSPI Flash, 1Gig Ethernet, 1GB DDRs SDRAM on HPS, UART serial ports, and ISA bus interface. RTEMS for the ARM processor BSP were built with CEXP shell, which will dynamically load the EPICS applications at runtime. U-boot is the primary bootloader to remotely load the kernel image into local memory from a DHCP/TFTP server over Ethernet, and automatically run the RTEMS and EPICS. The standard SoC IOC board would be mounted in a chassis and connected to a daughter card via a standard HSMC connector. The first design of the SoC IOC will be compatible with our current PC10^4 IOCs, which have been running on our accelerator control system for 10 years. Eventually, the standard SOC IOCS would be the next generation of low-level IOC for the Accelerator control at Jefferson Lab.

TUMPL04
16:54

LCLS-II Timing Pattern Generator Configuration GUIs

C. Bianchini, *J. Browne, K.H. Kim, M. Weaver, S. Zelazny (SLAC)*

The LINAC Coherent Light Source II (LCLS-II) is an upgrade of the SLAC National Accelerator Laboratory LCLS facility to a superconducting LINAC with multiple destinations at different power levels. The challenge in delivering timing to a superconducting LINAC is dictated by the stability requirements for the beam power and the 1MHz rate. A timing generator will produce patterns instead of events because of the large number of event codes required. The poster explains how the stability requirements are addressed by the design of two Graphical User Interfaces (GUI). The Allow Table GUI filters the timing pattern requests respecting the Machine Protection System (MPS) defined Power Class and the electron beam dump capacities. The Timing Pattern Generator (TPG) programs Sequence Engines to deliver the beam rate configuration requested by the user. The low level program, The TPG generates the patterns, which contains the timing information propagated to the Timing Pattern Receiver (TPR). Both are implemented with an FPGA solution and configured by EPICS. The poster shows an overall design of the high-level software solutions that meet the physics requirements for LCLS-II timing.

TUMPL05
16:57

Strategies for Migrating to a New Experiment Setup Tool at the National Ignition Facility

A.D. Casey, *R.G. Beeler, C.D. Fry, J. Mauvais, E.R. Pernice, M. Shor, J.L. Spears, D.E. Speck, S.L. West (LLNL)*

For the last 10 years, the National Ignition Facility (NIF) has provided scientists with an application, the Campaign Management Tool (CMT), to define the parameters needed to achieve their experimental goals. Conceived to support the commissioning of the NIF, CMT allows users to define over 18,000 settings. As NIF has transitioned to an operational facility, the low-level focus of CMT is no longer required by most users and makes setting up experiments unnecessarily complicated. At the same time, requirements have evolved as operations has identified new functionality required to achieve higher shot execution rates. Technology has also changed since CMT was developed, with the availability of the internet and web-based tools being two of the biggest changes. To address these requirements while adding new laser and diagnostic capabilities, NIF has begun to replace CMT with the Shot Setup Tool (SST). This poses challenges in terms of software development and deployment as the introduction of the new tool must be done with minimal interruption to ongoing operations. The development process, transition strategies and technologies chosen to migrate from CMT to SST will be presented.

TUMPL06
17:03

Implementation of Distributed Information Services for Control Systems Framework for Maintenance Domain in a Physical System

M. Oghbaie, *A. Khaleghi (IKIU) M. Akbari, J. Rahighi (ILSF)*

In physical systems for having best performance in processes like maintenance, troubleshooting, design, construction, update and etc., we need to store data that describe systems state and its components characteristics. Thus we need a framework for developing an application which can store, integrate and manage data and also execute permitted operations. DISCS (Distributed Information Services for

Control Systems) as a framework with mentioned capabilities can help us achieve our goals. In this paper, we first assessed DISCS and its basic architecture and then we implement this framework for maintenance domain of a system. With implementation of maintenance module, we'll be able to store preventive maintenance data and information which help us to trace the problems and analyze situation caused failure and destruction.

TUMPL07 17:06

LeWIS: Let's Write Intricate Simulators

***M. Hart**, O. Arnold (STFC/RAL/ISIS) M. Wedel (ESS)*

Lewis is a new device simulation framework in Python, being developed in collaboration between ESS and ISIS. It enables rapid development of detailed simulators to emulate complex device and controller behaviours at the network interface level. Simulation of devices, controllers and other infrastructure components is crucial for development, testing and debugging of instrument control software. Simple simulators that echo back constant values provide only minimal coverage compared to real devices. Lewis aims to facilitate development of detailed simulators by providing common and well-tested framework components and gradually building a library of standard devices that can easily be customised or extended. Communication protocols, such as EPICS, Modbus and TCP Stream, are provided by the framework and abstracted away from device implementation, allowing the same device to be exposed on multiple protocols via a thin interface layer. Lewis is currently in use by the IBEX* team at ISIS, and will be used to assist development of user-facing instrument control software at ESS.

TUMPL08 17:06

MAX IV BioMAX Beamline Control System: From Commissioning Into User Operation

***M. Eguiraun**, R. Appio, V.H. Hardion, J. Lidón-Simon, A. Milan-Otero, U. Müller, J. Nan, D.P. Spruce, T. Ursby (MAX IV Laboratory, Lund University)*

The BioMAX beamline at MAX IV is devoted to macromolecular crystallography and will achieve a high level of experimental automation when its full potential is reached due to the usage of high end instrumentation and comprehensive software environment. The control system is based on Tango and Sardana for managing the main elements of the beamline. Data acquisition and experiment control is done through MXCuBE v3, which interfaces with the control layer. Currently, the most critical elements such as the detector and diffractometer are already integrated into the control system, whereas the integration of the sample changer has already started. BioMAX has received its first users, who successfully collected diffraction data and provided feedback on the general performance of the control system and its usability. The present work describes the main features of the control system and its operation, as well as the next instrument integration plans

TUMPL09 17:09

Challenges of the ALICE Detector Control System for the LHC RUN3

***P.Ch. Chochula**, A. Augustinus, P.M. Bond, A.N. Kurepin, M. Lechman, J.L. Lång, O. Pinazza (CERN) A.N. Kurepin (RAS/INR) M. Lechman (IP SAS) O. Pinazza (INFN-Bologna)*

The ALICE Detector Control System (DCS) provides its services to the experiment for 10 years. It ensures uninterrupted operation of the experiment and guarantees stable conditions for the data taking. The decision to extend the lifetime of the experiment requires the redesign of the DCS data flow. The interaction rates of the LHC in ALICE during the RUN3 period will increase by a factor of 100. The detector readout will be upgraded and it will provide 3.4TBytes/s of data, carried by 10 000 optical links to a first level processing farm consisting of 1 500 computer nodes and ~100 000 CPU cores. A compressed volume of 20GByte/s will be transferred to the computing GRID facilities. The detector conditions, consisting of about 100 000 parameters, acquired by the DCS need to be merged with the primary data stream and transmitted to the first level farm every 50ms. This requirement results in an increase of the DCS data publishing rate by a factor of 5000. The new system does not allow for any DCS downtime during the data taking, nor for data retrofitting. Redundancy, proactive monitoring, and improved quality checking must therefore complement the data flow redesign.

TUMPA — Mini-Oral

Chair: S. Nemesure (BNL)

Co-Chair: Y.G. Song (Korea Atomic Energy Research Institute (KAERI))

TUMPA01 16:45

New Visual Alignment Sequencer Tool Improves Efficiency of Shot Operations at the National Ignition Facility (NIF)

__M.A. Fedorov__, J.R. Castro Morales, V. Pacheu, E.F. Wilson (LLNL)

Established control systems for scientific experimental facilities offer several levels of user interfaces to match domain-specific needs and preferences of experimentalists, operational and engineering staff. At the National Ignition Facility, the low-level device panels address technicians' need for comprehensive hardware control, while Shot Automation software allows NIF Shot Director to advance thousands of devices at once through a carefully orchestrated shot sequence. MATLAB scripting with NIF Layering Toolbox has enabled formation of intricate Deuterium-Tritium ice layers for fusion experiments. The latest addition to this family of user interfaces is the Target Area Alignment Tool (TAAT), which guides NIF operators through hundreds of measurement and motion steps necessary to precisely align targets and diagnostics for each experiment inside of the NIF's 10-meter target chamber. In this paper, we discuss how this new tool has integrated familiar spreadsheet calculations with intuitive visual aids and checklist-like scripting to allow NIF Process Engineers to automate and streamline alignment sequences, contributing towards NIF Shot Rate enhancement goals.

TUMPA02 16:48

Development of a Machine Protection System for KOMAC Facility

__Y.G. Song__, Y.-S. Cho, H.S. Jeong, D.I. Kim, H.S. Kim, J.H. Kim, S.G. Kim, H.-J. Kwon, S.P. Yun (Korea Atomic Energy Research Institute (KAERI))

The Korea multi-purpose accelerator complex (KOMAC) has two beam extraction points at 20 and 100 MeV for proton beam utilization. High availability should be achieved through high system reliability and short maintenance times to prevent and mitigate damage. A machine protection system is essential for avoiding damage leading to long maintenance times. KOMAC MPS that was developed using analog circuit interlock box has its limit to cover increasing interlock signals and modify interlock logic. The disadvantage has been solved with digital-based system for more efficient logic modification and interlock extension. The MPS is configured remotely using the EPICS-based application. In this paper, we present KOMAC machine protection architecture and performance results of the new machine protection system.

TUMPA03 16:51

The Implementation of KSTAR Fast Interlock System using CompactRIO

__M.K. Kim__, J.S. Hong, T.H. Tak (NFRI)

Tokamak using superconducting magnets is becoming more and more important as long pulse operation and the ability to confine high temperature and density plasma to the interlock system to protect the device. KSTAR achieved H-mode operation for 70 seconds in 2016. In this case, it is necessary to have precise and fast operation protection device to protect Plasma Facing Component from high energy and long pulse plasma. The higher the energy of the plasma, the faster the protection device is needed, and the accurate protection logic must be realized through the high-speed operation using signals from various devices. To meet these requirements, KSTAR implemented the Fast Interlock System using Compact RIO. Implementation of protection logic is performed in FPGA, so it can process fast and various input and output. The EPICS IOC performs communication with peripheral devices, CRIO control, and DAQ. The hard-wired signal for high-speed operation from peripheral devices is directly connected to the CRIO. In this paper, we describe the detailed implementation of the FIS and the results of the fast interlock operation in the actual KSTAR operation, as well as future plans.

TUMPA04
16:54

Operation Status of J-PARC MR Machine Protection System and Future Plan

T. Kimura *(KEK)*

The J-PARC MR's Machine Protection System (MR-MPS) was introduced from the start of beam operation in 2008. Since then, MR-MPS has contributed to the improvement of safety including stable operation of the accelerator and the experiment facilities. The present MR-MPS needs to be reviewed from the aspects such as increase of connected equipment, addition of power supply building, flexible beam abort processing, module uniqueness, service life etc. In this paper, we show the performance of MR-MPS and show future consideration of upgrade.

TUMPA05
16:57

OPC UA to DOOCS Bridge: A Tool for Automated Integration of Industrial Devices Into the Accelerator Control Systems at FLASH and European XFEL

F. Peters*, I. Hartl, C. Mohr, L. Winkelmann (DESY)*

Integrating off-the-shelf industrial devices into an accelerator control system often requires resource-consuming and error-prone software development to implement device-specific communication protocols. With recent progress in standards for industrial controls, more and more devices leverage the OPC UA machine-to-machine communication protocol to publish their functionality via an embedded information model. Here we present a generic DOOCS server, which uses a device's published OPC UA information model for automatic integration into the accelerator control systems of the FLASH and European XFEL free-electron laser facilities. The software makes all the device's variables and methods immediately accessible as DOOCS properties, reducing software development time and errors. We demonstrate that the server's and protocol's latency allows DOOCS-based burst-to-burst feedback in the 10Hz operation modes of FLASH and European XFEL and is capable of handling more than 10^4 data update events per second, without degrading performance. We also report on the successful integration of a commercial laser amplifier, as well as our own PLC-based laser protection system into DOOCS.

TUMPA06
17:00

RF Heat Load Compensation for the European XFEL

M.R. Clausen*, T. Boeckmann, J. Branlard, J. Eschke, O. Korth, J. Penning, B. Schoeneburg (DESY)*

The European XFEL is a 3.4km long X-ray Free Electron Laser. The accelerating structure consists of 96 cryo modules running at 1.3 GHz with 10 Hz repetition rate. The injector adds two modules running at 1.3 and 3.9 GHz respectively. The cryo modules are operated at 2 Kelvin. Cold compressors (CCs) pump down the liquid Helium to 30 mbar which corresponds to 2 Kelvin. Stable conditions in the cryogenic system are mandatory for successful accelerator operations. Pressure fluctuations at 2 K may cause detuning of cavities and could result in unstable CC operations. The RF losses in the cavities may be compensated by reducing the heater power in the liquid Helium baths of the nine cryogenic strings. This requires a stable readout of the current RF settings. The detailed signals are read out from several severs in the accelerator control system and then computed in the cryogenic control system for heater compensation. This paper will describe the commissioning of the cryogenic control system, the communication between the control systems involved and first results of machine operations with the heat loss compensation in place.

TUMPA07
17:03

Advances in Automatic Performance Optimization at FERMI

***G. Gaio**, N. Bruchon, M. Lonza (Elettra-Sincrotrone Trieste S.C.p.A.) L. Saule (University of Trieste)*

Despite the large number of feedback loops running simultaneously at the FERMI Free Electron Laser (FEL), they are not sufficient to keep the optimal machine working point in the long term, in particular when the machine is tuned in such a way to be more sensitive to drifts of the critical parameters. In order to guarantee the best machine performance, a novel software application which minimizes the shot to shot correlation between these critical parameters and the FEL radiation has been implemented. This application, which keeps spatially and temporally aligned the seed laser and the electron beam, contrary to many algorithms that inject noise in the system to be optimized, run transparently during the experiment beam times. In this paper we will also present a newly developed method to calculate a beam 'quality factor' starting from the images provided by a photon spectrometer, which tries to mimic the evaluation of machine physicists, as well as the results obtained using two model-less algorithms to optimize the FEL performance through maximization of the quality factor.

TUMPA08
17:06

The Automatic Quench Analysis Software for the High Luminosity LHC Magnets Evaluation at CERN

***M.F. Gomez De La Cruz**, H.M.A. Bajas, M. Bajko, J.V. Lorenzo Gomez, F.J. Mangiarotti, H. Reymond, A. Rijllart, G.P. Willering (CERN)*

The superconducting magnet test facility at CERN, called SM18, has been using the Automatic Quench Analysis (AQA) software to analyze the quench data during the LHC magnet test campaign. This application was developed using LabVIEW in the early 2000's by the Measurement Test and Analysis section at CERN. During the last few years the magnet facility has been upgraded for the High Luminosity LHC magnet prototypes. These magnets demand a high flexibility of AQA. The new requirements were that the analysis algorithms should be open, allow contributions from engineers and physicists with basic programming knowledge, execute automatically a large number of tests, generate reports and be maintainable by the MTA team. During the feasibility study, several architectures were considered, and after a phase of benchmarking, NI DIAdem was chosen, and complemented with analysis algorithms in Visual Basic Script with specific rules. The rationale behind the choice, the present status and user experience of AQA will be given, while future evolutions and maintainability will be discussed.

TUSH1 — Speakers' Corner

TUSH101
17:15 30

Creating Interactive Web Pages for Non-Programmers

***T. D'Ottavio**, P.S. Dyer, G.J. Marr, S. Nemesure (BNL)*

This paper describes a new web page creation system that allows web developers with limited programming experience to create interactive displays of control system data. Web pages can be created that display live control system data that updates in real-time, as well as data stored within our logging/archiving and database systems. Graphical, tabular, and textual displays are supported as well as standard interaction techniques via buttons, menus and tabs. The developer creates a web page using a custom web page builder. The builder presents a web page as a user-defined grid of tiled cells. The developer chooses the display style of each cell from a list of available cell types, then customizes its data content. Final polish can be applied using HTML and CSS. Specialized tools are available for creating mobile displays. This paper shows examples of the web pages created, and provides a summary of the experience of both the web developers and users.

TUSH102
17:45 30

PShell: from SLS beamlines to the SwissFEL control room

***A. Gobbo**, S.G. Ebner (PSI)*

PShell is an in-house developed scripting environment in use at PSI since 2014. Started as a beamline data acquisition tool at SLS, PShell is being used by different SwissFEL groups for the commissioning and operation of the SwissFEL machine. New features were added to meet new requirements, such as supporting beam synchronous data and streamed cameras. Besides providing a workbench for developing data acquisition logic, PShell also offers a convenient way to create user interfaces/panels that can easily trigger the execution of logic. To improve user experience and to simplify operation tools these panels can also be launched and used as standalone applications.

TUSH103
18:15 30

Web and Multi-Platform Mobile App at Elettra

***L. Zambon**, A.I. Bogani, S. Cleva, F. Lauro (Elettra-Sincrotrone Trieste S.C.p.A.) M. De Bernardi (University of Trieste)*

A few apps have been recently developed at Elettra Sincrotrone Trieste. The main requirements are the compatibility with the main mobile device platforms and with the web, as well as the "mobile-first" user interface approach. We abandoned the possibility of developing native apps for the main mobile OSs. There are plenty of libraries and frameworks for the development of modern cross platform web/mobile applications. In this scenario the choice of a particular set of libraries is crucial. In this paper we will discuss the motivation of our choice trying to compare it with the other possibilities in regard to our particular use cases, as well as the first applications developed.

10-Oct-17 17:15 – 18:45 Speakers' Corner 2

TUSH2 — Speakers' Corner

TUSH201
17:15 30

Online Luminosity Control and Steering at the LHC

__M. Hostettler__, R. Alemany-Fernandez, A. Calia, F. Follin, K. Fuchsberger, M. Gabriel, G.H. Hemelsoet, M. Hruska, D. Jacquet, G. Papotti, J. Wenninger (CERN)

This contribution reviews the novel LHC luminosity control software stack. All luminosity-related manipulations and scans in the LHC interaction points are managed by the LHC luminosity server, which enforces concurrency correctness and transactionality. Operational features include luminosity optimization scans to find the head-on position, luminosity levelling, and the execution of arbitrary scan patterns defined by the LHC experiments in a domain specific language. The LHC luminosity server also provides full built-in simulation capabilities for testing and development without affecting the real hardware. The performance of the software in 2016 and 2017 LHC operation is discussed and plans for further upgrades are presented.

TUSH202
17:45 30

The Laser Megajoule Facility: Personal Safety System

__M.G. Manson__ (CEA)

The Laser MegaJoule (LMJ) is a 176-beam laser facility, located at the CEA CESTA Laboratory near Bordeaux (France). It is designed to deliver about 1.4 MJ of energy to targets, for high energy density physics experiments, including fusion experiments. The first 8-beams bundle was operated in October 2014 and a new bundle was commissioned in October 2016. The next two bundles are on the way. The presentation gives an overview of the Personal Safety System architecture, focusing on the wired safety subsystem named SIC+SGAP. We describe the specific software tool used to develop wired safety functions. This tool simulates hardware and bus interfaces, helps writing technical specifications, conducts functional analysis, performs functional tests and generates documentation. All generated documentation and results from the tool are marked with a unique digital signature. We explain how the tool demonstrates SIL3 compliance of safety functions by integrating into a standard V-shaped development cycle.

TUSH203
18:15 30

System Identification and Control for the Sirius High Dynamics DCM

__R.M. Caliari__, R.R. Geraldes, M.A.L. Moraes, G.B.Z.L. Moreno (LNLS)

The monochromator is known to be one of the most critical optical elements of a synchrotron beamline. It directly affects the beam quality with respect to energy and position, demanding high stability performance and fine position control. The new high-dynamics DCM (Double-Crystal Monochromator) [1] prototyped at the Brazilian Synchrotron Light Laboratory (LNLS), was designed for the future X-ray undulator and superbend beamlines of Sirius, the new Brazilian 4th generation synchrotron [2]. At this kind of machine, the demand for stability is even higher, and conflicts with factors such as high power loads, power load variation, and vibration sources. This paper describes the system identification work carried out for enabling the motion control and thermal control design of the mechatronic parts composing the DCM prototype. The tests were performed in MATLAB/Simulink Real-Time environment, using a Speedgoat Real-Time Performance Machine as a real-time target. Sub-nanometric resolution and nanometric stability at 300 Hz closed loop bandwidth in a MIMO system were targets to achieve. Frequency domain identification tools and control techniques are presented in this paper.

10-Oct-17 17:15 – 18:45 Speakers' Corner 3

TUSH3 — Speakers' Corner

TUSH301
17:15 30

Stream Clustering in Hadoop Using Spark Engine on Data Synchrotron

S. Alishahnezhad, *A. Khaleghi (IKIU)*

Nowadays with the rapid growth of internet and the huge amount of documents in every field, fast processing data in a short time has become an important issue in computer science. In this era the amount of data is growing exponentially. Synchrotron generate huge amount of data in variant format. Therefor the traditional techniques of data processing are not able to deal with the great changes in data size. Spark is one of the fastest stream processing engine in Hadoop framework that can process data continually. Various algorithms with stream data have implemented in spark engine. Clustering algorithm is the common method that can remove problems in future research. Here we are going to review the literature of big data and mention some usages and framework of it and then explain our stream clustering algorithm in spark on data synchrotron.

TUSH302
17:45 30

uSOP: An Embedded Linux Board for the Belle2 Detector Controls

G. Tortone, *A. Anastasio, V. Izzo (INFN-Napoli) A. Aloisio, F. Di Capua, R. Giordano (University of Naples) F. Ameli (INFN-Roma1) P. Branchini (roma3)*

Control systems for scientific instruments and experiments would benefit from hardware and software platforms that provide flexible resources to fulfill various installation requirements. uSOP is a Single Board Computer based on ARM processor and Linux operating system that makes it possible to develop and deploy easily various control system frameworks (EPICS, Tango) supporting a variety of different buses (I2C, SPI, UART, JTAG), ADC, General Purpose and specialized digital IO. In this work we present a live demo of a uSOP board, showing a running IOC for a simple control task. We also describe the deployment of uSOP as a monitoring system architecture for the Belle2 experiment, presently under construction at the KEK Laboratory (Tsukuba, Japan).

TUSH303
18:15 30

Managing Your Timing System as a Standard Ethernet Network

A. Wujek, *G. Daniluk, M.M. Lipinski, J.P. Palluel (CERN) A. Rubini (GNUDD)*

White Rabbit (WR) is an extension of Ethernet which allows deterministic data delivery and remote synchronization of nodes with accuracies below 1 nanosecond and jitter better than 10 ps. Because WR is Ethernet, a WR-based timing system can benefit from all standard network protocols and tools available in the Ethernet ecosystem. This paper describes the configuration, monitoring and diagnostics of a WR network using standard tools. Using the Simple Network Management Protocol (SNMP), clients can easily monitor with standard monitoring tools like Nagios, Icinga and Grafana e.g. the quality of the data link and synchronization. The former involves e.g. the number of dropped frames; The latter concerns parameters such as the latency of frame distribution and fibre delay compensation. The Link Layer Discovery Protocol (LLDP) allows discovery of the actual topology of a network. Wireshark and PTP Track Hound can intercept and help with analysis of the content of WR frames of live traffic. In order to benefit from time-proven, scalable, standard monitoring solutions, some development was needed in the WR switch and nodes.

11-Oct-17 08:30 – 10:15 Plenary

WEAPL — Feedback Control and Process Tuning

Chair: M. Lonza (Elettra-Sincrotrone Trieste S.C.p.A.)
Co-Chair: J.M. Chaize (ESRF)

WEAPL01
08:30 15

Present and Future of Harmony Bus, a Real-Time High Speed Bus for Data Transfer Between Fpga Cores

***M. Broseta**, J.A. Avila-Abellan, G. Cuní, O. Matilla, M. Rodriguez, X. Serra-Gallifa (ALBA-CELLS Synchrotron)*

When feedback loops latencies shall be lower than milliseconds range the performance of FPGA-based solutions are unrivaled. One of the main difficulties in these solutions is how to make compatible a full custom digital design with a generic interface and the high-level control software. ALBA simplified the development process of electronic instrumentation with the use of Harmony Bus (HB)*. Based on the Self-Describing Bus, developed at CERN/GSI, it creates a bus framework where different modules share timestamped data and generate events. This solution enables the high-level control software in a Single Board Computer or PC, to easily configure the expected functionally in the FPGA and manage the real-time data acquired. This framework has been already used in the new Em# electrometer**, produced within a collaboration between ALBA and MAXIV, that is currently working in both synchrotrons. Future plans include extending the FPGA cores library, high-level functions and the development of a new auto-generation tool able to dynamically create the FPGA configuration file simplifying the development process of new functionalities.

WEAPL02
08:45 15

Automatic PID Performance Monitoring Applied to LHC Cryogenics

***B. Bradu**, E. Blanco Viñuela, R. Marti, F.M. Tilaro (CERN)*

At CERN, the LHC (Large Hadron Collider) cryogenic system employs about 4900 PID (Proportional Integral Derivative) regulation loops distributed over the 27 km of the accelerator. Tuning all these regulation loops is a complex task and the systematic monitoring of them should be done in an automated way to be sure that the overall plant performance is improved by identifying the poorest performing PID controllers. It is nearly impossible to check the performance of a regulation loop with a classical threshold technique as the controlled variables could evolve in large operation ranges and the amount of data cannot be manually checked daily. This paper presents the adaptation and the application of an existing regulation indicator performance algorithm on the LHC cryogenic system and the different results obtained in the past year of operation. This technique is generic for any PID feedback control loop, it does not use any process model and needs only a few tuning parameters. The publication also describes the data analytics architecture and the different tools deployed on the CERN control infrastructure to implement the indicator performance algorithm.

WEAPL03
09:00 15

Simulation of Cryogenic Process and Control of EAST Based on EPICS

***L.B. Hu**, X.F. Lu, Q. Yu, Z.W. Zhou, M. Zhuang, Q.Y. Zhang (ASIPP) M.R. Clausen (DESY)*

The cryogenic system of Experiment Advance Superconductor Tokomak (EAST) is a large capacity system at both 4.5 and 80K levels at huge superconducting magnet system together with 80k thermal shields, complex of cryogenic pumps and small cryogenic users. The cryogenic system and their control are highly complex due to the large number of correlated variables on wide operation ranges. Due to the complexity of the system, dynamic simulations represent the only way to provide adequate data during transients and to validate complete cooldown scenarios in such complex interconnected systems. This paper presents the design of EAST cryogenic process and control simulator. The cryogenic process model is developed by the EcosimPro and CRYOLIB. The control system model is developed based on EPCIS. The real-time communication between cryogenic process and control system is realized by OPC protocol. This simulator can be used for different purpose such as operator training, test of the new control strategies and the optimization of cryogenic system.

WEAPL04
09:15 15

Nanoprobe Results: Metrology & Control in Stacked Closed-Loop Systems

***C. Engblom**, Y.-M. Abiven, F. Alves, N. Jobert, S.K. Kubsky, F. Langlois, A. Lestrade (SOLEIL) T. Stankevic (MAX IV Laboratory, Lund University)*

Over the course of four years, the Nanoprobe project worked to deliver prototypes capable of nm-precision and accuracy with long-range millimetric sample positioning in 3D- scanning tomography for long beamline endstations in Synchrotron Soleil and MAXIV. The ambition of the project necessitated a joint progress between several fields of expertise combining mechanics, metrology, motion control, and software programming. Interferometry in stage characterization has been a crucial point; not only to qualify motion errors but to actively integrate it into control systems with feedback and/or feedforward schemes in order to reduce XYZ position errors down to the nm- level. As such, a new way of characterizing rotation stages (Patent application PCT/EP2015/074011) was developed and ultimately used in control schemes utilizing the Delta Tau PowerPMAC platform. This paper gives sketches the obtained results, as well as the methodology and approach taken in the project to achieve this.

WEAPL05
09:30 15

Parc : A Computational System in Support of Laser Megajoule Facility Operations

***J-P. Airiau**, s. Vermersch (CEA)*

The Laser MegaJoule (LMJ) is a 176-beam laser facility, located at the CEA CESTA Laboratory near Bordeaux (France). It is designed to deliver about 1.4 MJ of energy to targets, for high energy density physics experiments, including fusion experiments. The first 8-beams bundle was operated in October 2014 and a new bundle was commissioned in October 2016. The next two bundles are on the way. PARC * is the computational system used to automate the laser setup and the generation of shot report with all the results acquired during the shot sequence process (including alignment and synchronization). It has been designed to run sequence in order to perform a setup computation or a full facility shot report in less than 15 minutes for 1 or 176 beams. This contribution describes how this system solves this challenge and enhances the overall process.

WEAPL06
09:45 15

Skywalker: Python Suite for Automated Photon Alignment at LCLS

***T.A. Wallace**, A.P. Rashed Ahmed, T.F. Rendahl (SLAC)*

For the first seven years of its existence, the Linear Coherent Light Source (LCLS) at SLAC has been aligned manually by a combination of accelerator and beamline operators. In an effort to improve both the accuracy and speed of the initial delivery of X-ray light, a Python based automation suite Skywalker has been created to handle beam pointing to five unique experimental end stations. The module uses a configurable system identification algorithm to probe the parameter space of the mirror set, quickly building an accurate model without interrupting operation. The result is a robust model capable of precise movements without predefined assumptions. We will present the basic concepts and modules underlying Skywalker, analysis of the performance of the system at LCLS, and plans to extend the feature set to accommodate more intricate optical configurations.

WEAPL07
10:00 15

On-Line Optimization of XFELs and Light Sources with OCELOT

***I.V. Agapov**, I. Zagorodnov (DESY) A.B. Egger, T.J. Maxwell, D.F. Ratner (SLAC) G. Geloni, S.I. Tomin (XFEL. EU)*

OCELOT is a software suite that includes accelerator physics, FEL physics, electromagnetic radiation, and x-ray optics models, as well as on-line beam control software. It exploits a growing body of available python numerical and optimization libraries (numpy, scipy), machine learning software (scikit-learn), and advanced user frontend technologies (QT). This, in combination with physics models and flexible scripting, speeds up high-level control software development cycle: from accelerator physics simulations to prototype on-line software (in command-line mode) and then to production software (with graphical interface). After a brief introduction to the software, I will focus on its application to FEL optimization, covering - Model-based and model-free (empirical) approaches - Overview of empirical optimization methods for FELs, including: functional minimization methods, optimization objectives, strategy selection, issues related to pulse stability and pulse structure - Challenges in exploiting large amount of monitored data channels and performance statistics for tuning strategy readjustment - Experience of OCELOT usage at FLASH, European XFEL (both DESY), and LCLS (SLAC)

11-Oct-17 10:45 – 12:30 Plenary

WEBPL — Experiment Control 1

Chair: M. Janousch (PSI)

Co-Chair: G. Cuni (ALBA-CELLS Synchrotron)

WEBPL01
10:45 15

EPICS Architecture for Neutron Instrument Control at the European Spallation Source

***D.P. Brodrick**, T. Korhonen, J. Sparger (ESS)*

The European Spallation Source (ESS) are currently developing a suite of fifteen neutron instruments, the first eight of which will be available for routine scientific use by 2023. The instrument control system will be distributed through three layers: local controllers for individual instrument components; Experimental Physics and Industrial Control System (EPICS) software to implement higher level logic and act as a hardware abstraction layer; and an Experiment Control Program (ECP) which has an executive role, interacting with instrument components via the EPICS layer. ESS are now actively designing and prototyping the EPICS controls architecture for the neutron instruments, including systems which interface to core instrument components such as motion control systems, sample environment equipment, neutron choppers, instrument Programmable Logic Controller (PLC) systems, and the interfaces to the ECP. Prototyping activities have been executed in an integrated and coordinated manner to demonstrate the EPICS controls architecture in an environment representative of the neutron instruments to which the architecture will ultimately be applied.

WEBPL02
11:00 15

On-Axis 3D Microscope for X-Ray Beamlines at NSLS-II*

***K.J. Gofron**, Y.Q. Cai (BNL) J. Wlodek (Stony Brook University, Computer Science Department)*

A series of versatile on-axis X-ray microscopes with large working distances, high resolution and large magnification have been developed for in-situ sample alignment and X-ray beam visualization at beam-lines at NSLS-II [1]. The microscopes use reflective optics, which minimizes dispersion, and allows imaging from Ultraviolet (UV) to Infrared (IR) with specifically chosen objective components (coatings, etc.) [2]. Currently over seven reflective microscopes have been procured with several installed at NSLS2 beam-lines. Additional customizations can be implemented providing for example dual-view with high/low magnification, 3-D imaging, long working range, as well as ruby pressure system measurement. The microscope camera control frequently utilizes EPICS areaDetector. In specialized applications python programs integrate EPICS camera control, with computer vision, and EPICS motion control for goniostat centering or object detection applications.

WEBPL03
11:15 15

Beamline and Experiment Automations for the General Medical Sciences and Cancer Institutes Structural Biology Facility at the Advanced Photon Source (GM/CA@APS)

***S.A. Stepanov**, R. Fischetti, M. Hilgart, O. Makarov, Q. Xu (ANL) J.L. Smith (University of Michigan)*

Beamlines for macromolecular crystallography (MX) are among the most automated beamlines at synchrotron radiation facilities around the globe. GM/CA@APS operates three EPICS-controlled MX beamlines. All aspects of controls including data acquisition software, computing, networking, data storage and remote access are managed locally, which enables fast development and efficient integration of all parts of the process. The core of the GM/CA control system is the open-source JBluIce* distributed data acquisition software, which integrates automated sample screening with robotic sample mounters, automated searches for small crystals, multiple modes of data collection, and automated strategy and data processing calculations. This presentation gives an overview of JBluIce and reports recent developments to support up to 100 fps shutterless data collection with fast Dectris Eiger and Pilatus detectors. The integration involved new approaches to detector-goniometer synchronization and data visualization, redesign of the computing and storage environment, and implementation of automated distributed data processing on clusters.

WEBPL04 11:30 15

A Software Architecture for Full Beamline Automation - VMXi Use Case

C.J. Sharpe, *J.D. O'Hea (DLS)*

VMXi is the first beamline at Diamond Light Source to be entirely automated with no direct user interaction to set up and control experiments. This marks a radical departure from other beamlines at the facility and it presents a significant design challenge to GDA, the in-house software that manages data acquisition. The result is that GDA has changed from a user interface for human users to perform experiments to become a reactive robot controller for continual, uninterrupted processing of all user experiments. A major achievement has been to demonstrate that it is possible to successfully deliver a suitable architectural implementation for automation developed within a standard IDE, without the need for specialised software or a domain specific language. The objective is to: review the project on VMXi as a whole with an emphasis on hardware configuration and experiment processing; describe the software and control architecture for automation; and provide a general set of guidelines for developing software for automation at a scientific facility.

WEBPL05 11:45 15

BLISS - Experiments Control for ESRF EBS Beamlines

M. Guijarro, *A. Beteva, T.M. Coutinho, M.C. Dominguez, C. Guilloud, A. Homs, J.M. Meyer, E. Papillon, M. Perez, S. Petitdemange (ESRF)*

BLISS is the new ESRF control system for running experiments, with full deployment aimed for the end of the EBS upgrade program in 2020. BLISS provides a global approach to run synchrotron experiments, thanks to hardware integration, Python sequences and an advanced scanning engine. As a Python package, BLISS can be easily embedded into any Python application and data management features enable online data analysis. In addition, BLISS ships with tools to enhance scientists user experience and can easily be integrated into TANGO based environments, with generic TANGO servers on top of BLISS controllers. BLISS configuration facility can be used as an alternative TANGO database. Delineating all aspects of the BLISS project from beamline device configuration up to the integrated user interface, this talk will present the technical choices that drove BLISS design and will describe the BLISS software architecture and technology stack in depth.

WEBPL06 12:00 15

Sardana Based Continuous Scans at ALBA - Current Status

Z. Reszela, *F. Becheri, G. Cuní, C. Falcon-Torres, D. Fernández-Carreiras, R. Homs-Puron, J. Moldes, C. Pascual-Izarra, R. Pastor Ortiz, D. Roldán, M. Rosanes Siscart (ALBA-CELLS Synchrotron)*

A significant part of the experiments run at Alba Synchrotron* involve scans. The continuous scans were developed first ad hoc and latter the controls group dedicated important efforts to standardize them across the Alba instruments, enhancing the overall performance and allowing the users to better exploit the beamtime**. Sardana***, the experiment control software used at Alba, among other features, aims to provide a generic way of programming and executing continuous scans. This development just achieved a major milestone - an official version with a stable API. Recently the Alba instruments were successfully upgraded to profit from this release. In this paper we describe the evolution of these setups as well as the new continuous scan applications run at Alba. On the one hand, the most relevant hardware solutions are presented and assessed. On the other hand the Sardana software is evaluated in terms of its utility in building the continuous scans setups. Finally we discuss the future improvements plan designed to satisfy the ever-increasing requirements of the scientists.

WEBPL07
12:15 15

Optimised Multi-Dimensional Image Scanning With Rascan

***N. Afshar**, D. Howard, D. Paterson, A. C. Starritt, M.D. de Jonge (ANSTO)*

On-the-fly scanning has significantly improved one dimensional scans by removing motion overheads between pixels. However, realisation of multi-dimensional techniques such as tomography and XANES imaging is presently stymied by overheads that occur on a line-by-line basis. At the Australian Synchrotron's XFM beamline, inevitable "overheads" can add up to a significant wasted beam time. Therefore, there is a clear need for further optimisation of scan motion to formulate and minimise higher dimensional overheads. Here we outline our approach to realise trajectory scans that are optimised for trajectory tracking accuracy with minimised overhead times. The scan motion is seen as fly-scan lines, and overhead moves between the lines which form a two dimensional raster scan in a transformed geometry. This separation of 'required' and 'overhead' motions has provided an efficient platform for formulating an optimisation problem which is solved to obtain the optimised scan trajectory. The solution known as Rascan, is in operation at the XFM beamline of the Australian Synchrotron since May 2016, resulting in significant gains in throughput, performance and efficiency.

11-Oct-17 12:30 – 13:30 Plenary

WEKPL — Keynote Speaker

Chair: O. Matilla (ALBA-CELLS Synchrotron)

`WEKPL01` 12:30 60

La Basílica de la Sagrada Família

C. Gelpí (UPC)

Carles Gelpí is an architect, professor of Structure Calculations at the Polytechnic University of Catalonia. He is member of several associations, such as the Catalonian Architects, Structure Consultants and the Forensic Expert Architects Association. Carles manages his own architecture office since 1993 and he is also one of the directors, founding partners and project manager of 2BMFG arquitectes S.L.P, an Architecture Office located in Barcelona with more than 30 years of professional experience counting several notorious renowned projects such as the "Olympic Stadium and Olympic Ring" Barcelona 1992, or the Sagrada Familia's Expiatory Temple, in Barcelona, at the moment under construction. 2BMFGaquitectes counts more than sixty publications and it has received more than twenty national and International awards.

12-Oct-17 08:30 – 09:30 Plenary

THKPL — Keynote Speaker

Chair: M. Bickley (JLab)

THKPL01
08:30 60

More Than Particles: How Accelerators Can Speed Up Advanced Manufacturing… and What's Next

A. Ameyugo *(CEA LIST)*

Konosuke Matsushita, the founder of Panasonic, once said "We are apt to think that our ideas are the creation of our own wisdom, but the truth is that they are the result of the experience through outside contact". The ever-accelerating pace of progress in digital technologies is leading to a transformation of the manufacturing industry. With initiatives at regional, national (think Industria Conectada 4.0, Industrie du Futur, Industrie 4.0…) and international level, seizing the opportunity created by these technologies has become a priority for most developed economies. In France, CEA is one of the leading actors in this 4th industrial revolution, developing new digital and robotics technologies, and working together with industry to accelerate their deployment. In his talk, Greg Ameyugo will show how progress in Advanced Manufacturing can be and is already being inspired by Accelerator and Large Experimental Physics Control Systems, the current and emerging technology trends in manufacturing, and the changes they can bring about for industry.

12-Oct-17 09:30 – 10:45 Plenary

THAPL — User Interfaces and User eXperience (UX) 2

Chair: A. Götz (ESRF)
Co-Chair: R. Bacher (DESY)

THAPL01 09:30 15

Implementation of Web-based Operational Log System at RIBF

***A. Uchiyama**, N. Fukunishi, M. Komiyama (RIKEN Nishina Center)*

The operational log system is one of the electric log systems for recording and viewing the accelerator operation time and contents of an operated device. Zlog (Zope-based log system)* developed by KEK was utilized for the RIBF control system. Zope is an open-source Web server and Web application framework written in Python. Using the Web application, information on accelerator operation is designated by a character string on Web browsers. However, the displayed string character on the Web browser will be complex for accelerator operators because many parameters are changed in accelerator operation, though the Web-based system has many advantages. For smoother accelerator operation, an ergonomically designed operational log system is required. Therefore, we developed a new operational log system for RIBF control system. The new system is possible to provide operational logs with a variety of rich GUI components. As of now, the operational log system has been working for accelerator operation by monitoring approximately 3,000 points as the EPICS record without any serious problem.

THAPL02 09:45 15

Best Practices for Efficient Development of JavaFX Applications

***G. Kruk**, O. Da Silva Alves, L. Molinari, E. Roux (CERN)*

JavaFX, the GUI toolkit included in the standard JDK, has reached a level of maturity enabling its usage for Control Systems applications. Property bindings, built-in separation between logic (Controller) and visual part (FXML) that can be designed with Scene Builder, combined with the leverage of Java 8 features such as lambda expressions or method references, make this toolkit a very compelling choice for the creation of clean and testable GUI applications. This article describes best practices and tools that improve developer's efficiency even further. Structuring applications for productivity, simplified FXML loading, the application of Dependency Injection and Presentation Model patterns, testability are discussed among other topics, along with support of IDE tooling.

THAPL03 10:00 15

Usability Recommendations for the SKA Control Room Obtained by a User-Centred Design Approach

***V. Alberti** (INAF-OAT) G. Brajnik (IDS)*

User-Centered Design is a powerful approach for designing UIs that match and satisfy users' skills and expectations. Interviews, affinity diagrams, personas, usage scenarios are some of the fundamental tools for gathering and analysing relevant information. We applied these techniques to the development of the UI for the control room of the Square Kilometre Array (SKA) telescopes. We interviewed the personnel at two of the SKA precursors, LOFAR and MeerKAT, with the goal of understanding what features satisfy operators' needs and which ones can be improved. What was learned includes several usability issues dealing with fragmentation and low cohesiveness of the UIs, some gaps, and an excessive number of user actions needed to achieve certain goals. Low usability of the UI and the large scale of SKA are two challenges in developing its UI because they affect the extent to which operators can focus on important data, the likelihood of human errors and their consequences. This paper illustrates the followed method, provides examples of some of the artefacts that were produced and describes and motivates the resulting usability recommendations which are specific for SKA.

THAPL04
10:15 15

Python for User Interfaces at Sirius

***G.S. Fedel**, D.B. Beniz, L.P. Do Carmo, J.R. Piton (LNLS)*

Sirius is the new Brazilian Synchrotron and will be finished on 2018. Based on experiences at UVX light source along with researches and implementations, we present our new approach to develop user interfaces for beamlines control. On this process, the main tools explored are Python, Qt and some Python libraries: PyQt, PyDM and Py4syn. Python straightforward coding and powerful resources of these modules guarantees flexible user interfaces: it is possible to combine graphical applications with intelligent control procedures. At UVX, EPICS and Python are software tools already used respectively for distributed control system and for writing control routines. These routines often use Py4Syn, a library which provides high-level abstraction for devices manipulation. All these features will continue at Sirius. More recently PyQt turned out to be a compatible and intuitive tool to build GUI applications, binding Qt to Python. Also PyDM offers a practical framework to expose EPICS variables to PyQt. The result is a set of graphical and control libraries to support new Sirius user interfaces.

THAPL05
10:30 15

Nomad 3D: Augmented Reality in Instrument Control

***Y. Le Goc** (ILL)*

The life cycle of an ILL instrument has two main stages. During the design of the instrument, a precise but static 3D model of the different components is developed. Then comes the exploitation of the instrument of which the control by the Nomad software allows scientific experiments to be performed. Almost all instruments at the ILL have moveable parts often hidden behind radiological protection elements such as heavy concrete walls or casemate. Massive elements of the sample environment like magnets and cryostats must be aligned in the beam. All those devices are able to collide with the surrounding environment. To avoid those types of accident, the instrument moves must be checked by a pre-experiment simulation that will reveal possible interferences. Nomad 3D is the application that links the design and the experiment aspects providing an animated 3D physical representation of the instrument while it moves. Collision detection algorithms will protect the moveable parts from crashes. During an experiment, it will augment the reality by enabling to "see" behind the walls. It will provide as well a precise virtual representation of the instrument during the simulations.

12-Oct-17 11:15 – 12:45 Plenary

THBPL — Software Technology Evolution 3

Chair: G. Chiozzi (ESO)

Co-Chair: L. Van den Heever (SKA South Africa, National Research Foundation of South Africa)

THBPL01 C2MON SCADA Deployment on CERN Cloud Infrastructure

11:15 15

***B. Copy**, M. Bräger, F. Ehm, A. Lossent, E. Mandilara (CERN)*

The CERN Control and Monitoring Platform (C2MON)is an open-source Java platform for industrial controls data acquisition, monitoring, control and data publishing. C2MON's high-availability, redundant capabilities make it particularly suited for a large, geographically scattered context such as CERN. In order to make C2MON more scalable and compatible with Cloud Computing (#cloud), it was necessary to "containerize" C2MON components for the Docker container platform. This paper explains the challenges met and the principles behind containerizing a server-centric Java application, demonstrating how simple it has now become to deploy C2MON in any cloud-centric environment. It also demonstrates the advantages of a cloud-ready SCADA to build live and historical industrial controls data dashboards, allowing to stream control data directly into web page elements such as Scalable Vector Graphics diagrams via Websockets and Document Object Model (DOM) events.

THBPL02 Behavioural Models for Device Control

11:30 15

***L. Andolfato**, M. Comin, S. Feyrin, M. Kiekebusch, J. Knudstrup, F. Pellegrin, D. Popovic, C. Rosenquist, R. Schmutzer (ESO)*

ESO is in the process of designing a new instrument control application framework for the ELT project. During this process, we have used the experience in HW control gained from the first and second generation of VLT instruments that have been in operation for almost 20 years. The preliminary outcome of this analysis is a library of Statecharts models illustrating the behavior of some of the most commonly used devices in telescope and instrument control systems. This paper describes the architectural aspects taken into consideration when designing the models such as HW/SW state representation, common/specialized behavior, and failure management. An extension to Harel's formalism to facilitate reusability by dynamic creation of orthogonal regions is also proposed. The paper details the behavior of some devices like shutters, lamps and motors together with the rationale behind the modelling choices. A mapping of the models to a concrete implementation using real HW components is suggested. Although these models have been designed following the principles of our conceptual architecture, they are still generic and platform independent, so they can be easily reused in other projects.

THBPL03 A New ACS Bulk Data Transfer Service for CTA

11:45 15

***M.A. Araya**, R.S. Castillo, M.I. Jara, L. Pizarro, H.H. von Brand (UTFSM) E. Lyard (University of Geneva) I. Oya (DESY Zeuthen) I. Oya (Humboldt University Berlin, Institut für Physik)*

The ALMA Common Software (ACS) framework provides Bulk Data Transfer (BDT) service implementations that need to be updated for new projects that will use ACS, such as the Cherenkov Telescope Array (CTA) and other projects, with most cases having quite different requirements than ALMA. We propose a new open-source BDT service for ACS based on ZeroMQ, that meets CTA data transfer specifications while maintaining retro-compatibility with the closed-source solution used in ALMA. The service uses the push-pull pattern for data transfer, the publisher-subscriber pattern for data control, and Protocol Buffers for data serialization, having also the option to integrate other serialization options easily. Besides complying with ACS interface definition to be used by ACS components and clients, the service provide an independent API to be used outside the ACS framework. Our experiments show a good compromise between throughput and computational effort, suggesting that the service could scale up in terms of number of producers, number of consumers and network bandwidth.

THBPL04 12:00 15

The Design of Tango Based Centralized Management Platform for Software Devices

***Z. Ni**, J. Liu, J. Luo, X. Zhou (CAEP)*

Tango provides the Tango device server object model(TDSOM), whose basic idea is to treat each device as an object. The TDSOM can be divided into 4 basic elements, including the device, the server, the database and the application programmers interface. On the basis of the TDSOM, we design a centralized platform for software device management, named VisualDM, providing standard servers and client management software. Thus the functionality of VisualDM are mutli-folds: 1) dynamically defining or configuring the composition of a device container at run-time; 2) visualization of remote device management based on system scheduling model; 3) remote deployment and update of software devices; 4) registering, logouting, starting and stopping devices. In this paper, platform compositions, module functionalities, the design concepts are discussed. The platform is applied in computer integrated control systems of SG facilities.

THBPL05 12:15 15

The ELT Linux Development Environment

***F. Pellegrin**, C. Rosenquist (ESO)*

The Extremely Large Telescope (ELT) is a 39-metre ground-based telescope being built by ESO. It will be the largest optical/near-infrared telescope in the world and first light is foreseen for 2024. The ELT software development for telescopes and instruments poses many challenges: a variety of technologies, Java, C/C++ and Python as programming languages, QT5 as the GUI toolkit, communication frameworks such as OPCUA, DDS and ZeroMQ, and interaction with external entities such as PLCs and real-time hardware, and users, in-house and not, looking at new usage patterns. All this optimized to be on time for the first light. To meet these requirements, a new bag of tools was selected for the development toolkit. Its contents ranges from an IDE, to compilers, interpreters, analysis and debugging tools for the various languages and operations. At the heart of the toolkit lies the modern build framework waf: a versatile tool in Python targeted to the support of multiple languages and high performance. The overall ELT Linux Development Environment will be presented with an in-depth presentation of its core, the waf build system, and the customizations that ESO is currently developing.

THBPL06 12:30 15

First implementation of RASHPA, a High-performance RDMA-based Data Acquisition Platform for 2D X-ray Detectors

***W. Mansour**, P. Fajardo, N. Janvier (ESRF)*

The ESRF initiated few years ago the development of a novel platform for optimised transfer of 2D detector data based on zero-copy Remote Direct Memory Access techniques. The purpose of this new scheme, under the name of RASHPA, is to efficiently dispatch with no CPU intervention multiple parallel multi-GByte/s data streams produced by modular detectors directly from the detector head to computer clusters for data storage, visualisation and distributed data treatment. The RASHPA platform is designed to be implementable using any data link and transfer protocol that supports RDMA write operations and that can trigger asynchronous events. This paper presents the ongoing work for the first implementation of RASHPA in a real system using the hardware platform of the Medipix3 based SMARTPIX hybrid pixel detector developed at ESRF and relying on switched PCIe over cable network for data transfer. It details the implementation of the RASPHA controller at the detector side and provides input on the software for the management of the overall data acquisition system at the receiver side. The implementation and use of a PCIe switch built with components off-the-shelf is also discussed.

THBPA — IT Infrastructure for Control Systems

Chair: R. Mueller (BESSY GmbH)
Co-Chair: A. Buteau (SOLEIL)

THBPA01 11:15 15

Cyber Threat, the World Is No Longer What We Knew

S. Perez *(CEA)*

Security policies are becoming hard to apply as instruments are smarter than ever. Every oscilloscope gets its own stick with a Windows tag, everybody would like to control his huge installation through the air, IOT is on every lips' Stuxnet, the recent Ed. Snowden revelations have shown that cyber threat on SCADAs cannot be only played in James Bond movies. This paper aims to give simple advises in order to protect and make our installations more and more secure. How to write security files? What are the main precautions we have to take care of? Where are the vulnerabilities of my installation? Cyber security is everyone's matter, not only the cyber staff's!

THBPA02 11:30 15

Securing Light Source SCADA Systems

L. Mekinda*, V. Bondar, S. Brockhauser, W. Ehsan, S.G. Esenov, H. Fangohr, G. Flucke, G. Giovanetti, S. Hauf, D.G. Hickin, A. Klimovskaia, L.G. Maia, T. Michelat, A. Muennich, A. Parenti, H. Santos, A. Silenzi, K. Weger (XFEL. EU)*

Cyber security aspects are often not thoroughly addressed in the design of light source SCADA. In general the focus remains on building a reliable and fully-functional ecosystem. The underlying assumption is that a SCADA infrastructure is a closed ecosystem of sufficiently complex technologies to provide some security through trust and obscurity. However considering the number of internal users, engineers, visiting scientists, students going in and out light source facilities cyber security threats can no longer be minored. At the European XFEL, we envision a comprehensive security layer for the entire SCADA infrastructure. Karabo [1], the control, data acquisition and analysis software developed internally shall implement these security paradigms known in IT but not applicable off-the-shelf to the FEL context. The challenges are considerable: (i) securing access to photon science hardware that has not been designed with security in mind; (ii) granting limited fine-grained permissions to external users; (iii) truly securing Control and Data acquisition APIs while preserving performance. Only tailored solution strategies, as presented in this paper, can fulfill these requirements.

THBPA03 11:45 15

The Back-End Computer System for the Medipix Based PI-MEGA X-Ray Camera

H.D. de Almeida*, M.A.L. Moraes (LNLS)*

The Brazilian Synchrotron, in partnership with BrPhotonics, is designing and developing pi-mega, a new X-Ray camera using Medipix chips, with the goal of building very large and fast cameras to supply Sirius' new demands. This work describes the design and testing of the back end computer system that will receive, process and store images. The back end system will use RDMA over Ethernet technology and must be able to process data at a rate ranging from 50 Gbps to 100 Gbps per pi-mega element. Multiple pi-mega elements may be combined to produce a large camera. Initial applications include tomographic reconstruction and coherent diffraction imaging techniques.

THBPA04
12:00 15

Orchestrating MeerKAT's Distributed Science Data Processing Pipelines

A.F. Joubert, *B. Merry (SKA South Africa, National Research Foundation of South Africa)*

The 64-antenna MeerKAT radio telescope is a precursor to the Square Kilometre Array. The telescope's correlator beamformer streams data at 600 Gb/s to the science data processing pipeline that must consume it in real time. This requires significant compute resources, which are provided by a cluster of heterogeneous hardware nodes. Effective utilisation of the available resources is a critical design goal, made more challenging by requiring multiple, and highly configurable pipelines. A static allocation of processes to hardware nodes was used initially but is insufficient as the project scales up. This contribution describes recent improvements to our distributed container deployment, using Apache Mesos for orchestration. We also discuss how issues like non-uniform memory access (NUMA), network partitions, and fractional allocation of graphical processing units (GPUs) were addressed using a custom scheduler for Mesos.

THBPA05
12:15 15

Network Traffic Patterns and Performance Improvements for Tango Based Control System and PLC

M. Ostoja-Gajewski *(Solaris National Synchrotron Radiation Centre, Jagiellonian University)*

The network infrastructure in Solaris (National Synchrotron Radiation Center, Kraków) is carrying traffic between around 900 of physical devices and dedicated virtual machines running Tango control system. The Machine Protection System based on PLCs is also interconnected by network infrastructure. We have performed an extensive measurements of traffic flows and analysis of traffic patterns that revealed congestion of aggregated traffic from high speed acquisition devices. We have also applied the flow based anomaly detection systems that give an interesting low level view on Tango control system traffic flows. All issues were successfully addressed, thanks to proper analysis of traffic nature. This paper presents the essential techniques and tools for network traffic patterns analysis, tips and tricks for improvements and real-time data examples.

THBPA06
12:30 15

Configuration Management for the Integrated Control System Software of ELI-ALPS

L. Schrettner, *B. Bagó, B. Erdohelyi, T.M. Gaizer, A. Heidrich, G. Nyiri (ELI-ALPS)*

ELI-ALPS (Extreme Light Infrastructure - Attosecond Light Pulse Source) is a new Research Infrastructure under implementation in Hungary. The infrastructure will consist of various systems (laser sources, beam transport, secondary sources, end stations) built on top of common subsystems (HVAC, cooling water, vibration monitoring, vacuum system, etc.), yielding a heterogeneous environment. To support the full control software development lifecycle for this complex infrastructure a flexible hierarchical configuration model has been defined, and a supporting toolset has been developed for its management. The configuration model is comprehensive as it covers all relevant aspects of the entire controlled system, the control software components and all the necessary connections between them. Furthermore, it supports the generation of virtual environments that approximate the hardware environment for software testing purposes. The toolset covers configuration functions such as storage, version control, GUI editing and queries. The model and tools presented in our paper are not specific to the ELI-ALPS or to the ELI community, they may be useful for other research institutions as well.

12-Oct-17 13:45 – 15:30 Plenary

THCPL — Systems Engineering, Collaborations and Project Management

Chair: C.D. Marshall (LLNL)

Co-Chair: E. Carrone (SLAC)

THCPL01
13:45 30

Speaking of Diversity

K.S. White *(ORNL)*

Historically, attendance at the International Conference on Accelerator and Large Experimental Physics Control Systems has not been particularly diverse in terms of gender or race. In fact, the lack of diversity amongst the attendees was noted during the closing session of the 2015 conference by an invited speaker from outside the accelerator community. Informal discussion and observations support the assertion that our conference attendance reflects the diversity of the broader accelerator controls workforce. Facing very low participation of women in our field and even lower minority representation, it is important to examine this issue as studies point to the importance of diverse work groups to spark innovation and creativity as catalysts to solving difficult problems. This paper will discuss diversity and inclusion in the disciplines that comprise the accelerator controls workforce, including background, barriers and strategies for improvement.

THCPL02
14:15 15

Highlights of the European Ground System - Common Core Initiative

M. Pecchioli *(ESA/ESOC) J.M. Carranza (ESA-ESTEC)*

The European Ground System Common Core (EGS-CC) initiative is now materializing. The goal of the this initiative is to define, build and share a software framework and implementation that will be used as the main basis for pre- and post- launch ground systems (Electrical Ground Support Equipment and Mission Control System) of future European space projects. The initiative is in place since year 2011 and is being led by the European Space Agency as a formal collaboration of the main European stakeholders in the space systems control domain, including European Space National Agencies and European Prime Industry. The main expected output of the EGS-CC initiative is a core system which can be adapted and extended to support the execution of pre- and post-launch Monitoring and Control operations for all types of missions and throughout the complete life-cycle of space projects. This presentation will introduce the main highlights of the EGS-CC initiative, its governance principles, the fundamental concepts of the resulting products and the challenges that the team is facing.

THCPL03
14:30 15

A Success-History Based Learning Procedure to Optimize Server Throughput in Large Distributed Control Systems

Y. Gao*, T.G. Robertazzi (Stony Brook University) K.A. Brown (BNL) J. Chen (Stony Brook University, Computer Science Department)*

Large distributed control systems typically can be modeled by a hierarchical structure with two physical layers: Console Level Computers (CLCs) and Front End Computers (FECs). The controls system of the Relativistic Heavy Ion Collider (RHIC) consists of more than 500 FECs, each acting as a server providing services to a potentially unlimited number of clients. This can lead to a bottleneck in the system. Heavy traffic can slow down or even crash a system, making it momentarily unresponsive. One mechanism to circumvent this is to transfer the heavy communications traffic to more robust higher performance servers, keeping the load on the FEC low. In this work, we study this client-server problem from a different perspective. We introduce a novel game theory model for the problem, and formulate it into an integer programming problem. We point out its difficulty and propose a heuristic algorithms to solve it. Simulation results show that our proposed schemes efficiently manage the client-server activities, and result in a high server throughput and a low crash probability.

THCPL04 14:45 15

SKA Synchronization and Timing Local Monitor and Control - Software Design Approach

R. Warange *(National Centre for Radio Astrophysics, Tata Institute of Fundamental Research) , R.E. Braddock (University of Manchester)*

The Square Kilometre Array (SKA) is a global project that aims to build a large radio telescope in Australia and South Africa with around 100 organizations in 20 countries engaged in its detailed design. The Signal and Data Transport (SaDT) consortium, includes all the software and hardware necessary for the transmission of data and information between elements of SKA, and the Synchronization and Timing (SAT) system that provides frequency and clock signals. The local monitoring and control system (SAT. LMC) monitors and controls the SAT system. SAT. LMC has its team members distributed across India, South Africa and UK. This paper discusses the systems engineering methods adopted by SAT. LMC on interface design with work packages owned by different organizations, configuration control of design artifacts, quality control through intermediate releases, design assumptions and risk management. The paper also discusses the internal SAT. LMC team communication model, cross culture sensitivity and leadership principles adopted to keep the project on track, deliver quality design products whilst staying flexible to the changes in the overall SKA program.

THCPL05 15:00 15

TANGO Heads for Industry

A. Götz*, R. Bourtembourg, J.M. Chaize (ESRF) S. Gara (NEXEYA SYSTEMS) P.P. Goryl (3controls) I.A. Khokhriakov (HZG)*

The TANGO Controls Framework* continues to mature and be adopted by new sites and applications. This paper will describe how TANGO has moved closer to industry with the creation of startups and addressing industrial use cases. It will describe what progress has been made since the last ICALEPCS in 2015 to ensure the sustainability of TANGO for scientific and industrial users. It will present TANGO web based technologies and the deployment of TANGO in the cloud. Furthermore it will describe how the community has re-organised itself to fund and improve code sharing, documentation, code quality assurance and maintenance.

THCPL06 15:15 15

Sustaining the National Ignition Facility (NIF) Integrated Computer Control System (ICCS) over its Thirty Year Lifespan

B.T. Fishler*, Y.W. Abed, A.I. Barnes, G.K. Brunton, M.A. Fedorov, M.S. Flegel, A.P. Ludwigsen, V.J. Miller Kamm, M. Paul, R.K. Reed, E.A. Stout, E.F. Wilson (LLNL)*

The National Ignition Facility (NIF) is the world's largest and most energetic laser experimental facility with 192 beams capable of delivering 1.8 megajoules and 500-terawatts of ultraviolet light to a target. Officially commissioned as an operational facility on March 21, 2009, NIF is expected to conduct research experiments thru 2039. The 30-year lifespan of the control system presents several challenges in meeting reliability, availability, and maintainability (RAM) expectations. As NIF continues to expand on its experimental capabilities, the control system's software base of 3.5 million lines of code grows with most of the legacy software still in operational use. Supporting this software is further complicated by technology life cycles and turnover of senior experienced staff. This talk will present lessons learned and new initiatives related to technology refreshes, risk mitigation, and changes to our software development and test methodology to ensure high control system availability for supporting experiments throughout NIF's lifetime.

12-Oct-17 13:45 – 15:30 Parallel

THCPA — Functional Safety and Machine Protection Systems

Chair: M.T. Heron (DLS)
Co-Chair: A. Ercolani (ESA/ESOC)

THCPA01
13:45 15

Safety Instrumented Systems and the AWAKE Plasma Control as a Use Case

E. Blanco Viñuela, *H.F. Braunmuller, B. Fernández Adiego, R. Speroni (CERN)*

Safety is likely the most critical concern in many process industries, yet there is a general uncertainty on the proper engineering to reduce the risks and ensure the safety of persons or material at the same time of providing the process control system. Some of the reasons for this misperception are unclear requirements, lack of functional safety engineering knowledge or incorrect protection functionalities attributed to the BPCS (Basic Process Control System). Occasionally the control engineers are not aware of the hazards inherent to an industrial process and this causes the lack of the right design of the overall controls. This paper illustrates the engineering of the SIS (Safety Instrumented System) and the BPCS of the plasma vapour controls of the AWAKE R&D project, the first proton-driven plasma wakefield acceleration experiment in the world. The controls design and implementation refers to the IEC61511/ISA84 standard, including technological choices, design, operation and maintenance. Finally, the publication reveals usual difficulties appearing in such kind of industrial installations and the actions to be done to ensure the proper functional safety system design.

THCPA02
14:00 15

ESS Accelerator Safety Interlock System

D. Paulic, *S.L. Birch, M. Mansouri, A. Nordt, Y.K. Sin, A. Toral Diez (ESS)*

Providing and assuring safe conditions for personnel is a key parameter required to operate the European Spallation Source (ESS). The main purpose of Personnel Safety Systems (PSS) at ESS is to prevent workers from the facility's ionising radiation hazards, but also identify as well as mitigate against all other hazards such as high voltage and oxygen depletion. PSS consist of four systems: the Safety interlock system, the Access control system, the ODH monitoring system and the Radiation monitoring system. The Safety interlock system ensures the safety functions of the PSS by interlocking all hazardous equipment for starting the beam operation and powering the RF-powered units. This paper will describe ESS PSS Accelerator Safety interlock system's scope, strategy, functions, methodology and current design and architecture.

THCPA03
14:15 15

Applying Layer of Protection Analysis (LOPA) to Accelerator Safety Systems Design

F. Tao, *J.M. Murphy (SLAC)*

Large accelerator safety system design is complex and challenging. The complexity comes from the wide geographical distribution and the entangled control/protection functions that are shared across multiple control systems. To ensure safety performance and avoid unnecessary overdesign, a systematic approach should be followed when setting the functional requirements and the associated safety integrity. Layer of Protection Analysis (LOPA) is a method in IEC61511 for assigning the SIL to a safety function. This method is well suited for complex applications and is widely adopted in the process industry. The outputs of the LOPA study provide not only the basis for setting safety functions design objective, but also a reference document for managing system change and determining test scope. In this paper, the Safety System for SLAC's LCLS-II is used to demonstrate the application of this semi-quantitative method. This example will illustrate how to accurately assess the hazardous event, analyze the independence of different protection layers, and determine the reliability of a particular protection function.

THCPA04 14:30 15

Development of a Safety Classified System With LabView and EPICS

C.H. Haquin *(GANIL)*

The Spiral2 linear accelerator will drive high intensity beams, up to 5 mA and 200 kW at linac exit. In tuning phase, or when not used by the experimental areas, the beam will be stopped in a dedicated beam dump. To avoid excessive activation of this beam dump, in order to allow human intervention, a safety classified system had been designed to integrate the number of particles dropped in it within each 24 hours time frame. For each kind of beam, a threshold will be defined and as soon as the threshold is reached a beam cut-off will be sent to the machine protection system. This system, called SLAAF: System for the Limitation of the Activation of the beam dump (Arret Faisceau in French) rely on LabView and EPICS (Experimental Physics and Industrial Control) technology. This paper will describe the specification and development processes and how we dealt to meet both functional and safety requirements using two technologies not commonly used for safety classified systems.

THCPA05 14:45 15

Development and Implementation of the Treatment Control System in Shanghai Proton Therapy Facility

M. Liu*, K.C. Chu, C.X. Yin, L.Y. Zhao (SINAP)*

Shanghai Proton Therapy Facility is in the phase of commissioning. We developed the treatment control system in consideration of a plurality of IEC standards. The system is comprised of the irradiation control sub-system (ICS) and the treatment interlock sub-system (TIS). The irradiation flow was implemented and monitored by firmware in ICS, with the benefit of low latency. Hardware based TIS conducts the calculation of interlock logics. The protection of patients and the machine from hazards could be guaranteed by TIS with high reliability. ICS is integrated into the main timing system, and ICS controls treatment-related sequence of the accelerator complex via the timing system. The function of switching treatment rooms is realized by hardware in the timing system. The design philosophy, the safety analysis and the design of critical modules are demonstrated in the paper.

THCPA06 15:00 15

A Real-Time Beam Monitoring System for Highly Dynamic Irradiations in Scanned Proton Therapy

G. Klimpki*, C. Bula, M. Eichin, A.L. Lomax, D. Meer, S. Psoroulas, U. Rechsteiner, D.C. Weber (PSI) D.C. Weber (University of Zurich, University Hospital)*

Patient treatments in scanned proton therapy exhibit dead times, e.g. when adjusting beamline settings for a different energy or lateral position. On the one hand, such dead times prolong the overall treatment time, but on the other hand they grant possibilities to (retrospectively) validate that the correct amount of protons has been delivered to the correct position. Efforts in faster beam delivery aim to minimize such dead times, which calls for different means of monitoring irradiation parameters. To address this issue, we report on a real-time beam monitoring system that supervises the proton beam position and current during beam-on, hence while the patient is under irradiation. For this purpose, we sample 1-axis Hall probes placed in beam-scanning magnets and plane-parallel ionization chambers every 10 µs. FPGAs compare sampled signals against verification tables - time vs. position/current charts containing upper and lower tolerances for each signal - and issue interlocks whenever samples fall outside. Furthermore, we show that by implementing real-time beam monitoring in our facility, we are able to respect patient safety margins given by international norms and guidelines.

THCPA07
15:15 15

Development of an Expert System for the High Intensity Neutrino Beam Facility at J-PARC

K. Nakayoshi*, Y. Fujii, T. Nakadaira, K. Sakashita (KEK)*

A high intensity neutrino beam produced at J-PARC is utilized by the T2K long baseline neutrino oscillation experiment. To generate the high intensity neutrino beam, a high intensity proton beam is extracted from the 30 GeV Main Ring synchrotron to the neutrino primary beamline. In the beamline, one mistaken shot can potentially do serious damage to beamline equipment. To avoid such a consequence, many beamline equipment interlocks which automatically stop the beam operation are implemented. If an interlock is activated, the beam operator references the operation manual, confirms the safety of the beamline equipment and resumes the beam operation. In order to improve the present system, we are developing an expert system for prompt and efficient understanding of the status of the beamline to quickly resume the beam operation. When an interlock is activated, the expert system references previous interlock patterns and infers what happened in the beamline. And the expert system will suggest how to resume the beam operation to the beam operator. We have developed and evaluated this expert system. In this talk, we will report the development status and initial results.

12-Oct-17 16:00 – 16:45 Plenary

THDPL — Experiment Control 2

Chair: G. Cuni (ALBA-CELLS Synchrotron)

Co-Chair: M. Janousch (PSI)

THDPL01 16:00 15

Configuring and Automating an LHC Experiment for Faster and Better Physics Output

***C. Gaspar**, R. Aaij, J. Barbosa, L.G. Cardoso, M. Frank, B. Jost, N. Neufeld, R. Schwemmer (CERN)*

LHCb has introduced a novel online detector alignment and calibration for LHC Run II. This strategy allows for better trigger efficiency, better data quality and direct physics analysis at the trigger output. This implies: running a first High Level Trigger (HLT) pass synchronously with data taking and buffering locally its output; use the data collected at the beginning of the fill, or on a run-by-run basis, to determine the new alignment and calibration constants; run a second HLT pass on the buffered data using the new constants. Operationally, it represented a challenge: it required running different activities concurrently in the farm, starting at different times and load balanced depending on the LHC state. However, these activities are now an integral part of LHCb's dataflow, seamlessly integrated in the Experiment Control System and completely automated under the supervision of LHCb's 'Big Brother'. In total, around 60000 tasks run in the ~1600 nodes of the farm. Load balancing of tasks between activities takes less than 1 second. The mechanisms for configuring, scheduling and synchronizing different activities on the farm and in the experiment in general will be discussed.

THDPL02 16:15 15

GigaFRoST (Gigabyte Fast Read-Out System for Tomography): Control and DAQ System Design

***T. Celcer** (PSI)*

The GigaFRoST (Gigabit Fast Read-out System for Tomography) detector and readout system used at the tomographic microscopy beamline TOMCAT of the Swiss Light Source will be presented. GigaFRoST was built at Paul Scherrer Institute (PSI) and designed to overcome the limitations of existing commercially available high-speed CMOS detectors. It is based on a commercial CMOS fast imaging sensor (pco.dimax) with custom-designed readout electronics and control board. The latter is used for detector configuration, coordination of image readout process and system monitoring. The detector can acquire and stream data continuously at 7.7 GB/s to a dedicated backend server, using two data readout boards, each equipped with two FPGAs, and each directly connected with the server via four 10 Gbit/s fiber optics connections. The paper will focus on the implementation of the EPICS control system, data acquisition (DAQ) system, integration of the detector into the beamline infrastructure and implementation of efficient distribution of TTL triggers between the devices involved in the experiments (i.e. GigaFRoST detector, sample rotation stage, arbitrary external devices).

THDPL03 16:30 15

areaDetector: What's New and What's Next?

***M.L. Rivers** (CARS)*

areaDetector is an EPICS framework for 2-D and other types of detectors that is widely used in synchrotron and neutron facilities. Recent enhancements to the EPICS areaDetector module will be presented. -Plugins can now run multiple threads to significant increase performance -Scatter/gather capability for plugins to run in parallel -ImageJ plugin that uses EPICS V4 pvAccess rather than Channel Access. Provides structured data with atomic update, and better performance than Channel Access plugin. -ImageJ plugin that allows graphically defining detector readout region, ROIs, and overlays. -Plugins can now be reprocessed without receiving a new NDArray for testing effect of different parameters, etc. A roadmap for future developments will also be presented.

12-Oct-17 16:45 – 17:15 Plenary

THMPL — Mini-Oral

Chair: D.J. Nicklaus (Fermilab)
Co-Chair: K.T. Hsu (NSRRC)

THMPL01
16:45

A Simple Temporal Network for Coordination of a Collaborative System-of-Systems in Research Operations With Large Exogenous Uncertainties

M.A. Schaffner *(Sandia National Laboratories)*

The Z Machine is the world's largest pulsed power machine, routinely delivering over 20 MA of electrical current per experiment. The large-scale, multidisciplinary nature of these experiments requires resources and expertise from disparate organizations with independent functions and management, forming a Collaborative System-of-Systems. This structure and the research-oriented nature of experiment preparations create significant challenges in planning and coordinating required activities for a given experiment. The present work demonstrates an approach to scheduling planned activities and presenting information relevant on 'shot day' to aid as an enabling interface between disparate workers, using minimal information to begin forming a Simple Temporal Network (STN). First, a simplified model of an experiment comprising common shot activities is defined, with the minimum physically possible times between those activities described. Latest possible activity times are then derived by using a single operational goal to back-schedule all latest times of when activities must begin to achieve the goal. The resulting product's use in real-time operations and further work are discussed.

THMPL02
16:48

Upgrade of KEK Electron/positron Linac Control System for the Both SuperKEKB and Light Sources

K. Furukawa*, F. Miyahara, M. Satoh (KEK)*

KEK injector linac has delivered electrons and positrons for particle physics and photon science experiments for more than 30 years. It is being upgraded for the SuperKEKB project, which aims at a 40-fold increase in luminosity over the previous project of KEKB, in order to increase our understanding of flavour physics. This project requires ten-times smaller emittance and five-times larger current in injection beam from the injector. And many hardware components are being tested and installed. Even during the 6-year upgrade, it was requested to inject beams into light sources storage rings of PF and PF-AR. Furthermore, the beam demanding approaches from those storage rings are different. SuperKEKB would demand highest performance, and unscheduled interruption may be acceptable if the performance would be improved. However, light sources expect a stable operation without any unscheduled break, mainly because most users run experiments for a short period. In order to deal with the both requirements several measures are taken for operation, construction and maintenance strategy including simultaneous top-up injections.

THMPL03
16:51

A New Simulation Architecture for Improving Software Reliability in Collider-Accelerator Control Systems

Y. Gao*, T.G. Robertazzi (Stony Brook University) K.A. Brown, J. Morris, R.H. Olsen (BNL)*

The Relativistic Heavy Ion Collider (RHIC) complex of accelerators at Brookhaven National Laboratory (BNL) operates using a large distributed controls system, consisting of approximately 1.5 million control points, over 430 VME based control modules, and thousands of server processes. We have developed a new testing platform that can be used to improve code reliability and help streamline the code development process by adding more automated testing. The testing platform simulates the control system using the actual controls system code base but by redirecting the I/O to simulated interfaces. In this report, we will describe the design of the system and the current status of its development.

THMPL04
16:54

Telescope Control System of the ASTRI SST-2M prototype for the Cherenkov Telescope Array

E. Antolini, *M. Bagaglia, G. Nucciarelli, G. Tosti (Università degli di Perugia) L.A. Antonelli, S. Gallozzi, S. Lombardi, M. Mastropietro, V. Testa (INAF O.A. Roma) P. Bruno, G. Leto, S. Scuderi (INAF-OACT) A. Busatta, C. Manfrin, G. Marchiori, E. Marcuzzi (EIE Group s.r.l.) R. Canestrari, G. Pareschi, J. Schwarz, S. Scuderi, G. Sironi, G. Tosti (INAF-Osservatorio Astronomico di Brera) E. Cascone (INAF - Osservatorio Astronomico di Capodimonte) V. Conforti, F. Gianotti, M. Trifoglio (INAF) D. Di Michele, C. Grigolon, P. Guarise (Beckhoff Automation Srl) E. Giro (INAF- Osservatorio Astronomico di Padova) N. La Palombara (INAF - Istituto di Astrofisica Spaziale e Fisica Cosmica di Milano) F. Russo (INAF O.A. Torino)*

The ASTRI SST-2M telescope is a prototype proposed for the Small Size class of Telescopes of the Cherenkov Telescope Array (CTA). The ASTRI prototype adopts innovative solutions for the optical system, which poses stringent requirements in the design and development of the Telescope Control System (TCS), whose task is the coordination of the telescope devices. All the subsystems are managed independently by the related controllers, which are developed through a PC-Based technology and making use of the TwinCAT3 environment for the software PLC. The TCS is built upon the ALMA Common Software framework and uses the OPC-UA protocol for the interface with the telescope components, providing a simplified full access to the capabilities offered by the telescope subsystems for normal operation,testing, maintenance and calibration activities. In this contribution we highlight how the ASTRI approach for the design, development and implementation of the TCS has made the prototype a stand-alone intelligent and active machine, providing also an easy way for the integration in an array configuration such as the future ASTRI mini-array proposed to be installed at the southern site of the CTA.

THMPL05
16:57

Applying Ontological Approach to Storing Configuration Data

M.A. Ilina, *P.B. Cheblakov (BINP SB RAS)*

Control systems of large experimental facilities need a great number of heterogeneous interconnected parameters to control software applications. As configuration information grows in volume, it becomes harder to be maintained manually and poses a potential threat to data integrity. To tackle this problem, we applied ontological approach to storing configuration data. Ontology is a formal representation of concepts and relations of the domain of discourse, enriched by rules for inferring assumed knowledge. We designed the ontology that describes the controlling electronics for the double-direction bipolar transfer line K-500, which transports beam from the Injection Complex to colliders VEPP-4 and VEPP-2000 at BINP, Novosibirsk, Russia. We populated the ontology by importing data from existing configuration files of the control system and developed the interface for querying configuration data. The designed storage has several benefits over the conventional approaches. It maintains heterogeneous objects with non-trivial dependencies in centralized form, performs data verification and can be expanded to the diverse ontology describing all information about the facility.

THMPL06
17:00

Cameras in ELI Beamlines: A Standardized Approach

__B. Plötzeneder__, V. Gaman, O. Janda, P. Pivonka (ELI-BEAMS) P. Bastl (Institute of Physics of the ASCR)

The ELI Beamlines facility is a Petawatt laser facility in the final construction and commissioning phase in Prague, Czech Republic. The central control system connects and controls more than 40 complex subsystems (lasers, beam transport, beamlines, experiments, facility systems, safety systems) with hundreds of cameras. For this, a comprehensive set of standard solutions is provided: Hardware interface standards guarantee ad-hoc software integration, for commonly used models, standardised auxiliary hardware (triggering: optical/TTL, power supplies) is available. Information on key parameters (vacuum compatibility, noise levels) is collected. 95% of cameras are interfaced using an vendor-independent C+±SDK. Exceptions are only made for special detectors (for example: wavefront sensors, x-ray cameras). By using a strict model-based approach and a component-based design, all cameras and 2D-detectors can be controlled with the same C+±API. This leads to standardized GUIs, TANGO-servers,..

THMPL07
17:03

DARUMA: Data Collection And Control Framework For X-Ray Experimental Stations Using MADOCA

__T. Matsumoto__, T. Abe, H. Masunaga (JASRI/SPring-8) Y. Furukawa, T. Matsushita, K. Nakada (JASRI)

In X-ray experimental stations at SPring-8, beamline staff and experimental users sometimes need to reconfigure the measurement system for new experiments. Quick reconfiguration for the system is required and this resulted in elaborated work. Aim of DARUMA is to provide standardized procedure for constructing a flexible system of the data collection and control system for experimental stations. It utilizes the control framework MADOCA II* developed for the distributed control of accelerators and beamlines at SPring-8. Unified control procedure with abstracted text-based messaging helps to reduce significant time and cost for preparing the measurement system. DARUMA provides the applications for 2D detectors such as PILATUS, pulse motor and trigger system used in stations. Image data are collected with metadata into NoSQL database, Elasticsearch. Analysis tools for image such as online monitoring and offline analysis are also provided. User applications can be easily developed with Python and LabVIEW. DARUMA can be flexibly applied to experimental stations and is being implemented into BL03XU at SPring-8. We are also planning to introduce it into other experimental stations.

THMPL08
17:06

SLAC's Common-Platform Firmware for High-Performance Systems

__T. Straumann__, J.M. D'Ewart, J.C. Frisch, G. Haller, R.T. Herbst, B.A. Reese, R. Ruckman, E. Williams (SLAC)

LCLS-II's high beam rate of almost 1MHz and the requirement that several "high-performance" systems (such as MPS, BPM, LLRF, timing etc.) shall resolve individual bunches precludes the use of a traditional software based control system but requires many core services to be implemented in FPGA logic. SLAC has created a comprehensive open-source firmware framework which implements many commonly used blocks (e.g., timing, globally-synchronized fast data buffers, MPS, diagnostic data capture), libraries (Ethernet protocol stack, AXI interconnect, FIFOs, memory etc.) and interfaces (e.g., for timing, diagnostic data etc.) thus providing a versatile platform on top of which powerful high-performance systems can be built and rapidly integrated.

THMPL09 17:09

VME Based Digitizers for Waveform Monitoring System of Linear Induction Accelerator (LIA-20)

E.S. Kotov*, A.M. Batrakov, G.A. Fatkin, A.V. Pavlenko, M.Yu. Vasilyev (BINP SB RAS) G.A. Fatkin,* ***E.S. Kotov****, A.V. Pavlenko, M.Yu. Vasilyev (NSU)*

The Linear Induction Accelerator LIA-20 is being created at the Budker Institute of Nuclear Physics. Waveform monitoring system (WMS) is an important part of LIA-20 control system. WMS includes "slow" and "fast" monitoring subsystems. Three kinds of digitizers have been developed for WMS. "Slow" subsystem is based on ADCx32. This digitizer uses four 8-channel multiplexed SAR ADCs (8 µs conversion cycle) with 12-bit resolution. Main feature of this module is program configurable channel sequencing, which allows to measure signals with different timing characteristics. Two types of digitizers are involved in "fast" subsystem. The first one, ADC4x250-4CH, is 4 channel 250 MSPS digitizer. The second one, ADC4x250-1CH, is single channel digitizer with sample rate of 1 GSPS. Resolution of both devices is 12 bit. "Fast" modules are based on the common hardware. This paper describes hardware and software architecture of these modules.

THMPL10 17:12

New VME-Based Hardware for Automation in BINP

G.A. Fatkin*, A.O. Baluev, A.M. Batrakov, E.S. Kotov, Ya.M. Macheret, V.R. Mamkin, A. Panov, A.V. Pavlenko, A.N. Selivanov, M.Yu. Vasilyev (BINP SB RAS)* ***G.A. Fatkin****, E.S. Kotov, A.V. Pavlenko, M.Yu. Vasilyev (NSU)*

A new VME-based crate and modules are presented in this work. This hardware is primarily intended for LIA-20 control system, but we also plane to use it for the upgrade of the controls of existing complexes such as: VEPP-2000, VEPP-4, VEPP-5 Preinjector. Modules were designed with an ability to be used planned projects such as Super c-tau factory. A crate is 6U VME64x compatible crate with additional synchronization, daisy-chain lines and 6U RIO-modules. Each crate has a built-in status monitoring over CAN-BUS with independent power supply. A family of VME modules is based on the same design sample and include: digitizers, timing modules, CAN-interface module, interlock module. All modules are cost effective and have TANGO device servers developed for them.

THMPA — Mini-Oral

Chair: E. Blanco Vinuela (CERN)

Co-Chair: Y.B. Yan (SSRF)

THMPA01 16:45

The Interlock System of FELiChEM

***Z. Huang**, Y. Song (USTC/NSRL)*

FELiChEM is an infrared free-electron laser user facility under construction at NSRL. The design of the interlock system of FELiChEM is based on EPICS. The interlock system is made up of the hardware interlock system and the software interlock system. The hardware interlock system is constructed with PROFINET and redundancy technology. The software interlock system is designed with an independent configuration file to improve the flexibility. The test results are also described in this paper.

THMPA02 16:48

Investigations of Spatial Process Model for the Closed Orbit Feedback System at the Sis18 Synchrotron at GSI

***S.H. Mirza**, P. Forck, R. Singh (GSI)*

A robust fast closed orbit feedback system is being developed at SIS-18 synchrotron of GSI Darmstadt for usage during acceleration ramp and is investigated concerning the modal structure of orbit response matrix. Singular value decomposition (SVD) is most widely used algorithm for the calculation of corrector strengths. A clear relation between SVD modes and Fourier modes of orbit response matrix has been established for symmetric distribution of BPMs and correctors. The effect of typical operational scenarios such as missing BPMs, incorrect machine model on the efficacy of the feedback system will be demonstrated using both SVD and Fourier analysis with the help of MADX simulations.

THMPA03 16:51

A Simulation System for the European Spallation Source (ESS) Distributed Data Streaming

***C. Reis**, R. Borghes, G. Kourousias, R. Pugliese (Elettra-Sincrotrone Trieste S.C.p.A.)*

European Spallation Source (ESS), the next-generation neutron source facility, is expected to produce an immense amount of data. Various working groups mostly associated with the EU project BrightnESS aim at developing solutions for its data-intensive challenges. The real-time data management and aggregation is among the top priorities. The Apache KAFKA framework will be the base for ESS real-time distributed data streaming. One of the major challenges is the simulation of data streams from experimental data generation to data analysis and storage. This presentation outlines a simulation approach based on the DonkiOrchestra data acquisition and experiment control framework, re-purposed as a data streaming simulation system compatible with the ESS-KAFKA infrastructure.

THMPA04 16:54

RF Energy Management for the European XFEL

***O. Hensler** (DESY)*

The European XFEL is in its commissioning phase at this time. One of the major tasks is to bring up all the 25 installed RF-stations, which will allow for beam energy of up to 17.5GeV. It is expected, that a klystron may fail every 1-2 month. The accelerator is designed at the moment with an energy overhead corresponding to 2-3 RF-station, as the last 4 accelerating modules will be installed in a later stage. This will allow recovering the missing energy with the other functioning RF-stations to keep downtime as short as possible in the order of seconds. The concept and corresponding High-Level software accomplishing this task will be presented in this paper.

THMPA05
16:57

The AFP Detector Control System

L. Seabra *(LIP) E. Banaś, S. Czekierda, Z. Hajduk, J. Olszowska, B. Zabinski (IFJ-PAN) D. Caforio (Institute of Experimental and Applied Physicis, Czech Technical University in Prague) P. Sicho (Czech Republic Academy of Sciences, Institute of Physics)*

The ATLAS Forward Proton (AFP) detector is one of the forward detectors of the ATLAS experiment at CERN aiming at measuring momenta and angles of diffractively scattered protons. Silicon Tracking and Time of Flight detectors are located inside roman pot stations inserted into beam pipe aperture. The AFP detector is composed of two stations on each side of the ATLAS interaction point and is under commissioning. The detector is provided with high and low voltage distribution systems. Each station has vacuum and cooling system, movement control and all the required electronics for signal processing. Monitoring of environmental parameters, like temperature and radiation, is also available. The Detector Control System (DCS) provides control and monitoring of the detector hardware and ensures the safe and reliable operation of the detector, assuring good data quality. Comparing with DCS systems of other detectors, the AFP DCS main challenge is to cope with the large variety of AFP equipment. This paper describes the AFP DCS system: a detector overview, the operational aspects, and the hardware control of the AFP detectors, the high precision movement, cooling, and safety vacuum system.

THMPA06
17:00

Building Controls Applications Using HTTP Services

T. D'Ottavio*, K.A. Brown, A. Fernando, S. Nemesure (BNL)*

This paper describes the development and use of an HTTP services architecture for building controls applications within the BNL Collider-Accelerator department. Instead of binding application services (access to live, database, and archived data, etc.) into monolithic applications using libraries written in C++ or Java, this new method moves those services onto networked processes that communicate with the core applications using the HTTP protocol and a RESTful interface. This allows applications to be built for a variety of different environments, including web browsers and mobile devices, without the need to rewrite existing library code that has been built and tested over many years. Making these HTTP services available via a reverse proxy server (NGINX) adds additional flexibility and security. This paper presents implementation details, pros and cons to this approach, and expected future directions.

THMPA07
17:03

Improvement of Temperature and Humidity Measurement System for KEK Injector Linac

I. Satake *(KEK)*

A temperature and humidity measurement system at the KEK injector linac consists of 26 data loggers connected to around 700 temperature and humidity sensors, one EPICS IOC, and CSS archiver. CSS archiver engine retrieves the temperature and humidity data measured by the data loggers via Ethernet. These data are finally stored into the PostgreSQL based database. A new server computer has been recently utilized for the archiver of CSS version 4 instead of version 3. It can drastically improve the speed performance for retrieving the archived data. The long-term beam stability of linac is getting a quite important figure of merit since the simultaneous top up injection is required for the independent four storage rings toward the SuperKEKB Phase II operation. For this reason, we developed a new archiver data management application with a good operability. Since it can bring the operators a quick detection of anomalous behavior of temperature and humidity data resulting in the deterioration of beam quality, the improved temperature and humidity measurement system can be much effective. We will report the detailed system description and practical application to the daily beam operation.

THMPA08 17:06 ₃

Processing of the Schottky Signals at RHIC

***A. Sukhanov**, K.A. Brown, C.W. Dawson, J.P. Jamilkowski, A. Marusic, J. Morris (BNL)*

Schottky monitors are used to determine important beam parameters in a non-destructive way. In this paper we present improved processing of the transverse and longitudinal Schottky signals from a hi-Q resonant 2.07 GHz cavity and transverse signals from a low-Q 245 MHz cavity with the main focus on providing the real-time measurement of beam tune, chromaticity and emittance during injection and ramp when the beam condition is changing rapidly. The analysis and control is done in python using recently developed interfaces to Accelerator Device Objects.

THMPA09 17:09 ₃

MACUP (Material for data ACquisition - UPgrade): Project Focusing on DAQ Hardware Architecture Upgrade for SOLEIL

***G. Renaud**, Y.-M. Abiven, F. Ta, Q.H. Tran, S. Zhang (SOLEIL)*

Since operation-startup more than 10 years ago, Synchrotron SOLEIL has chosen acquisition architectures that are mainly based on CompactPCI systems. The last few years there has however been an acceleration of obsolescence issues on the CPCI products and it has also been identified that this technology would become a bottleneck in terms of performance for new projects. The MACUP project was therefore created with two main objectives: maintaining the current facility operations by addressing the hardware obsolescence risks, all while searching for alternate high-performance solutions with better embedded processing capabilities to face new challenging requirements. One additional guideline for the project is to facilitate collaborative work for accelerator and beamline projects by evaluating and standardizing a limited set of technologies like the Xilinx ZYNQ SOC, VITA 57 FMC and µTCA standards. This paper describes the adopted methodologies and roadmap to drive this project.

THSH1 — Speakers' Corner

THSH101 17:15 30

Using Control Surfaces to Operate CS-Studio OPIs

C. Rosati *(ESS)*

Modern control software has given us virtually unlimited possibilities for monitoring and controlling EPICS systems, but sacrifices the organic feel of faders and knobs at our fingertips. This article will show how to reclaim that experience without losing the power of software through control surfaces commonly used with DAWs (Digital Audio Workstations) to manipulate audio, demonstrating how real motorised touch-sensitive faders, buttons and assignable V-pots will improve and speed up the control experience.

THSH102 17:45 30

PyDM: A Python-Based Framework for Control System Graphical User Interfaces

M.L. Gibbs*, D.L. Flath, Z.L. Lentz, T.F. Rendahl (SLAC)*

PyDM (Python Display Manager) is a new framework for building control system graphical user interfaces using Python and Qt. It provides a system for the drag-and-drop creation of user interfaces using Qt Designer, and also allows for the creation of displays driven by Python code. PyDM is intended to span the range from simple displays without any dynamic behavior, to complex high level applications, with the same set of widgets. Developers can extend the framework with custom widgets for site-specific tasks, and plug-ins for multiple control systems. The design goals and architecture of PyDM will be presented, as well as examples of PyDM user interfaces intended for use at the Linac Coherent Light Source (LCLS) and LCLS-II at SLAC.

THSH103 18:15 30

Using Color Blindness Simulator During User Interface Development for Accelerator Control Room Applications

S. Aytac *(DESY)*

For normally sighted developers it is hard to imagine how the user interface is going to look to a color blind person. This paper presents the integration of color blindness simulators into the development process of user interfaces. At the end we discuss the main contributing factors.

12-Oct-17 17:15 – 18:45 Speakers' Corner 2

THSH2 — Speakers' Corner

THSH201 17:15 30

Integration of MeerKAT and SKA telescopes using KATCP <-> Tango Translators

***N. Marais**, K. Madisa, A.J.T. Ramaila, L. Van den Heever (SKA South Africa, National Research Foundation of South Africa)*

The MeerKAT radio telescope control system uses the KATCP protocol and technology stack developed at SKA SA. The future SKA project chose the TANGO controls technology stack. However, MeerKAT and phase 1 of the SKA-mid telescope are intimately related: SKA-mid will be co-located with MeerKAT at the SKA SA Karoo site; the first SKA-mid prototype dishes will be tested using MeerKAT systems; MeerKAT will later be incorporated into SKA-mid. To aid this interoperation, TANGO to KATCP and KATCP to TANGO translators were developed. A translator process connects to a device server of protocol A, inspects it and exposes an equivalent device server of protocol B. Client interactions with the translator are proxied to the real device. The translators are generic, needing no device-specific configuration. While KATCP and TANGO share many concepts, differences in representation fundamentally limits the abilities of a generic translator. Experience integrating TANGO devices into the MeerKAT and of exposing MeerKAT KATCP interfaces to TANGO based tools are presented. The limits of generic translation and strategies for handling complete use cases are discussed.

THSH202 17:45 30

Design and Implementation of the LLRF System for LCLS-II

***M. Boyes**, A.L. Benwell, G.W. Brown, A. Ratti (SLAC) R. Bachimanchi, C. Hovater (JLab) B.E. Chase, E. Cullerton, J. Einstein (Fermilab) L.R. Doolittle, G. Huang, C. Serrano (LBNL)*

The SLAC National Accelerator Laboratory is building LCLS-II, a new 4 GeV CW superconducting (SCRF) linac as a major upgrade of the existing LCLS. The SCRF linac consists of 35 ILC style cryomodules (eight cavities each) for a total of 280 cavities. Expected cavity gradients are 16 MV/m with a loaded QL of ~ 4 x 10^7. Each individual RF cavity will be powered by one 3.8 kW solid state amplifier. To ensure optimum field stability a single source single cavity control system has been chosen. It consists of a precision four channel cavity receiver and two RF stations (Forward, Reflected and Drive signals) each controlling two cavities. In order to regulate the resonant frequency variations of the cavities due to He pressure, the tuning of each cavity is controlled by a Piezo actuator and a slow stepper motor. In addition the system (LLRF-amplifier-cavity) was modeled and cavity microphonic testing has started. This paper will describe the main system elements as well as test results on LCLS-II cryomodules.

THSH203 18:15 30

Internet of Things (IoT): Wireless Diagnostics Solutions

***R. Homs-Puron**, S. Astorga, G. Cuní, D. Fernández-Carreiras, O. Matilla, A. Rubio (ALBA-CELLS Synchrotron) R. Montaño (ESS)*

ALBA has some diagnostics needs to be covered; mainly temperature acquisition in several different locations around the facility: inside tunnel, service area, experimental area, laboratories and auxiliary facilities. There is a big area to be covered and the measurable points are variable in the time and they have a strong correlation with the machine startup configuration. This has a sizable impact on traditional cabled installation, generated by the huge numbers of measurement points to be covered, in addition, the restricted Machine access schedule difficults more their installation. One solution based on wireless sensors, will help us to identify which points must be added to the interlock system (Equipment Protection System*). For that reason we decide to evaluate different wireless technologies nowadays living in the market (Zigbee, WiFi). In this paper we will describe our investigation and its results after the comparison of three technologies: WiFi (ESP8266), Zigbee (Xbee Pro S2B) and Ethernet (Raspberry Pi family).

THSH3 — Speakers' Corner

THSH301 17:15 30

ADStream Module

B.L. Hill *(SLAC)*

ADStream makes it easy to configure an areaDetector camera IOC for one or more image streams, each of which has it's own dedicated stdArray, ROI, CC, Overlay, Process and V4 NTNDArray plugin, along w/ some extra PV's to characterize the stream type, input source, height, width, and desired update rate. You can also do image averaging, and view and adjust 4 crosses and 4 ROI overlay boxes. The overlays have calc records to handle binning differences between streams. A python script is used to reconfigure each stream's plugin chain as needed to produce the desired result.

THSH302 17:45 30

1000 Things you always want to know about SSO but you never dared to ask!

L. Rodriguez *(CERN)*

How many times you were in a meeting with a sales person and you start to sweat when you hear "yes the system will be fully integrated with your SSO"? How many times have you searched on internet for "SSO" and you closed your browser after the second click? SAML, OAUth, ws-fed… which of these is the right protocol? Shibboleth, OpenAM, ADFS2, CAS… do I need all of them? Do I need them at all? Which is the right solution to my application? How to protect my APIs? This session wants to cover the most popular SSO scenarios and it will guide you in the sometimes obscure path to the "login once and access all" grail.

THSH303 18:15 30

CS-Studio Display Builder

K.-U. Kasemir *(ORNL) M.L. Grodowitz (ORNL RAD)*

The Display Builder started as a comprehensive update to the CS-Studio BOY panel editor and runtime. The design was changed to a modular approach, separating the model of widgets and their properties from the graphical representation and the runtime. The model is fully multithreaded. The representation has been demonstrated in both SWT and JavaFX, for now intending to concentrate on the latter. The runtime, based on the thread-safe model, avoids user thread delays and improves overall performance for complex widgets like images as well as scripts and rules. We present the current state of the development and initial deployments at beam lines of the Oak Ridge National Laboratory Spallation Neutron Source.

13-Oct-17 08:30 – 09:15 Plenary

FRKPL — Keynote Speaker

Chair: K. Furukawa (KEK)

FRKPL01 08:30 45

The Birth of the Gravitational Wave Astronomy

E. Coccia *(LNGS)*

Prof. Eugenio Coccia is the founder of the School of Advanced Studies GSSI (Gran Sasso Science Institute) and its Rector since 2016. He is a physicist with expertise on astroparticle physics, with a focus on gravitational wave experiments. He is recognized for the development of cryogenic detectors of gravitational waves and is one of the authors of the recent discovery of gravitational waves and of the first observation of Black Holes. He has been Full Professor at the Università di Roma Tor Vergata (2000-2016), Chair of the INFN Scientific Committee on Astroparticle Physics (2002-2003), Director of the INFN Gran Sasso Laboratory (2003-2009), President of the Italian Society of General Relativity and Gravitational Physics (2000-2004), Chair of the Gravitational Wave International Committee (GWIC) (2011-2015), among other responsibilities. He has given lectures and seminars in Universities and research centers all over the world and is the author of about 300 scientific articles in international journals and editor of six books in the field of astroparticle physics. He is member of the Academia Europaea, honoris causa, and Fellow of the European Physical Society.

13-Oct-17 09:15 – 11:00 Plenary

FRAPL — Project Status Report 2

Chair: J.F. Maclean (ANL)

Co-Chair: D.P. Spruce (MAX IV Laboratory, Lund University)

`FRAPL01` 09:15 15

Status of the Square Kilometre Array

***J. Santander-Vela**, L. Pivetta, N.P. Rees (SKA Organisation)*

The Square Kilometre Array (SKA) is a global project to build a multi-purpose radio telescope that will play a major role in answering key questions in modern astrophysics and cosmology. It will be one of a small number of cornerstone observatories around the world that will provide astrophysicists and cosmologists with a transformational view of the Universe. Two major goals of the SKA is to study the history and role of neutral Hydrogen in the Universe from the dark ages to the present-day, and to employ pulsars as probes of fundamental physics. Since 2008, the global radio astronomy community has been engaged in the development of the SKA and is now nearing the end of the 'Pre-Construction' phase. This talk will give an overview of the current status of the SKA and the plans for construction, focusing on the computing and software aspects of the project..

`FRAPL02` 09:30 15

Commisioning and Calibration of the Daniel K. Inouye Solar Telescope

***C.J. Mayer**, B.D. Goodrich, W. McBride (Advanced Technology Solar Telescope, National Solar Observatory)*

The Daniel K. Inouye Solar Telescope (DKIST) is currently under construction on the summit of Haleakala on the island of Maui. When completed in late 2019 it will be the largest optical solar telescope in the world with a 4m clear aperture and a suite of state of the art instruments that will enable our Sun to be studied in unprecedented detail. In this paper we describe the current state of testing, commissioning and calibration of the telescope and how that is supported by the DKIST control system.

`FRAPL03` 09:45 15

Status of the Control System for the SACLA/SPring-8 Accelerator Complex

***T. Fukui**, N. Hosoda (RIKEN SPring-8 Center, Innovative Light Sources Division) A. Gimenez (RIKEN) M. Ishii, Y. Ishizawa, K. Okada, C. Saji, T. Sugimoto, M.T. Takeuchi (JASRI/SPring-8) H. Maesaka, T. Ohshima (RIKEN SPring-8 Center) T. Maruyama, M. Yamaga (RIKEN/SPring-8)*

At the SPring-8 site, the X-ray free electron laser facility, SACLA, and the third generation light source, SPring-8 storage ring, is operated. The SACLA generate brilliant coherent X-ray beams with wavelength of below 0.1nm and the SPring-8 provides brilliant X-ray to large number of experimental users. On the SPring-8 upgrade project we have a plan to use the linac of SACLA for a full-energy injector. For this purpose, two accelerators should be controlled seamlessly and the SACLA has to operate as to generate X-ray laser and injector for the SPring-8 simultaneously. We start the design of control system to meet those requirements. We redesign all of a control framework such as Database, Messaging System and Equipment Control include with NoSQL database, MQTT and EtherCAT. In this paper, we will report the design of control system for SACLA/SPring-8 together with status of the SPring-8 upgrade project.

`FRAPL04` 10:00 15

Diagnostics and Instrumentation Challenges at LCLS-II

***P. Krejcik** (SLAC)*

LCLS-II is the new superconducting linac-based hard x-ray free electron laser at SLAC and poses a significant new challenge for diagnostics and instrumentation over the present LCLS-I copper linac facility. LCLS-II operates in CW mode with a bunch repetition rate of 1 MHz compared to the pulsed 120 Hz operation at LCLS-I. Tuning and optimization of the beam requires single bunch measurement of beam parameters at up to the full beam rate. We rely on FPGA-based embedded controls and data processing to handle this high bandwidth of data. The presentation will give an overview of the major global systems including the timing and machine protection systems as well as detailing the individual diagnostics for beam position, bunch length, beam size and FEL output required for tuning the machine.

FRAPL05
10:15 15

Hardware Architecture of the ELI Beamlines Control and DAQ System

P. Bastl *(Institute of Physics of the ASCR) V. Gaman, O. Janda, P. Pivonka, B. Plötzeneder, J. Sys, J. Trdlicka (ELI-BEAMS)*

The ELI Beamlines facility is a Petawatt laser facility in the final construction and commissioning phase in Prague, Czech Republic. End 2017, a first experiment will be performed. In the end, four lasers will be used to control beamlines in six experimental halls. The central control system connects and controls more than 40 complex subsystems (lasers, beam transport, beamlines, experiments, facility systems, safety systems), with high demands on network, synchronisation, data acquisition, and data processing. It relies on a network based on more than 15.000 fibres, which is used for standard technology control (PowerLink over fibre and standard Ethernet), timing (WhiteRabbit) and dedicated high-throughput data acquisition. Technology control is implemented on standard industrial platforms (B&R) in combination with uTCA for more demanding applications. The data acquisition system is interconnected via Infiniband, with an option to integrate OmniPath. Most control hardware installations are completed, and many subsystems are already successfully in operation. An overview and status will be given.

FRAPL06
10:30 15

The Laser MegaJoule Facility Control System Status Report

H. Durandeau *(CEA)*

The Laser MegaJoule (LMJ) is a 176-beam laser facility, located at the CEA CESTA Laboratory near Bordeaux (France). It is designed to deliver about 1.4 MJ of energy to targets, for high energy density physics experiments, including fusion experiments. The first 8-beams bundle was operated in October 2014 and a new bundle was commissioned in October 2016. The next two bundles are on their way. There are three steps for the validation of a new bundle and its integration to the existing control system. The first step is to verify the ability of every command control subsystems to drive the new bundle using a secondary independent supervisory. It is performed from a dedicated integration control room. The second is to switch the bundle to the main operations control room supervisory. At this stage, we perform the global system tests to validate the commissioning of the new bundle. In this paper we focus on the switch of a new bundle from the integration control room to the main operations control room. We have to connect all equipment controllers of the bundle to the operations network and update the Facility Configuration Management.

FRAPL07
10:45 15

The ESRF's Extremely Bright Source - a 4th Generation Light Source

J.M. Chaize*, R. Bourtembourg, F. Epaud, A. Götz, F. Poncet, J.L. Pons, E.T. Taurel, P.V. Verdier (ESRF)*

After 20 years of operation, the ESRF has embarked upon an extremely challenging project - the Extremely Brilliant Source (ESRF - EBS) . The goal of this project is to construct a 4th generation light source storage ring inside the existing 844m long tunnel. The EBS will increase the brilliance and coherence by a factor of 100 with respect to the present ESRF storage ring. A major challenge is to keep the present ring operating 24x7 while designing and pre-constructing all the elements of the new ring. This is the first time a 4th generation light source will be constructing inside an existing tunnel. This paper concentrates on the control system aspects. The control system is 100% TANGO based. The paper will list the main challenges of the new storage ring like the Hot Swap Powersupply, the new timing system, how reliable operation was maintained while modernizing the injector control system and preparing the new storage ring control system, the new historical database, and how extensive use was made of software simulators achieve this.

13-Oct-17 11:30 – 12:15 Plenary

FRBPL — Workshops Summary

Chair: O. Matilla (ALBA-CELLS Synchrotron)

FRBPL01 11:30

EPICS Satellite Meeting

T. Korhonen *(ESS)*

EPICS (Experimental Physics and Industrial Control System) is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes, experiment beam lines and other large scientific experiments. The EPICS collaboration meeting provides an opportunity for developers and managers from the various different sites to come together and discuss their work in progress and make plans for the future. They give a chance to see what is being done at other laboratories, and to review the specifications for new tools or enhancements to existing ones in order to maximize their usefulness to the whole community and avoid duplication of effort. Topics that will be addressed: - The upcoming EPICS 7 release - Project status reports -User Interface tools - Technical presentations from EPICS users.

FRBPL02 11:34

White Rabbit Tutorial Workshop

J. Serrano *(CERN)*

White Rabbit (WR) is a multi-laboratory, multi-company collaboration to design open source hardware, gateware and software in the field of distributed hard real-time controls and data acquisition systems. The core of these systems is a WR network, which features sub-ns synchronization with fiber delay compensation and a guaranteed upper bound in message latency. WR is a backwards compatible extension of Ethernet and IEEE 1588 (aka Precise Time Protocol). The WR collaboration typically conducts workshops where users and core developers present their progress and applications. In this ICALEPCS pre-conference workshop, we would like to take a slightly different approach. We would like to make this a tutorial workshop, meaning that somebody who has never been exposed to WR technology should walk out of the workshop with a very good idea of how to use WR to solve real life problems, having seen real WR gear in action. We would also like to cater for experienced WR users by providing several examples of WR applications in domains they may not have tackled yet, and by including advanced material at the end of the day.

FRBPL03 11:38

TANGO Workshop

A. Buteau *(SOLEIL)*

This workshop will give a general overview of the TANGO control system framework and its different aspects including latest developments. The following general topics will be covered: - General overview of Tango concepts - Latest developments - New features in tools - PyTango and ITango-RestApi & Cloud. The TANGO virtual machine will be used to demonstrate the following: - Designing a simple TANGO device server, developing the code, debugging and deploying it - Configuring properties, attribute properties, events, polling, archiving - Accessing it from generic clients. ATK, JDraw, Taurus, ITango, RestApi Finally there will be a session dedicated to installing TANGO on your own laptop or computer.

FRBPL04 11:42

PLC Based Control Systems

E. Blanco Viñuela *(CERN)*

This workshop intends to create a collaborative space where attendees will show their best practices, tools employed and return of experience when engineering PLC based control systems. This time the workshop focuses specifically the management of the control applications. Precise topics that will be addressed: - Specifications, requirements trace, documents: analysis, design, implementation - Software development: standards and/or frameworks, novel paradigms (e.g. automatic code generation, object orientation), language choice and coding conventions, best practices. - Testing and verification: methodologies and tests (FAT, SAT), simulation, static analysis, verification (e.g. formal methods) - Application management: versioning, deployment, online changes, upgrades, reverse engineering

FRBPL05
11:46

HDF5 and Data Format

E.I. Pourmal *(The HDF Group)*

During ICALEPCS 2015 it became clear that HDF5 is the de facto standard in the controls and acquisition field for storing large datasets. This workshop builds on the success of the last HDF5 workshop at ICALEPCS 2015. The HDF group will present training tutorials on HDF5 basics including tools, performance tuning and new features. The workshop will discuss recent developments in HDF5 and the experiences and plans of different sites, using the HDF5 library to record and store data and associated metadata. Topics to be addressed include: - HDF5 on multiple-platforms and multiple versions - Use of additional definition standards like NeXus - New tools like HDFql, news on h5py, viewers, 3rd party libraries - Tuning and optimising for High Performance detector systems and HPC - Experiences and plans for use of new features such as Single Writer Multiple Reader (SWMR), Virtual Dataset (VDS) and Direct Chunk Write.

FRBPL06
11:50

Control System Cybersecurity Workshop

S. Lüders *(CERN)*

Today's accelerator and detector control systems do not differ significantly from the control systems used in industry or devices being part of the "Internet-of-Things"(IoT). Modern Information Technologies(IT) are commonly used, control systems are based more and more on common-of-the-shelf hardware/ software(VME crates,PLCs,VxWorks,LynxOS,network switches,networked controls hardware,SCADA,commercial middleware,etc.) or Windows/Linux PCs. Furthermore, due to the academic freedom in the High Energy Physics community, control systems are produced in a wide, decentralized community, which leads to heterogeneous systems and often necessitates remote access. With this adoption of modern IT standards, control systems are also exposed to the inherent vulnerabilities of the corresponding hardware and software. The consequences of a security breach in an accelerator or detector control system might be severe, and attackers won't ignore HEP systems just because it's HEP. The series of (CS)2/HEP workshops is intended to share and discuss counter-measures, to review configuration and development procedures for secure control systems, and to review the progress since the last (CS)2/HEP workshop

FRBPL07
11:54

Motion Control Workshop

Y.-M. Abiven

The ICALEPCS MOCRAF workshop group has been created on www. MOCRAF.org to discuss about the organization of the ICALEPCS Motion Control pre-conference Workshop. Its purpose is to get feedback from attendees to make the workshop as interesting and as pleasurable as possible. This group will remain alive after the workshop to be the input for the future ICALEPCS MOCRAF meeting. The aim of the workshop is to be helpful to you the community and so we welcome input (*) on the content and style. After the previous workshop in at ICALEPCS in Melbourne it was suggested that more time should be put aside for interactive group discussions. We are proposing two talks per session each of around 15 to 20 minutes leaving 50 - 60 minutes for relevant discussion topics.

FRBPL08 11:58

Sardana - Scientific SCADA Suite

Z. Reszela

Sardana (www.sardana-controls.org) is an open source, python software suite for Supervision, Control and Data Acquisition in scientific installations. This workshop will demonstrate how to build a complete laboratory control system from scratch. After a quick guide on how to install and configure the Sardana system the workshop participants will start from learning the generic interfaces of the most common laboratory equipment exposed by the device Pool. Afterwards some practical example of how to integrate a new hardware into Sardana will be demonstrated. In continuation a basic course on how to write and execute the user procedures, called macros, will be given. Finally, it will be demonstrated how easy it is to build a modern and flexible graphical interface to the laboratory instruments using Taurus library (www.taurus-scada.org). Furthermore an example on how to mix different data sources in the same GUI will be shown with the how to write a custom Taurus scheme tutorial.

FRBPL09 12:02

User Experience in MicroTCA

T. Walter *(DESY)*

This workshop will introduce different applications and uses of MicroTCA standard in accelerators and large experimental physics control systems. Topics that will be addressed: - MicroTCA: Introduction to the Standard and latest news on European XFEL - Kay Rehlich (DESY) - MicroTCA in Real Life: Thomas Holzapfel (Powerbridge, on behalf of N.A.T.) - Implementation of MicroTCA for Beam Diagnostics and Synchronization (Matthias Felber (DESY) - Scalability of MicroTCA.4 Systems (Thomas Holzapfel, Powerbridge)

FRBPL10 12:06

MRF Timing Protocol Users Workshop

E. Björklund *(LANL)*

This workshop is for users of event-based timing systems implementing the Micro Research Finland (MRF) protocols and interfaces. This would include (but is not limited to) products from MRF, SINAP, and Instrument Technologies. The content of the workshop will depend on the submissions received, but could include: - New hardware product announcements - Report on open FPGA hardware platform - New software development reports - User experience and status reports - New feature requests (hardware and software).

13-Oct-17 12:15 – 13:15 Plenary

FRXPL — Closing Remarks

Chair: A. Gotz (ESRF)

FRXPL01 12:15 15

ICALEPCS 2019

K.A. Brown *(BNL)*

FRXPL02 12:30 15

ICALEPCS 2021

D. Fernández-Carreiras *(ALBA-CELLS Synchrotron)*

Update on the ICALEPCS 2021 venue selection.

FRXPL03 12:45 15

Final Remarks

D. Fernández-Carreiras *(ALBA-CELLS Synchrotron)*

Thank you for attending ICALEPCS 2017 in Barcelona! Looking forward seeing you in ICALEPCS 2019.

10-Oct-17 16:45 – 19:00 Hall

TUPHA — Poster Session

TUPHA001 Research on Fault Diagnosis of Power Supply Control System on BEPCII

***D. Wang**, J. Liu, X.L. Wang (IHEP)*

The reliable and stable operation of the accelerator is the premise and foundation of physics experiments. For example, in the BEPCII, the fault of the magnet power supply front-end electronics devices may cause accelerator energy instability and even lead to beam loss. Therefore, it is very necessary to diagnose and locate the device fault accurately and rapidly, that will induce the high cost of the accelerator operation. Faults diagnosis can not only improve the safety and reliability of the equipment, but also effectively reduce the equipment's cycle costing. The multi-signal flow model proposed by Pattipati K.R is considered as the preferred method of industrial equipment faults detection. However, there are still some problems about fault probability conflict in the processing of correlation matrix diagnosis due to the hierarchical nature of multi-signal flow modeling. Thus we develop the fault diagnosis strategy based on the important prior knowledge of the fault. This method is applied to the front-end electronic devices of BEPCII magnet power supply control system and improves the fault diagnosis and analysis ability of magnet power supply control system.

TUPHA003 How to Recycle a Synchrotron, or What to Do With Equipment When Synchrotron Is Retiring or Going Through a Major Upgrade? BDN NSLS2 Project Status.

***O. Ivashkevych**, J. Adams, G.L. Carr, L.C. De Silva, S. Ehrlich, M. Fukuto, R. Greene, C.A. Guerrero, J. Ma, G. Nintzel, P. Northrup, D. Poshka, R. Tappero, Z. Yin (BNL)*

With many synchrotron facilities retiring or going through upgrades, what is the future of the some of the state-of-the-art equipment and the beamlines built for a specific science at these older facilities? Can the past investments continue supporting the current scientific mission? Beamlines Developed by NSLS2 (BDN) started in 2013 as the NxtGen project prior to NSLS last light on September, 30 2014. Hundreds of pieces of equipment still scientifically useful and valuable have been collected, packed and stored to become part of the new beamlines at the NSLS2 complex. CMS and TES beamlines were built in 2016 in 6 month from bare hutches to the First Light and are already doing user science. QAS, XFM, FIS/MET are taking first light in late 2017/early 2018 and users in 2018. Repurposed components have been fitted with standard NSLS2 EPICS based control systems, Delta Tau motion controllers, digital imaging. Intensity monitors and diagnostics have been equipped with new electronics. Data collection is performed via home grown customizable, beamline specific Bluesky Data Acquisition System. Status of the project and an overview of controls efforts will be presented.

TUPHA004 Procedures of Software Integration Test and Release for ASTRI SST-2M Prototype proposed for the Cherenkov Telescope Array

***V. Conforti**, A. Bulgarelli, V. Fioretti, F. Gianotti, G. Malaguti, M. Trifoglio (INAF) E. Antolini (Università degli di Perugia) L.A. Antonelli, S. Gallozzi, S. Lombardi, F. Lucarelli, M. Mastropietro, V. Testa (INAF O.A. Roma) M. Bartolini, A. Orlati (INAF - IRA) P. Bruno, A. Costa, A. Grillo, F. Vitello (INAF-OACT) R. Canestrari, J. Schwarz, S. Scuderi, S. Vercellone (INAF-Osservatorio Astronomico di Brera) O. Catalano, P. Sangiorgi (INAF IASF Palermo) F. Russo (INAF O.A. Torino) G. Tosti (INFN-PG)*

The Cherenkov Telescope Array (CTA) project is an international initiative to build a next generation ground-based observatory for very high energy gamma-rays.

Three classes of telescopes with different dish size will be located in the northern and southern hemispheres. The ASTRI mini-array of CTA pre-production is one of the small sized telescopes mini-arrays proposed to be installed at the CTA southern site. The ASTRI mini-array will consist of nine units based on the end-to-end ASTRI SST-2M prototype already installed on Mt. Etna (Italy). The Mini-Array Software System (MASS) supports the end to end ASTRI SST-2M prototype and mini-array operations. The ASTRI software integration team defined the procedures to perform effectively the integration test and release activities. The developer has to use properly the repository tree and branches according to the development status. We require that the software includes also specific sections for automated tests and that the software is well tested (in simulated and real system) before any release. Here we present the method adopted to release the first MASS version to support the ASTRI SST-2M prototype test and operation activities.

TUPHA005 **Virtual Model Environment for the Sirius High Dynamics DCM**

***G.B.Z.L. Moreno**, R.M. Caliari, R.R. Geraldes, L. Sanfelici (LNLS)*

The monochromator is known to be one of the most critical optical elements of a synchrotron beamline. It directly affects the beam quality with respect to energy and position, demanding high stability performance and fine position control. The new high-dynamics DCM (Double-Crystal Monochromator) [1] prototyped at the Brazilian Synchrotron Light Laboratory (LNLS), was designed for the future X-ray undulator and superbend beamlines of Sirius, the new Brazilian 4th generation synchrotron [2]. At this kind of machine, the demand for stability is even higher, and conflicts with factors such as high power loads, power load variation, and vibration sources. To accelerate the commissioning process of new Monochromators in Sirius, while preserving equipment and resources, a virtual DCM model environment is outlined. This model is designed in MATLAB/Simulink environment, which is the same environment used for the system identification, control design, and Hardware-in-the-Loop tests [3]. The virtual model enables the offline simulation of new off-the-shelf equipment, also without the need for a Simulink RT target machine, reducing risks and enabling flexibility.

TUPHA006 **Automation of the Software Production Process for Multiple Cryogenic Control Applications.**

***C.F. Fluder**, M. Pezzetti, A. Tovar González (CERN) P. Plutecki (AGH University of Science and Technology) T. Wolak (AGH)*

The development of process control systems for the cryogenic infrastructure at CERN is based on an automatic software generation approach. The overall systems' complexity, frequent evolution as well as the extensive use of databases, repositories, commercial engineering software and CERN frameworks have led to complete automation of building control software projects. Consequently, the Continuous Integration practice has been applied, integrating all software production tasks, tools and technologies. Thanks to this solution, the production and maintenance of the control software for multiple cryogenic applications have become more reliable, while significantly reducing the required time and effort. As a result, a large number of process control system upgrades have been successfully performed for the LHC Tunnel cryogenic. Besides, the concept has become a process control software development guideline for new cryogenic systems. This paper presents the software production methodology as well as the summary of several years of experience with enhanced automatic cryogenic control software production, already implemented in the LHC Tunnel and cryogenic test facilities infrastructure.

TUPHA007 SOLEIL and SYMETRIE Company Collaborate to Build Tango Ready in-Vacuum Diffractometer

__Y.-M. Abiven__, G. Ciatto, P. Fontaine, S. Zhang (SOLEIL) AL. Anthony, O. Dupuy, P. Noire, T. Roux (SYMETRIE)

Two years ago, SOLEIL (France) and MAXIV(Sweden) synchrotron light sources started a joint project to partially fund two similar in-vacuum diffractometers to be installed at the tender X-ray beamlines SIRIUS and FemtoMAX . SOLEIL diffractometer, manufactured by the French company SYMETRIE* and complementarily funded by a <Ile de France> region project (DIM Oxymore) gathering SIRIUS beamline and other laboratories, features an in-vacuum 4-circles goniometer and two hexapods. The first hexapod is used for the alignment of the vacuum vessel, and the second one for the alignment of the sample stage which is mounted on the 4-circles diffractometer. In order to integrate efficiently this complex mechanical experimental station into SOLEIL control architecture based on TANGO and DeltaTau motion controller, SOLEIL and SYMETRIE work in a close collaboration. Synchronization of the different elements of the diffractometer is a key issue in this work to get a good sphere of confusion thanks to corrections done by the in vacuum hexapod. This paper details this collaboration, status of the project in terms of control system capabilities and the results of the first tests.

TUPHA008 Software Quality Assurance for the Daniel K. Inouye Solar Telescope Control Software

__A. Greer__, A. Yoshimura (OSL) B.D. Goodrich, S. Guzzo, C.J. Mayer (Advanced Technology Solar Telescope, National Solar Observatory)

The Daniel K. Inouye Solar Telescope (DKIST) is currently under construction in Hawaii. The telescope control system comprises a significant number of subsystems to coordinate the operation of the telescope and its instruments. Integrating delivered subsystems into the control framework and managing existing subsystem versions requires careful management, including processes that provide confidence in the current operational state of the whole control system. Continuous software Quality Assurance provides test metrics on these systems using a Testing Automation Framework (TAF), which provides system and assembly test capabilities to ensure that software and control requirements are met. This paper discusses the requirements for a Quality Assurance program and the implementation of the TAF to execute it.

TUPHA009 A Motion Systems Support Model in the Australian Synchrotron

__N. Afshar__ (ANSTO) R. Clarken, J.T. Cornes (ASCo) P. Martin (SLSA) W.N. Rambold (SLSA-ANSTO)

Deployment and maintenance processes for PMAC motion systems are reviewed and improved in the past three years using systems engineering methods. Subsystems and components are identified and analyzed for four distinct motion application classes of User commissioned, Basic, Advanced and Special Motion Systems. Processes are improved by reduction and simplification of component and resource dependencies based on application classes, and time and resources constraints in the Australian Synchrotron. As a result, significant improvements in effort and delivery time as well as service quality are recorded for deploying, upgrading and maintenance. Operations are easier to plan and more efficiently executed based on the resulted processes.

TUPHA010 Towards a Common Reliability & Availability Information System for Particle Accelerator Facilities

***K. Höppner**, Th. Haberer, A. Peters (HIT) J. Gutleber (CERN) H. Humer (AIT) A. Niemi (Tampere University of Technology)*

Failure event and maintenance record based data collection systems have a long tradition in industry. Today, the particle accelerator community does not possess a common platform that permits storing and sharing reliability and availability information in a technically efficient way. In large particle accelerator facilities used for fundamental physics research, each machine is unique, the scientific culture, work organisation, management structures and best-effort resource allocations often incompatible with a streamlined industrial approach. Other accelerator facilities enter the area of industrial process improvement, like medical accelerators due to legal requirements and constraints. The Heidelberg Ion Beam Therapy Center and CERN decided to explore the technical and organisational requirements for a community-wide information system on accelerator system and component reliability and availability. This initiative is part of the H2020 project ARIES, starting in May 2017. We will present the technical scope of the planned system that is supposed to access and obtain statistical information on reliability in ways not compromising the information suppliers and system producers.

TUPHA011 A New Distributed Control System for the Consolidation of the CERN Tertiary Infrastructures.

***L. Scibile**, C. Martel (CERN)*

The operation of the CERN tertiary infrastructures is carried out via a series of control systems distributed over the CERN sites. The scope comprises: 260 buildings, 2 large heating plants with 27 km heating network and 200 radiators circuits, 500 Air Handling Units, 52 chillers, 300 split systems, 3000 electric boards and 100k light points. With the infrastructure consolidations, CERN is carrying out a migration and an extension of the old control systems dated back to the 70's, 80's and 90's to a new simplified, yet innovative, distributed control system aimed at minimizing the programming and implementation effort, standardizing equipment and methods and reducing lifecycle costs. This new methodology allows for a rapid development and simplified integration of the new controlled infrastructure processes. The basic principle is based on open standards PLC technology that allows to easily interface to a large range of proprietary systems. The local and remote operation and monitoring is carried out seamlessly with Web HMIs that can be accessed via PC, touchpads or mobile devices. This paper reports on the progress and future challenges of this new control system.

TUPHA012 New Control System for LAPECR2

***J.J. Chang**, S. An, L. Ge, J.K. Liu, X.J. Liu, P.P. Wang, M. Yue, W. Zhang, Y.B. Zhou (IMP/CAS)*

Lanzhou All Permanent magnet ECR ion source No.2(LAPECR2) is the ion source for 320 kV HV platform. Its old control system has been used for nearly 12 years and some problems has been gradually exposed and affected its daily operation. A set of PLC from Beckhoff company is in charge of the control of magnet power supplies, diagnostics and motion control. EPICS and Control System Studio(CSS) as well other packages are used in this facility as the control software toolkit. Based on these state-of-the-art technologies on both hardware and software, this paper designed and implemented a new control system for LAPECR2. After about half a year of running, the new control reflects its validity and stability in this facility.

TUPHA013 Accelerator Fault Tracking at CERN

***C. Roderick**, L. Burdzanowski, D. Martin Anido, S. Pade, P. Wilk (CERN)*

CERNs Accelerator Fault Tracking (AFT) system aims to facilitate answering questions like: "Why are we not doing Physics when we should be?" and "What can we do to increase machine availability?" People have tracked faults for many years, using numerous, diverse, distributed and un-related systems. As a result, and despite a lot of effort, it has been difficult to get a clear and consistent overview of what is going on, where the problems are, how long they last for, and what is the impact. This is particularly true for the LHC, where faults may induce long recovery times after being fixed. The AFT project was launched in February 2014 as collaboration between the Controls and Operations groups with stakeholders from the LHC Availability Working Group (AWG). The AFT system has been used successfully in operation for LHC since 2015, yielding a lot of attention and generating a growing user community. In 2017 the scope has been extended to cover the entire Injector Complex. This paper will describe the AFT system and the way it is used in terms of architecture, features, user communities, workflows and added value for the organisation.

TUPHA014 Booster RF Controls Upgrade for SPEAR3

***S. Condamoor**, S. Allison, D. Rogind, J.A. Vásquez, E. Williams (SLAC)*

SLAC’s SPEAR3 Booster RF system was recently upgraded where the existing klystron providing RF power to a 5-cell cavity was replaced with a Solid State Amplifier (SSA). The Low Level RF Controls (LLRF) to drive the SSA was provided by a high performance FPGA based system built on SLAC ATCA modules. RF Cavity Tuner Controls were replaced with EtherCAT-based stepper motor controller. New hardware was designed and built for PLC-based Machine Protection System (MPS). Fast digitizers to sample and acquire LLRF signals were implemented in a linuxRT PC. All of these required new Controls Software implementation. This paper describes the Controls Software efforts associated with each of the above hardware upgrades.

TUPHA016 Overview of the GANIL Control Systems for the Different Projects Around the Facility

***E. Lécorché**, D.J.C. Deroy, P. Gillette, C.H. Haquin, E. Lemaître, C.H. Patard, L. Philippe, R.J.F. Roze, D.T. Touchard (GANIL)*

The GANIL facility is drastically extending its possibilities with new projects, so increasing its capabilities in nuclear physics. The most significant one is the Spiral2 installation based on a linear accelerator, then to be associated with the S3, NFS and DESIR new experimental rooms. Beside of the legacy home made control system handling the original installation, Epics was chosen as the basic framework for these projects. First, some control system components were used during preliminary beam tests. In parallel, the whole architecture was designed while the organization for future operation started to be considered; also, more structured and sophisticated tools were developed and the first high level applications for the whole machine tuning started to be tested, jointly with the current onsite beam commissioning. Progression of the control system development is presented, from the first beam tests up to the whole Spiral2 commissioning. Then, according to the new projects to cope with, some highlights are given concerning the related organization as well as specific items and developments to be considered, taking benefit from the Spiral2 control system feedback experience.

TUPHA019 Optimized Calculation of Timing for Parallel Beam Operation at the FAIR Accelerator Complex

A. Schaller *(GSI)*

For the new FAIR accelerator complex at GSI the settings management system LSA is used. It is developed in collaboration with CERN and until now it is executed strictly serial. Nowadays the performance gain of single core processors have nearly stagnated and multicore processors dominate the market. This evolution forces software projects to make use of the parallel hardware to increase their performance. In this thesis LSA is analyzed and parallelized using different parallelization patterns like task and loop parallelization. The most common case of user interaction is to change specific settings so that the accelerator performs at its best. For each changed setting, LSA needs to calculate all child settings of the parameter hierarchy. To maximize the speedup of the calculations, they are also optimized sequentially. The used data structures and algorithms are reviewed to ensure minimal resource usage and maximal compatibility with parallel execution. The overall goal of this thesis is to speed up the calculations so that the results can be shown in a user interface with nearly no noticeable latency.

TUPHA020 MATLAB Control Applications Embedded into EPICS Process Control Computers (IOCs) and their Impact on Facility Operations at the Paul Scherrer Institute

P. Chevtsov*, T. Pal (PSI) M. Dach (Dach Consulting GmbH)*

An automated tool for converting MATLAB based controls algorithms into C codes, executable directly on EPICS process control computers (IOCs), was developed at the Paul Scherrer Institute (PSI). Based on this tool, several high level control applications were embedded into the IOCs, which are directly connected to the control system sensors and actuators. Such embedded applications have significantly reduced the network traffic, and thus the data handling latency, which increased the reliability of the control system. The paper concentrates on the most important components of the automated tool and the performance of MATLAB algorithms converted by this tool.

TUPHA021 Experiences Using Linux Based VME Controller Boards

D. Zimoch*, D. Anicic (PSI)*

For many years, we have used a commercial real-time operating system to run EPICS on VME controller boards. However, with the availability of EPICS on Linux it became more and more charming to use Linux not only for PCs, but for VME controller boards as well. With a true multi-process environment, open source software and all standard Linux tools available, development and debugging promised to become much easier. Also the cost factor looked attractive, given that Linux is for free. However, we had to learn that there is no such thing as a free lunch. While developing EPICS support for the VME bus interface was quite straight forward, pitfalls waited at unexpected places. We present challenges and solutions encountered while making Linux based real-time VME controllers the main control system component in SwissFEL.

TUPHA022 Upgrading Z-Beamlets Controls (The Story of a Pulsed Power Lasers Control System)

A.C. Lombrozo *(Sandia National Laboratories)*

Z-Beamlet is a kilojoule-class pulsed power laser system constructed in the early 90's as a prototype for a multi-laser system. After a decade of operation, it was carefully deconstructed, transported 1600 km away, and painstakingly rebuilt to continue daily operations for another decade. During this time, no major controls upgrades were attempted and temporary fixes were performed every week. This is the story of how the entire control system was reverse-engineered, modernized in a piecemeal fashion, and then rebuilt from the ground up without significantly impacting the laser's normal operations schedule. Many lessons were learned during this transition including reverse engineering with outdated schematics, solving problems caused by poorly selected replacement parts, what happens when you make assumptions, and what a crippling fear of the unknown leads to. The new control system introduced a level of flexibility, maintainability, and evolutivity that was never even considered during the original system design. This control system has continued to grow along with the facility to include many new devices and subsystems.

TUPHA023 Z Machine Control System Upgrade

S. Radovich *(Sandia National Laboratories)*

As of 2014, the Z Machine relied on outdated HP computers installed in the 90's and a proprietary OPC server-like program designed to communicate with Allen Bradley PLC5 controllers. A simple failure of one of these elements would bring down the world's most powerful x-ray generator for weeks or even months while a replacement could be implemented. Instead of waiting for the inevitable, we began development on the new system. Development, simulation, and testing all took place in parallel with normal machine activity. As pieces of the new system were completed, we were able to work them into low consequence daily operations as a final test. While there were many usability improvements, the overall look and feel was carefully thought out to be similar to the old system and therefore did not require operator retraining and allowed for a smooth transition to the updated system. Ultimately, the new system was deployed with zero downtime and has greatly improved reliability as well as ease of use.

TUPHA024 ModBus/TCP Applications for CEBAF Accelerator Control System

J. Yan*, S. Philip, C. Seaton (JLab)*

Modbus-TCP is the Modbus RTU protocol with the TCP interface running on Ethernet. In our applications, an Xport device utilizing Modbus-TCP is used to control the remote devices and communicate with accelerator control system (EPICS). Modbus software provides a layer between the standard EPICS asyn support , and EPICS asyn TCP/IP or serial port driver. The EPICS application for each specific Modbus device is developed, and it can be deployed on a soft ioc. The configuration of Xport and Modbus-TCP is easy to setup and suitable for applications that do not require high speed communication. Additionally, the use of Ethernet makes it quicker to develop instrumentation for remote deployment.

TUPHA025 Magnetic Measurements Bench Makeover

L. Belingar*, M. Kokole, T. Milharčič (KYTE)*

Specialized Hall and flip-coil benches have been instrumental for magnetic characterizing and building good insertion devices, from simple phase shifters to demanding undulators. With increasing technical requirements of the product, also the bench needed an upgrade. Requirements were to make the control system more compact and at the same time modular enough to allow later changes in hardware, such as motorized linear stages, while keeping the precision intact. Increased measurements speed would be a bonus. Paper presents design choices and improvements on the control system. For the new automation hardware Beckhoff is chosen for its simplicity. Software is rewritten using Python and Structured Text languages. Data acquisition from Senis hall probe and Keysight multimeters is also integrated, making external controllers and libraries obsolete. And as a bonus, due to better system hierarchy and faster data transmission, measurements can be executed up to twice as fast as before.

TUPHA028 Recent Update of the RIKEN RI Beam Factory Control System

***M. Komiyama**, M. Fujimaki, N. Fukunishi, A. Uchiyama (RIKEN Nishina Center) M. Hamanaka, T. Nakamura (SHI Accelerator Service Ltd.)*

RIKEN Radioactive Isotope Beam Factory (RIBF) is a cyclotron-based heavy-ion accelerator facility for producing unstable nuclei and studying their properties. Many components of the RIBF accelerator complex are controlled by using the Experimental Physics and Industrial Control System (EPICS). We will here present the overview of the EPICS-based RIBF control system and its latest update work in progress. We are developing a new beam interlock system from scratch for applying to some of the small experimental facility in the RIBF accelerator complex. The new beam interlock system is based on a programmable logic controller (PLC) as well as the existing beam interlock system of RIBF (BIS), however, we newly employ a Linux-based PLC-CPU on which EPICS programs can be executed in addition to a sequencer in order to speed up the system. After optimize the performance of the system while continuing operation, we plan to expand the new system as a successor to the BIS that has been working more than 10 years since the start of its operation.

TUPHA029 Live Visualisation of Experiment Data at ISIS and the ESS

***M.J. Clarke**, F.A. Akeroyd, O. Arnold, M.A. Gigg, L.A. Moore (STFC/RAL/ISIS) N.J. Draper, M.D. Jones (Tessella) T.S. Richter (ESS)*

As part of the UK's in-kind contribution to the European Spallation Source, ISIS is working alongside the ESS and other partners to develop a new data streaming system for managing and distributing neutron experiment data to multiple receivers. The new data streaming system is based on the open-source distributed streaming platform Apache Kafka. A central requirement of the system is to be able to supply live experiment data for processing and visualisation in near real-time via the Mantid data analysis framework. There already exists a basic TCP socket-based data streaming system at ISIS, but it has limitations in terms of scalability, reliability and functionality. The intention is for the new Kafka-based system to replace the existing socket-based system at ISIS. This migration will not only provide enhanced functionality for ISIS but also an opportunity for developing and testing the system prior to use at the ESS.

TUPHA030 Using of Artificial Intelligence in the Predictive Model of the Fault Management of SKA Telescope Manager

***M. Canzari**, M. Di Carlo, M. Dolci (INAF - OA Teramo) R. Smareglia (INAF-OAT)*

SKA (Square Kilometer Array) is a project to design and build a large radio-telescope, composed using thousands of antennae and related support systems. The orchestration is performed by the Telescope Manager (TM), a suite of software applications. In order to ensure the proper and uninterrupted operation of TM, a local monitoring and control system is being developed and composes a suite of TM Services. Fault Management (FM) is composed by processes and infrastructure associated with detecting, diagnosing and fixing faults, and finally returning to normal operations. During the detective phase, FM uses a predictive model, based on the history and statistics of system, to calculate the trend analysis and failure prediction. According with monitoring data and health status detected by the software system monitor, the predictive model ensures that the system is operating within its normal operating parameters and takes corrective actions. The predictive model is based on intelligence software algorithms, that gather the data (from monitoring, log and so on) and extract statistics, rules and patterns.

TUPHA031 The Alarm and Downtime Analysis Development in the TLS

***C.H. Kuo**, B.Y. Chen, H.H. Chen, H.C. Chen, C.S. Huang, S.J. Huang, J.A. Li, C.C. Liang, W.Y. Lin, Y.K. Lin (NSRRC)*

TLS (Taiwan light Source) is a 1.5 GeV synchrotron light source at NSRRC which has been operating for users more than twenty year. There are many toolkits that are delivered to find out downtime responsibility and processing solution. New alarm system with EPICS interface is also applied in these toolkits to keep from machine fail of user time in advance. These toolkits are tested and modified in the TLS and enhance beam availability. The relative operation experiences will be migrated to TPS (Taiwan photon source) in the future after long term operation and big data statistic. These analysis and implement results of system will be reported in this conference.

TUPHA032 Parallel Processing for the High Frame Rate Upgrade of the LHC Synchrotron Radiation Telescope

***D. Alves**, E. Bravin, G. Trad (CERN)*

The Beam Synchrotron Radiation Telescope (BSRT) is routinely used for estimating the size, profile and emittance of the beams circulating in the LHC; quantities playing a crucial role in the optimization of the number of collisions delivered to the experiments. During the 2017 LHC run, the intensified analog cameras of the BSRT have been replaced by GigE digital cameras. Preliminary tests revealed that the typically used sub-image rectangles of 128x128 pixels can be acquired at rates of up to 400 frames per second, more than 10 times faster than the previous acquisition rate. To address the increase in CPU workload for the image processing, new VME CPU cards (Intel 4 core/2.5GHz/8GB RAM) were installed (replacing the previous Intel Core 2 Duo/1.5GHz/1GB RAM). This paper focuses on the software changes introduced to take advantage of the multi-core capabilities for parallel computations of the new CPU. It will describe how beam profile calculations and camera gain feedback control are pipe-lined through a pool of threads ensuring that the CPU keeps up with the increased data rate. To conclude, an analysis of the system performance will be presented as well as recent results.

TUPHA033 Availability Analysis and Tuning Tools at the Light Source Bessy II

***R. Müller**, T. Birke, A. Jankowiak, V. Laux, I. Müller, A. Schälicke (HZB)*

The 1.7GeV light source BESSY II features about 50 beamlines overbooked by a factor of 2 on the average. Thus availability of high quality synchrotron radiation (SR) is a central asset. SR users at BESSY II can base their beam time expectations on numbers generated according to the common operation metrics*. Major failures of the facility are analyzed according to * and displayed in real time, analysis of minor detriments are provided regularly by off line tools. Many operational constituents are required for extraordinary availability figures: meaningful alarming and dissemination of notifications, complete logging of program, device, system and operator activities, post mortem analysis and data mining tools. Preventive and corrective actions are enabled by consequent root cause analysis based on accurate eLog entries, trouble ticketing and consistent failure classifications. This paper describes the tool sets, developments, their implementation status and some showcase results at BESSY II.

TUPHA034 SCADA Statistics Monitoring Using the ELK (Elasticsearch, Logstash, Kibana) Stack

***J.A.G. Hamilton**, M. Gonzalez-Berges, B. Schofield (CERN)*

The Industrial Controls and Safety systems group at CERN, in collaboration with other groups, have developed and currently maintain around 200 controls applications that include domains such as LHC magnet protection, cryogenics and electrical network supervision systems. Millions of value changes and alarms from many devices are archived to a centralized Oracle database but it not easy to obtain high-level statistics from such an archive. A system based on Elasticsearch, Logstash and Kibana (the ELK stack) has been implemented in order to provide easy access to these statistics. This system provides aggregated statistics based on the number of value changes and alarms, classified according to several criteria (e.g. time, application, system, device). The system can be used, for example, to detect abnormal situations and alarm misconfiguration. In addition to these statistics each application generates text-based log files which we parse, collect and display using the ELK stack, to provide centralized access to all the application logs. Further work will explore the possibilities of combining the statistics and logs to better understand the behaviour CERN's control applications.

TUPHA035 **Data Analytics Reporting Tool for CERN SCADA Systems**

***P.J. Seweryn**, M. Gonzalez-Berges, B. Schofield, F.M. Tilaro (CERN)*

This paper describes the concept of a generic data analytics reporting tool for the SCADA systems at CERN. The tool is a response to a growing demand for smart solutions in the supervision and analysis of control systems. Large scale data analytics is a rapidly advancing field, but simply performing the analysis is not enough; the results must be made available to the appropriate users (for example operators and process engineers). The tool can report data analytics for objects such as valves and PID controllers directly into the SCADA used for operations. More complex analyses involving process interconnections (such as correlation analysis based on machine learning) can also be displayed. A pilot is being developed for the WinCC OA SCADA system using Hadoop as storage. The reporting tool obtains the metadata and analysis results from Hadoop using Impala, but can easily be switched to any database system that supports SQL standards.

TUPHA036 **Applying Service-Oriented Architecture to Archiving Data in Control and Monitoring Systems**

***J.M. Nogiec**, K. Trombly-Freytag (Fermilab)*

Current trends in the architectures of software systems focus our attention on building systems using a set of loosely coupled components, each providing a specific functionality known as service. It is not much different in control and monitoring systems, where a functionally distinct sub-system can be identified and independently designed, implemented, deployed and maintained. One functionality that renders itself perfectly to becoming a service is archiving the history of the system state. The design of such a service and our experience of using it are the topic of this article. The service is built with responsibility segregation in mind, therefore, it provides for reducing data processing on the data viewer side and separation of data access and modification operations. The service architecture and the details concerning its data store design are discussed. An implementation of a service client capable of archiving EPICS process variables and LabVIEW shared variables is presented. The use of a gateway service for saving data from GE iFIX is also outlined. Data access tools, including a browser-based data viewer (HTML 5) and a mobile viewer (Android app), are also presented.

TUPHA038 **A Generic Rest Service for Control Databases**

***W. Fu**, T. D'Ottavio, S. Nemesure (BNL)*

Accessing database resources from Accelerator Controls servers or applications with JDBC/ODBC and other dedicated programming interfaces have been common for many years. However, performance limitations of these technologies were obvious as rich web and mobile communication technologies became more mainstream. HTTP REST services have become a more reliable and common way for easy accessibility for most types of data resources, include databases. Several commercial database REST services have become available in recent years, each with their own pros and cons. This paper presents a way for setting up a generic HTTP REST database service with technology that combines the advantages of application servers (such as Glassfish), JDBC drivers, and Java technology to make major RDBMS systems easy to access and handle data in a secure way. This allows database clients to retrieve data (user data or meta data) in standard formats such as XML or JSON.

TUPHA039 Bunch Arrival Time Monitor Control Setup for SwissFEL Applications

***P. Chevtsov**, V.R. Arsov (PSI) M. Dach (Dach Consulting GmbH)*

Bunch Arrival time Monitor (BAM) is a precise beam diagnostics instrument assessing the accelerator stability on-line. It is one of the most important components of the SwissFEL facility at the Paul Scherrer Institute (PSI). The overall monitor complexity demands the development of an extremely reliable control system that handles basic BAM operations. A prototype of such a system was created at PSI. The system is very flexible. It provides a set of tools allowing one to implement a number of advanced control features such as tagging experimental data with a SwissFEL machine pulse number or embedding high level control applications into the process controllers (IOC). The paper presents the structure of the BAM control setup. The operational experience with this setup is also discussed.

TUPHA040 Development of Real-Time Data Publish and Subscribe System Based on Fast RTPS for Image Data Transmission in KSTAR

***G.I. Kwon**, J.S. Hong, T.G. Lee, W.R. Lee, J.S. Park, T.H. Tak (NFRI)*

In fusion experiment, real-time network is essential to control plasma real-time network used to transfer the diagnostic data from diagnostic device and command data from PCS(Plasma Control System). Among the data, transmitting image data from diagnostic system to other system in real-time is difficult than other type of data. Because, image has larger data size than other type of data. To transmit the images, it need to have high throughput and best-effort property. And To transmit the data in real-time manner, the network need to has low-latency. RTPS(Real Time Publish Subscribe) is reliable and has Quality of Service properties to enable best effort protocol. In this paper, eProsima Fast RTPS was used to implement RTPS based real-time network. Fast RTPS has low latency, high throughput and enable to best-effort and reliable publish and subscribe communication for real-time application via standard Ethernet network. This paper evaluates Fast RTPS about suitability to real-time image data transmission system. To evaluate performance of Fast RTPS base system, Publisher system publish image data and multi subscriber system subscribe image data.

TUPHA041 Conception and Realization of the Synchronization of Databases Between Two Research Facilities

***S. Mueller** (GSI)*

For the new control system for the FAIR accelerator complex at GSI parts of the Oracle database structure from CERN are used, in a collaboration between these two institutes. This thesis focuses on synchronization and version control of databases and how the cooperation in the departments of GSI and CERN can be improved using database tools. In this process, the database tools Liquibase and Flyway, are used and integrated as prototypes into the Oracle system-landscape. When implementing the prototypes some problems were identified, which result from the existing database-systems and reorganization and also the current state of collaboration between the departments of both research facilities. When creating the prototypes a special emphasis was placed on their flexibility and the capability to readily adapt to the conditions of the existing database landscapes, in order to allow for a seamless integration on both sides. The creation of a flexible and adjustable system enables the two research facilities to use, synchronize and update their shared database landscape.

TUPHA042 ADAPOS: An Architecture for Publishing ALICE DCS Conditions Data

J.L. Lång, *A. Augustinus, P.M. Bond, P.Ch. Chochula, A.N. Kurepin, M. Lechman, O. Pinazza (CERN) A.N. Kurepin (RAS/INR) M. Lechman (IP SAS) O. Pinazza (INFN-Bologna)*

ALICE Data Point Service (ADAPOS) is a software architecture being developed for the Run 3 period of LHC, as a part of the effort to transmit conditions data from ALICE Detector Control System (DCS) to GRID, for distributed processing. ADAPOS uses Distributed Information Management (DIM), 0MQ, and ALICE Data Point Processing Framework (ADAPRO). DIM and 0MQ are multi-purpose application-level network protocols. DIM and ADAPRO are being developed and maintained at CERN. ADAPRO is a multi-threaded application framework, supporting remote control, and also real-time features, such as thread affinities, records aligned with cache line boundaries, and memory locking. ADAPOS and ADAPRO are written in C++14 using OSS tools, Pthreads, and Linux API. The key processes of ADAPOS, Engine and Terminal, run on separate machines, facing different networks. Devices connected to DCS publish their state as DIM services. Engine gets updates to the services, and converts them into a binary stream. Terminal receives it over 0MQ, and maintains an image of the DCS state. It sends copies of the image, at regular intervals, over another 0MQ connection, to a readout process of ALICE Data Acquisition.

TUPHA043 Concept and First Evaluation of the Archiving System for FAIR

V. Rapp *(GSI) V. Cucek (XLAB d.o.o.)*

Since the beginning of the computer era one of the main focuses of IT Systems was on storing and analyzing of the incoming data. Therefore, it is no wonder that the users and operators of the coming FAIR complex have expressed a strong requirement to collect the data coming from different accelerator components and store it for the future analysis of the accelerator performance and its proper function. This task will be performed by the Archiving System, a component, which will be developed by FAIRs CSCO team in cooperation with XLAB. With more than 2000 devices, over 50000 parameters and around 30 MB of data per second to store the Archiving System will face serious challenges in terms of performance and scalability. Besides of the actual storage complexity the system will also need to provide the mechanisms to access the data in an efficient matter. Fortunately, there are open source products available on the market, which may be utilized to perform the given tasks. This paper presents the first conceptual design of the coming system, the challenges and choices met as well as the integration in the coming FAIR system landscape.

TUPHA044 Automatic Management of Vacuum Equipment in CERN's Enterprise Asset Management System

A.P. Rocha, *G. Gkioka, P. Gomes, L.A. Gonzalez (CERN)*

The vacuum group is responsible for the operation and consolidation of vacuum systems across all CERN accelerators. Concerning over 15 000 pieces of control equipment, the maintenance management requires the usage of an Enterprise Asset Management system (EAM), where the life-cycle of every individual equipment is managed from reception through decommissioning. On vacuum SCADA, the operators monitor and interact with equipment that were declared in the vacuum database (vacDB). The creation of work orders and the follow up of the equipment is done through inforEAM, which has its own database. These two databases need to be coupled, so that equipment accessible on the SCADA are available in inforEAM for maintenance management. This paper describes the underlying architecture and technologies behind vacDM, a web application that ensures the consistency between vacDB and inforEAM, thus guaranteeing that the equipment displayed in the vacuum SCADA is available in inforEAM. In addition to this, vacDM performs the management of equipment labelling jobs by assigning equipment codes to new equipment, and by automatically creating their corresponding assets in inforEAM.

`TUPHA045` Secured Accelerator & Experiment Control Systems for the Future

S. Lüders *(CERN)*

With the nation-sponsored "Stuxnet" attack of 2010 and a shift in focus of adversaries attacking control systems and, in particular, home devices dubbed the "Internet-of-Things", old paradigms of developing and running control systems do not hold anymore. Modern IT/security technologies are needed to better protect and secure accelerator and experiment control systems: updates and patch cycles need to be revised, software development and roll-out reviewed, access control tightened. This presentation shall give an outlook on how a well-protected control system could look like in 5-10 years.

`TUPHA046` PLC Factory: Automating Routine Tasks in Large-Scale PLC Software Development

G. Ulm*, F. Bellorini, D.P. Brodrick, R.N. Fernandes, N. Levchenko, D.P. Piso (ESS)*

The European Spallation Source ERIC (ESS) in Lund, Sweden, is building large-scale infrastructure that is projected to include hundreds of programmable logic controllers (PLCs). Given the future large-scale deployment of PLCs at ESS, we therefore explored ways of automating some of the tasks associated with PLC programming. We designed and implemented PLC Factory, which is an application written in Python that facilitates large-scale PLC development. With PLC Factory, we managed to automate repetitive tasks associated with PLC programming and interfacing PLCs with an EPICS database. A key part of PLC Factory is its embedded domain-specific programming language PLCF#, which makes it possible to define dynamic substitutions. Using a database for configuration management, PLC Factory is able to generate both EPICS database records as well as code blocks in Structured Control Language (SCL) for the Siemens product TIA Portal. Hierarchies of devices of arbitrary depth are taken into account, which means that dependencies of devices are correctly resolved. PLC Factory is in active use at ESS.

`TUPHA047` Automatic Deployment of EPICS IOCs Using Puppet

M.G. Konrad*, D. Chabot (FRIB)*

The Facility of Rare Isotope Beams (FRIB) is practicing continuous integration and continuous delivery for its controls software. For each revision of the code in our code repository our continuous delivery pipeline automatically provides us with a software package that is ready to be installed. This contribution describes how we leverage Puppet to deploy the required software packages (EPICS base libraries, device drivers etc.) to a large number of IOC machines and how we keep them up to date or at the desired version. We also describe how IOC processes are provided with their EPICS database files as well as their access security configuration, how IOCs are started as a service, and how logging and secure remote access are set up. This contribution describes how we leverage Puppet to automate this deployment process. In particular we describe an open source Puppet module that has been developed for managing EPICS IOCs. We will also report on our experience using this system to support commissioning of the FRIB front end.

TUPHA048 VDI (Virtual Desktop Infrastructure) Implementation for Control System - Overview and Analysis

P. Kurdziel *(Solaris National Synchrotron Radiation Centre, Jagiellonian University)*

At Solaris (National Synchrotron Radiation Center , Kraków) we have deployed test VDI software to virtualize physical desktops in the control room to ensure stability, more efficient support, system updates, and restores. The test was aimed to accelerate the installation of new work places for the single users. Horizon software gives us an opportunity to create roles and access permission . VDI software has contributed to efficient management and lower maintenance costs of virtual machines than physical hosts. We are still testing VMware Horizon 7 at Solaris.

TUPHA049 ARES: Automatic Release Service

I. Prieto Barreiro*, F. Varela (CERN)*

This paper presents the Automatic RElease Service (ARES) developed by the Industrial Controls and Safety systems group at CERN. ARES provides tools and techniques to fully automate the software release procedure. The service replaces release mechanisms which in some cases were cumbersome and error prone, by an automated procedure where the software release and publication is completed with a few mouse clicks. ARES allows optimizing the time and the work to be performed by developers in order to carry out a new release. Consequently, this enables more frequent releases and therefore a quicker reaction to user requests. The service uses standard technologies (Jenkins, Nexus, Maven, Drupal, MongoDB) to release software components from the source code, packaging and deployment to different repositories (Nexus, EDMS), as well as the final publication to Drupal web sites.

TUPHA050 The SKA Dish Local Monitoring and Control System

S. Riggi*, U. Becciani, A. Costa, A. Ingallinera, F. Schillirò, C. Trigilio (INAF-OACT) S. Buttaccio, G. Nicotra (INAF IRA) R. Cirami, A. Marassi (INAF-OAT)*

The Square Kilometre Array (SKA) will be the world's largest and most sensitive radio observatory ever built. SKA is currently completing the pre-construction phase before initiating mass construction phase 1, in which two arrays of radio antennas - SKA1-Mid and SKA1-Low - will be installed in the South Africa's Karoo region and Western Australia's Murchinson Shire, each covering a different range of radio frequencies. The SKA1-Mid array comprises 130 15-m diameter dish antennas observing in the 350 MHz-14 GHz range and will be remotely orchestrated by the SKA Telescope Manager (TM) system. To enable onsite and remote operations each dish will be equipped with a Local Monitoring and Control (LMC) system responsible to directly manage and coordinate antenna instrumentation and subsystems, providing a rolled-up monitoring view and high-level control to TM. This paper gives a status update of the antenna instrumentation and control software design and provides details on the LMC software prototype being developed.

TUPHA051 The Control System of Novosibirsk Free Electron Laser

S.S. Serednyakov*, V.R. Kozak, E.A. Kuper, P.A. Selivanov, S.V. Tararyshkin, A.G. Tribendis, N.A. Vinokurov (BINP SB RAS)*

Novosibirsk Free electron Laser (FEL) based on multi-turn energy recovery linac is the source of coherent radiation with ability of wavelength tuning. It involves one single-turn and one 4-turn microtron-recuperator, which are have general injection channel and acceleration section. There are three different free electron lasers, mounted on different tracks of these accelerators, and operating on different electron beam energy and have different wavelength range and power of generated radiation. Whole FEL facility is a complex physics installation, controlled by large amount of equipment of different types. Therefore, for effective control and monitor of FEL operation state and its parameters, the particularized control system was developed. In this paper the architecture, hardware, software compound parts of this control system are considered. Also main abilities, characteristics of this system and examples of its usage are presented.

`TUPHA054` Data Supply and Accelerator Control Aspects for the GSI Linacs

P. Gerhard *(GSI)*

The first accelerator at GSI, the UNILAC, went into operation in the early 1970s. Being a universal heavy ion linear accelerator, today the UNILAC consists of three ion sources, two injector linacs, one main linac, and two strippers, and serves several experimental areas and the synchrotron SIS18 as main user. Three ion species can be provided at different energies simultaneously in a fast time multiplex scheme. The UNILAC is going to be the heavy ion injector linac for FAIR, supported by a dedicated proton linac to be built in the next years. Another dedicated cw linac is under development to serve the super heavy element community, while the linear decelerator HITRAP has been commissioned in the last years. The current UNILAC control system dates back to the 1990s. The FAIR accelerator complex including the proton linac will be operated based on i. a. the framework LSA (LHC Software Architecture), while the conversion of the UNILAC control system is just being started. This contribution reports about general aspects of the control system and data supply for the GSI linacs from a machine physicist's point of view, and highlights challenges encountered.

`TUPHA056` Conceptual Design of Treatment Control System for a Proton Therapy Facility at HUST

***W. Li**, D. Li (HUST)*

A superconducting-based proton cyclotron facility for cancer treatment is to be built for the university clinic of Huazhong University of Science and Technology (HUST), Wuhan, China. This facility is aimed at providing proton beams with continuously tunable energy within 70~250MeV, for kinds of cancer treatments. The treatment control system consists of many subsystems and a number of functional devices. In this paper, we will report our conceptual design of the treatment control system and introduce the main subsystems.

`TUPHA057` The Control System for the Eli-NP Gamma Beam Delivery and Diagnostics

***G. Chen**, M. Ciubancan, M. Matei, A. Pappalardo, G. Suliman, C.A. Ur (IFIN-HH)*

The high brilliance Gamma Beam System (GBS) at ELI-NP will deliver quasi-monochromatic gamma beams with a high spectral density (10,000 photons/s/eV) and high degree of linear polarization (>95%). The Gamma Beam Delivery and Diagnostics (GBDD) of ELI-NP is implemented to deliver the gamma beams to the experimental setups and to monitor the characteristics of the beams. An EPICS control system is developed for the GBDD to support two main categories of equipment: i) equipment for the delivery of the gamma beam including vacuum systems, collimators, alignment platforms, and moveable beam dumps; ii) devices to be used during the operation of the GBS for diagnostics and monitoring including digitizers, power supplies, detectors, and profile system. High-level applications for the Gamma Beam diagnostics system are under development to complement the real-time measurements and monitoring including energy spread measurement, flux and polarization measurement, spatial profile monitor and time structure monitor. This paper describes all the aspects of the EPICS Control System for ELI-NP GBDD, including the hardware integration, network architecture, and high-level applications.

TUPHA058 The Control Systems of SXFEL and DCLS

__Y.B. Yan__, G.H. Chen, J.G. Ding, S.M. Hu, Y.J. Liu, Q.R. Mi, H.F. Miao, C.L. Yu, H. Zhao, H.J. Zhu (SSRF)

The high-gain free electron lasers (FEL) have given scientists hopes for new scientific discoveries in many frontier research areas. The Shanghai X-Ray Free-Electron Laser (SXFEL) test facility is commissioning at the Shanghai Synchrotron Radiation Facility (SSRF) campus. The Dalian Coherent Light Source (DCLS) has successfully commissioned in the northeast of China, which is the brightest vacuum ultraviolet (VUV) free electron laser facility. The control systems of the two facilities are base on EPICS. The industrial computer, programmable logic controller (PLC) and field programmable gate array (FPGA) are adopt for device control. The archiver is based on the PostgreSQL database. The high-level applications are developed using Python. The details of the control system design, construction and commissioning will be reported in this paper.

TUPHA059 Status of the GBAR control project at CERN

__P. Lotrus__ (CEA) G.A. Durand (CEA/DSM/IRFU) A. Gaget, A. Gomes, J.F. Lecointe (CEA/DRF/IRFU)

One yet unanswered questions in physics today concerns the action of gravity upon antimatter. The GBAR experiment proposes to measure the free fall acceleration of neutral antihydrogen atoms. Installation of the project at CERN (ELENA) began in late 2016. This research project is facing new challenges and needs flexibility with hardware and software. EPICS modularity and distributed architecture has been tested for control system and to provide flexibility for future installation improvement. This paper describes the development of the software and the set of software tools that are being used on the project.

TUPHA060 Control System of the Linear Accelerators as a Part of Nuclear Facility NSC KIPT Neutron Source

__D.V. Tarasov__, V.P. Lyashchenko, A.Y. Zelinsky (NSC/KIPT)

NSC KIPT Neutron Source on the base of subcritical assembly involves 100 MeV/100 kW electron linear accelerator as a driver. Because the Neutron Source is nuclear facility all technological systems of the facility are under regulation of State Inspection of Nuclear Regulation of Ukraine that is working in accordance with international nuclear regulation legislation. This regulation demands certain requirement to the design and realization of the facility control system in order to provide the conditions of the facility safe operation. In the paper, the features of control system of the linear accelerators as a part of nuclear facility NSC KIPT Neutron Source are described.

TUPHA061 Status of the NSC KIPT Neutron Source

__O. Bezditko__, I.M. Karnaukhov, A. Mytsykov, D.V. Tarasov, A.Y. Zelinsky (NSC/KIPT)

In NSC KIPT, Kharkov, Ukraine the state of art nuclear facility Neutron Source on the base of subcritical assembly driven with 100 MeV/100 kW electron linear accelerator has been build. The electron beam generates neutrons during bombarding the tungsten or uranium target. The subcritical assembly of low enrichment uranium is used to multiply the initial neutrons due to fission of the uranium nuclei. The facility is the first world facility of such kind. It is supposed that maximal value of multiplying neutron factor in the source will be equal to 0.95. So, the neutron flux will be increased as much as 50 times. Because of sub-criticality the facility eliminates the possibility to produce the self-sustained chain reaction. Now the Neutron source is under commissioning. In the report the facility and its control system current status is presented.

TUPHA063 ASKAP - From Construction to Operation

M. Marquarding *(CASS)*

The Australian Square Kilometre Pathfinder (ASKAP) is a radio telescope array in Western Australia. A third of the 36 telescopes forming the array have been fully commissioned and are in use under the early science program. The construction phase for the rest of the array has now completed and commissioning is continuing. This report continues on from the last status update and addresses new challenges as the telescope moves into the operational phase. The architecture of the system has proven robust, however some of the third party software choices have been reviewed as new software packages have appeared in the years since the initial adoption. We present the reasoning behind replacing some of our processes and software packages to ensure long-term operation of the instrument.

TUPHA064 The LIGHT Control and Interlock Systems

R. Moser*, H. Pavetits (ADAM SA)*

LIGHT (Linac Image Guided Hadron Technology) is a particle therapy system developed by Advanced Oncotherapy plc. Accelerator, control and interlock systems are developed by its subsidiary A.D.A.M. SA, a CERN spin-off. The system is being designed to accelerate protons up to 230 MeV using a modular and compact 25-meter-long linear accelerator. It is being designed to operate in pulsed mode where beam properties (energy, pulse charge and spot size) can be changed at 200 Hz. The LIGHT product will be installed in different facilities. As such, the installations will differ in accelerator and beam transfer line layouts, number of treatment rooms (with an optional gantry), facility services, equipment suppliers and equipment versions. Thus the control and interlock systems need to be extensible through configuration and modularization. To achieve this, the control system relies on a multi-tier architecture with a clear separation between front-end devices and controllers. To minimize time-to-market, the systems rely mostly on COTS hardware and software, including a timing and triggering system and a light-weight software framework to standardize front-end controllers.

TUPHA066 A Real-Time, Distributed Power Measuring and Transient Recording System for Accelerators' Electrical Networks

E. Freddi*, O.Ø. Andreassen, K. Develle, J. Lahaye, A. Rijllart (CERN)*

Particle accelerators are complex machines with fast and high power absorption peaks. Power quality is a critical aspect for correct operation. External and internal disturbances can have significant repercussions causing beam losses or severe perturbations. Mastering the load and understanding how network disturbances propagate across the network is a crucial step for developing the grid model and realizing the limits of the existing installations. Despite the fact that several off-the-shelf solutions for real time data acquisition are available, an in-house FPGA based solution was developed to create a distributed measurement system. The system can measure power and power quality on demand as well as acquire raw current and voltage data on a defined trigger, similar to a distributed oscilloscope. In addition, the system allows recording many digital signals from the high voltage switchgear enabling electrical perturbations to be easily correlated with the state of the network. The result is a scalable system with fully customizable software, written specifically for this purpose. The system prototype has been in service for two years and full-scale deployment is currently ongoing.

TUPHA067 PCI Express Hot Plug under Linux in MTCA Systems

L.P. Petrosyan *(DESY)*

One of the main characteristics of any computer architecture is reliability and uninterrupted operation. This important if a system allows a possibility to add and remove devices in run. The Hot-Plug Service in a computer system is generally provided by the central bus. The MTCA systems uses the PCIe as a central bus of data transmission. One of especially important features of this bus is a possibility of hot replacement of the devices without reseting an operating system. The Hot-Swap service is irreplaceable not only in the process of development of final devices but also in the use, thus ensuring continuous functioning of the system as a whole. Such feature plays an important role especially in control systems. The Hot-Swap PCIe service is being used relatively long. However, the MTCA system makes its own amendments into general architecture of the PCIe Hot-Swap and in the methods and ways of use. The current poster describes the main PCI Express and PCIe Express Hot Plug Hardware and Linux Software components on MTCA systems.

TUPHA068 FPGA-Based Pulsed-RF Phase and Amplitude Detector at SLRI

R.R. Rujanakraikarn *(SLRI)*

In this paper, the prototype of phase and amplitude detector for pulsed-RF measurement is described. The hardware is designed in VHDL and implemented using Field Programmable Gate Array (FPGA) for digital processing. The main phase and amplitude detection algorithm is implemented using state machine in the MicroBlaze soft processor. The detector system is designed to measure the phase and amplitude of a 5-microsecond wide 2,856 MHz pulsed-RF at a repetition rate of 0.5 Hz. The front-end hardware for the pulsed-RF signal acquisition is also described with the interface to the FPGA-based controller part. Initial test results of the prototype are presented.

TUPHA069 FPGA-Based Motion Control System for Medical Linear Accelerator Development at SLRI

R.R. Rujanakraikarn *(SLRI)*

Linear accelerator technology has been widely applied to radiotherapy machines and there has been an increasing demand of the machines in Thailand over the recent years. An attempt to increase the availability of the low-cost machines has been proposed for the domestic use purposes. Currently, the prototype of the 6 MeV medical linear accelerator is under development at Synchrotron Light Research Institute (SLRI) in Nakorn Ratchasima, Thailand. For beam shaping purposes a so-called secondary collimator is utilized with different size arrangement of the collimator jaws. The collimator motion control is one of the necessary machine subsystems for producing the desired field size of the beam. In this paper, the FPGA-based motion control system of the machine prototype is presented. The programmable logic part of the hardware is designed in VHDL for digital processing. The main motion control algorithm is implemented in the main processor of Zedboard FPGA. Communication between the motion control subsystem and the main control system software of the machine is also described.

TUPHA070 Commissioning and Validation of the ATLAS Level-1 Topological Trigger

A.T. Aukerman *(University of Pittsburgh) J. Kirk (STFC/RAL)*

The ATLAS experiment has recently commissioned a new hardware component of its first-level trigger: the topological processor (L1Topo). This innovative system, using state-of-the-art FPGA processors, selects events by applying kinematic and topological requirements on candidate objects (energy clusters, jets, and muons) measured by calorimeters and muon sub-detectors. Since the first-level trigger is a synchronous pipelined system, such requirements are applied within a latency of 200ns. We will present the first results from data recorded using the L1Topo trigger; these demonstrate a significantly improved background event rejection, thus allowing for a rate reduction without efficiency loss. This improvement has been shown for several physics processes leading to low-pT leptons, including H->tau tau and J/Psi->mu mu. In addition, we will discuss the use of an accurate L1Topo simulation as a powerful tool to validate and optimize the performance of this new trigger system. To reach the required accuracy, the simulation must take into account the limited precision that can be achieved with kinematic calculations implemented in firmware.

TUPHA071 Run Control Communication for the Upgrade of the ATLAS Muon-to-Central Trigger Processor Interface (MUCTPI)

J.G. Panduro Vazquez *(Royal Holloway, University of London) , R. Spiwoks (CERN)*

The Muon-to-Central Trigger Processor Interface (MUCTPI) of the ATLAS experiment at the Large Hadron Collider (LHC) at CERN will be upgraded to an ATCA blade system for Run 3. The new design requires development of new communication models for control, configuration and monitoring. A System-on-Chip (SoC) with a programmable logic part and a processor part will be used for communication to the run control system and to the MUCTPI processing FPGAs. Different approaches have been compared. First, we tried an available UDP-based implementation in firmware for the programmable logic. Although this approach works as expected, it does not provide any flexibility to extend the functionality to more complex operations, e.g. for serial protocols. Second, we used the SoC processor with an embedded Linux operating system and an application-specific software written in C++ using a TCP remote-procedure-call approach. The software is built and maintained using the Yocto/OpenEmbedded framework. This approach was successfully used to test and validate the MUCTPI prototype. A third approach under investigation is the option of porting the ATLAS run control software directly to the embedded Linux.

TUPHA072 Real-Time Liquid Scintillator Calibration Based on Intensity Modulated LED

F. Pollastrone*, M. Riva (ENEA C.R. Frascati) G.C. Cardarilli (Università degli Studi di Roma "Tor Vergata")*

In many nuclear applications such as in nuclear/high-energy physics and nuclear fusion, sensors are extensively used in order to detect high energy particles. One of the available technologies is the scintillator, which is generally coupled with a photomultiplier and pulse amplifier. The detector acquisition chain is not stationary; mainly, it changes its gain as a function of the photomultiplier temperature and sensor irradiation, therefore it needs to be periodically calibrated during its operation. A calibration method reported in the literature is based on the use of a pulsed LED that flashes on the photomultiplier by generating a train of reference pulses. An alternative method may be the use of an LED with continuous sinusoidal intensity emission. This provides as an output of the detector chain a small sinusoidal signal which can be digitally processed in real time, by measuring the gain and the delay time of the detector chain. Moreover, this sinusoidal background signal can be removed in real-time, before any processing or storage of data. This paper presents the technique, reporting its simulation and the main characteristics of the developed firmware and the hardware.

TUPHA073 RF Leakage Detector System

M. Jobs*, K. Fransson, K.J. Gajewski (Uppsala University)*

FREIA Laboratory is a new facility for developing and testing instrumentation for particle accelerators. There are two pulsed 400 kW 352 MHz RF sources, presently used for testing superconducting RF cavities and there is a need to monitor the electromagnetic field in the experimental hall. The RF leakage detector system consists of number of physically identical nodes with one of them configured as a master and the rest as slaves. Each node supports 3 separate RF measurement channels with a frequency span of 100 kHz to 1 GHz. A desired frequency band is selected using a front-end band-pass filter. The sensitivity of the sensor is -34 dBm and the dynamic range 48 dB. The slaves are battery powered for easy installation. Special care has been taken to minimize the power consumption resulting in battery life to be 4-13 months using 3xAAA batteries. The footprint of the module is 60x100x40 mm. The communication between the master and the slaves uses a Wireless Link operating at the 868 MHz ISM band. The system is controlled by EPICS using the StreamDevice driver. The master RF module is connected via an RS-232 line and a MOXA NPort server to the control system network.

TUPHA075 A MicroTCA based Beam Position Monitoring System at CRYRING@ESR

P.B. Miedzik*, H. Bräuning, T. Hoffmann, A. Reiter (GSI)*

At FAIR the commissioning of the re-assembled CRYRING accelerator, formerly hosted by Manne Siegbahn Laboratory Stockholm, is currently in progress. This compact low energy heavy ion synchrotron and experimental storage ring will be a testing platform for the future beam instrumentation and control system concepts decided on for FAIR. Besides many other measurement systems CRYRING is equipped with 18 beam position monitors (BPM), for which a new data acquisition system (DAQ) was developed. Based on the upcoming MicroTCA form factor in combination with FPGA mezzanine card (FMC) technology the DAQ system was designed to be state-of-the-art, reliable, modular and of high performance. Testing "Open Hardware", here the ADC FMCs and FMC carrier boards, was another intention of that concept. The DAQ layout and obstacles that had to be overcome as well as first measurements and performance tests will be presented.

TUPHA076 FPGA Systems at the Australian Synchrotron From Altera to Zynq

R.B. Hogan*, S. Chen, T.D. Cornall, A. Michalczyk, E. Tan (SLSA) , P. Martin, W.N. Rambold (SLSA-ANSTO)*

The Australian Synchrotron is a third generation 3GeV, 200mA light source located in Melbourne, Australia operating since 2007. There have been many improvements to FPGA technology since the facility started operations. Four years ago we started to equip our team with tools for FPGA development. Almost all high end data acquisition and processing has been moving to FPGA technology. To maximise the benefits we have been trying to find methods to quickly implement effective solutions on FPGA based systems. A few of these systems have been brought online in 2017 namely: the Fast Orbit Feedback System, Fast Fault Memory System and the SLED Diagnostics System. An outline of the projects will be presented, including some of the toolchains we use to speed up development as well as a few future plans for the application of FPGA technology at the Australian Synchrotron.

TUPHA077 Klystron 5045 Modulator Control System Based on CompactRIO

A. Panov *(BINP SB RAS)*

Klystron 5045 developed in the 1980's as an upgraded RF power source for the Stanford Linear Collider, it has popularity and used in many accelerator facilities of the Budker Institute of Nuclear Physics (BINP). During this time (about 30 years) control electronics of the klystron pulse power supply (modulator) has already obsolete both morally and physically. A new set of control electronics are being developed in the klystron modulator modernization context. Control system is based on the CompactRIO platform from leading electronics producer National Instruments (NI). Purchased chassis cRIO-9067 with embedded real-time controller is base of all system, but C-series modules are being produced in BINP. For control purposes are being used both modules similar on NI devices (ADC, DAC, digital inputs/outputs) and special function module (BI-1601) for fast interlock system. Real-time controller is worked under NI LinuxRT and its integration in shared control system are being realized with deployed EPICS or CX server.

TUPHA078 The New Beam Diagnostic System at INFN LNL

***D. Pedretti**, D. Bortolato, F. Gelain, D. Marcato, E. Munaron, S. Pavinato, M. Poggi (INFN/LNL) M.A. Bellato, C. Fanin, R. Isocrate (INFN- Sez. di Padova)*

The transport of the Radioactive Ion Beams (RIB) foreseen by the SPES facility* ** requires a new beam diagnostic system that outperforms the legacy VME based current and beam position monitors. The beam diagnostic is an essential component without whom the operator would blindly attempt to set-up all the accelerator parameters in order to transport the beam from the source to the target area. The paper provides a complete overview about the SPES distributed environment focusing on the new diagnostic data readout chain that will be based on the Input Output Controller (IOC)***, a custom COM Express carrier board which hosts an FPGA to perform real time tasks alongside the general-purpose desktop functionalities. One single IOC serves up to four diagnostic points each including a Faraday cup and a custom Beam Profiler Monitor (BPM). IOC digitizes the vertical and horizontal beam positions and the current signals thanks to the onboard ADCs and a commercial FPGA mezzanine card, and bridges the diagnostic data to the control network for the remote visualization. The prototypes have shown good performance improvements and the beam current resolution has been extended to tens of pA.

TUPHA079 Timing System Using FPGA for Medical Linear Accelerator Prototype at SLRI

***P. Koonpong** (SLRI)*

A prototype of medical linear accelerator is under development at Synchrotron Light Research Institute (SLRI). In order to maintain the proper operation of the machine, the pulse signal is used to synchronize the various subsystems such as electron gun, RF trigger, and magnetron trigger subsystems. In this project, we design the timing system using a XilinxSpartan-3 FPGA development board with VHDL in order to achieve the desired characteristics and sequences of the timing signals for those subsystems. A LabVIEW GUI is designed to interface with the timing system in order to control the time delay and pulse width via RS-232 serial interface. The results of the system design is achieved with the pulse resolution of a 20 nsec per step for four timing channels. The time delay and pulse width for each channel can be set independently based on the SYNC reference signal.

TUPHA080 New Data Acquisition System Implemented Based on MTCA.4 Form Factor for KSTAR Diagnostic System

***T.G. Lee**, J.S. Hong, G.I. Kwon, W.R. Lee, T.H. Tak (NFRI)*

In Korea Superconducting Tokamak Advanced Research (KSTAR), various diagnostics systems were operated from the first plasma in 2008. Many diagnostic devices have been installed for measuring the various plasma properties such as plasma current, magnetic current, electron density, electron temperature, impurity, and so on. The DAQ system for measuring the various plasma properties were developed with various form factor digitizer such as VME, CPCI, PXI, VXI. and PCIe. These complicated form factors installed on KSTAR have difficulties with hardware management, software management and performance upgrades. In order to control real-time systems using several diagnostic signals, the real-time control system is required to share the data without delay between the diagnostic measurement system and the real-time control system without branch one signal. Therefore, we developed the Multifunction Control Unit (KMCU) as the standard control system MTCA.4 form-factor and implemented the various diagnostic DAQ system using KMCU V2, that is KMCU-Z30. This paper will present the implementation of KSTAR diagnostic DAQ systems configured with KMCU based on MTCA.4 and their operating results.

TUPHA081 Pilot Application of New Control System at SPring-8 RF Test Stand

***N. Hosoda**, M. Ishii, T. Ohshima, M. Yamaga (JASRI/SPring-8) T. Fukui (RIKEN SPring-8 Center, Innovative Light Sources Division) A. Gimenez (RIKEN)*

After 20 years successful operation of SPring-8, the third generation synchrotron radiation facility, maintaining old analogue modules of LLRF system tend to be difficult. Meanwhile a digital technology like FPGA, fast ADC/DAC become popular. We decided to replace the old analog LLRF system with modern MTCA.4 based one. Prior to replacing the system, we planed to examine the performance of the new system at an RF test stand. An AMC digitizer and a RTM vector modulator were introduced. A feedback control function was reproduced in the FPGA of the digitizer. We also adopted EtherCAT for relatively slow control, such as a motor control for cavity tuner and monitoring of a vacuum pressure. In addition to developing the new hardware of MTCA.4, we were developing a new data acquisition system and a new MQTT based messaging system for an integrated control framework of SPring-8 and SACLA, the X-ray free electron laser facility. To prove feasibility of new control system, it was implemented at the RF test stand. As the result of high power RF operation, we achieved demanding stability of RF in the cavity. We also confirmed that new software framework was enough to control LLRF system.

TUPHA082 The Timing System of HIRFL-CSR

***W. Zhang**, S. An, S.Z. Gou, K. Gu, P. Li, Y.J. Yuan, M. Yue (IMP/CAS)*

This article gives a brief description of the timing system for Heavy Ion Research Facility in Lanzhou- Cooler Storage Ring (HIRFL-CSR). It introduces in detail mainly of the timing system architecture, hardware and software. We use standard event system architecture. The system is mainly composed of the events generator (EVG), the events receiver (EVR) and the events fan-out module. The system is the standard three-layer structure. OPI layer realizes generated and monitoring for the events. The intermediate layer is the events transmission and fan out. Device control layer performs the interpretation of the events. We adopt our R&D EVG to generate the events of virtual accelerator. At the same time, we have used our own design events fan-out module and realize distributed on the events. In equipment control layer, we use EVR design based on FPGA to interpret the events of different equipment and achieve an orderly work. The Timing System realize the ion beam injection, acceleration and extraction.

TUPHA083 The TimIQ Synchronization for Sub-Picoseconds Delay Adjustment

***J.P. Ricaud**, N. Hubert, C. Laulhé (SOLEIL) H. Enquist (MAX IV Laboratory, Lund University)*

Synchrotron facilities provides short, regular and high frequency flashes of light. These pulses are used by the scientific community for time resolved experiments.

To improve the time resolution, demands for always shorter X-ray pulses are growing. To achieve this goal, Synchrotron SOLEIL and MAX IV laboratory have developed special operating modes such as low-alpha and femtoslicing, as well as a single pass linear accelerator. For the most demanding experiments, the synchronization between short light pulses and pump-probe devices requires subpicoseconds delay adjustment. The TimIQ system has been developed for that purpose. It is a joint development between Synchrotron Soleil and MAX IV Laboratory. It is aimed to be used on three beamlines at Soleil and one at MAX IV. Based on IQ modulation technics, it allows shifting a radio frequency clock by steps of #100 fs. This paper is a description of this system and of its performances.

TUPHA084 **Decoupling CERN Accelerators**

***A. Dworak**, J.C. Bau (CERN)*

The accelerator complex at CERN is a living system. Accelerators are being dismantled, upgraded or change their purpose. New accelerators are built. The changes do not happen overnight, but when they happen they may require profound changes across the handling systems. Central timings (CT), responsible for sequencing and synchronization of accelerators, are good examples of such systems. This paper shows how over the past twenty years the changes and new requirements influenced the evolution of the CTs. It describes experience gained from using the CBCM CT model, for strongly coupled accelerators, and how it led to a design of a new Dynamic Beam Negotiation (DBN) model for the AD and ELENA accelerators, which reduces the coupling, increasing accelerator independence. The paper ends with an idea how to merge strong points of both models in order to create a single generic system able to efficiently handle all involved CERN accelerators and provide more beam time to experiments and LHC.

TUPHA085 **Z DAS Distributed Timing Techniques**

***J.A. Mills** (Sandia National Laboratories)*

The Z Data Acquisition System provides recording of more than six hundred channels of waveform data for each down line Z Accelerator shot using over two hundred recorders from various manufactures. These recorders are located in remote recording locations spread throughout the accelerator facility. The timing relationship between recorded waveforms is of considerable interest to experimenters and other users of data generated when Z conducts an experiment. Several systems are used to measure the timing differences and then apply them to the waveform data prior to data reduction activities. Those systems and other timing considerations that reduce waveform timing uncertainties to less than 1ns between any location will be explained.

TUPHA086 **Timing System Upgrade for Top-off Operation of HLS-II**

***C. Li**, J.L. Li, W. Li, G. Liu, J.G. Wang, L. Wang, K. Xuan (USTC/NSRL)*

The Hefei Light Source II (HLS-II) is a vacuum ultraviolet (VUV) synchrotron light source. A major upgrade of the light source was finished in 2014, and the timing system was rebuilt with event-system to meet synchronization requirements of the machine. The new timing system provides about 100 output signals with various interfaces. The time resolution of this system is 9.8 ns for most devices and 9 ps for the electron gun and the injection kickers. The measured jitter of the output signal is less than 27 ps (RMS). In order to improve the performance of light source, the top-off operation mode has been planned. As part of this plan, device supports and drivers of timing hardware are redesigned in EPICS architecture. By obtaining real-time data of beam measurement of storage ring, the automatic selection of the bucket is implemented. With any designated bunch pattern, top-off injection is achieved, and the storage ring beam can be uniform filled well.

TUPHA087 The Timing Diagram Editing and Verification Method

***G.A. Fatkin**, A.I. Senchenko (BINP SB RAS) **G.A. Fatkin**, A.I. Senchenko (NSU)*

Preparation and verification of the timing diagrams for the modern complex facilities with diversified timing systems is a difficult task. A mathematical method for convenient editing and verification of the timing diagrams is presented. This method is based on systems of linear equations and linear inequalities. Every timing diagram has three interconnected representations: a textual equation representation, a matrix representation and a graph (tree) representation. A prototype of software using this method was conceived in Python. This prototype allows conversion of the timing data between all three representations and its visualization.

TUPHA088 Timing System at ESS

***J. Cereijo García**, T. Korhonen, J.H. Lee (ESS)*

The European Spallation Source (ESS) uses the event-based timing system developed by Micro-Research Finland (MRF). Its main purposes are: event generation and distribution, time stamping, synchronous transmission of beam-related data, synchronous clock signals distribution and triggering signals in different subsystems of the facility. The timing system has a basic topology: an Event Generator (EVG) sends the events, clocks and data to an array of Event Receivers (EVRs) through an optical distribution layer (fan-out modules). The event clock frequency will be 88.0525 MHz, divided down from the bunch frequency of 352.21 MHz. An integer number of ticks of this clock will define the beam macro pulse full length, around 2.86 ms, with a repetition rate of 14 Hz. An active delay compensation mechanism will provide stability against long-term drifts. An advantage of ESS over other facilities is the use of the features provided by EVRs in uTCA form factor, such as trigger and clock distribution over the backplane. These EVRs are already being deployed in some systems and test stands.

TUPHA090 TiCkS: A Flexible White-Rabbit Based Time-Stamping Board

***C. Champion**, R. Oger, M. Punch (Laboratoire APC) Y. Moudden (CEA/DRF/IRFU)*

We have developed the TiCkS board based on the White Rabbit (WR) SPEC node, to provide ns-precision time-stamps (TSs) of input signals (e.g., triggers from a connected device) and transmission of these TSs to a central collection point. TiCkS was developed within the specifications of the Cherenkov Telescope Array (CTA) as one of the candidate TS nodes, with a small form-factor allowing its use in any CTA camera. The essential part of this development concerns the firmware in its Spartan-6 FPGA, with the addition of: 1) a 1ns-precision TDC for the TSs; 2) a UDP stack to transmit TSs and auxiliary information over the WR fibre, and to receive configuration & slow control commands over the same fibre. It also provides a 1-PPS and other clock signals to the connected device, from which it can receive auxiliary event-type information over an SPI link. A version of TiCkS with an FMC connector will be made available in the WR OpenHardware repository, so allowing the use of a mezzanine card with varied formats of input/output connectors, providing a cheap, flexible, and reliable solution for ns-precision time-stamping of trigger signals up to 200 kHz, for use in other experiments.

TUPHA091 A Reliable White Rabbit Timing Network for the Fair Control System

***C. Prad
os** (GSI)*

A new timing system based on White Rabbit (WR) is being developed for the upcoming FAIR facility at GSI, in collaboration with CERN and other partners. The timing system is responsible for the synchronization of nodes and distribution of timing events, which allows for real-time control of the accelerator equipment.

WR is a time-deterministic, low latency Ethernet-based network for general data transfer and sub-ns time and frequency and time distribution. The FAIR timing system WR network is considered operational only if it provides deterministic packet delivery and resilient data and clock distribution. In order to achieve this level of service, methods and techniques to increase the robustness, reliability and resilience of the WR network has been evaluated. Unfortunately it is not possible to apply common networks solutions due to the demanding requirements of the FAIR systems. Therefore the author has explored, within the standard limits, alternative methods and techniques. This paper presents the FAIR timing system requirements and novel networking solutions to overcome the intrinsic problems of timing switches networks.

TUPHA092 Two Years of FAIR General Machine Timing - Experiences and Improvements

***M. Kreider**, R. Bär, J.N. Bai, D. Beck, A. Hahn, J. Hoffmann, N. Kurz, C. Prados, S. Rauch, M. Reese, M. Zweig (GSI) J.N. Bai (IAP) **M. Kreider** (Glyndŵr University)*

The FAIR General Machine Timing system has been in operation at GSI since 2015 and significant progress has been made in the last two years. The CRYRING accelerator was the first machine on the GSI/FAIR campus operated with the new timing system and serves as a proving ground for new control system technology to this day. A White Rabbit (WR) network was set up, connecting parts of the existing facility. The Timing Master was improved and is now under direct control by the LSA physics framework. Several form factors of Timing Receiver nodes (Scalable Control Unit, the standard front-end controller for FAIR, VME, PCIe and standalone) were developed. Their hard and software is now in their second release version and subject to a continuous series of long- and short-term tests in varying network scenarios. The final goal is time-synchronization of 2000-3000 nodes using the WR Precision-Time-Protocol distribution of TAI time stamps and synchronized command and control of FAIR equipment. Promising test results for scalability and accuracy were obtained when moving from temporary small lab setups to CRYRING's control system with more than 30 nodes connected over 3 layers of WR Switches.

TUPHA093 Development of the Fast Protection System Prototype in the RAON Accelerator Control System

***H. Jin**, H. Jang, S. Lee (IBS) L.R. Dalesio (EPIC Consulting) W.K. Lewis (BNL) W.E. Norum (LBNL)*

The RISP (Rare Isotope Science Project) in Korea has developed the RAON accelerator that generates and accelerates a wide range of rare isotopes and stable ions for scientific experiments in various fields. For a uranium case, the beam energy reaches 200 MeV/u after passing through the high energy superconducting linear accelerator, and the beam power approaches 400 kW. During the transportation and the acceleration of this kind of beam, the beam loss can lead to the significant damage of the superconducting RF cavities and other accelerator equipment. For that reason, the fast protection system (FPS) is required to take mitigating action due to such severe damage occurring within a few tens of microseconds. For the development of this FPS in the RAON accelerator, the FPS prototype based on an FPGA platform has been developed as a priority. Here we will present the development of the FPS prototype in the RAON accelerator control system and describe the test results.

TUPHA094 Monitoring the Utility System Parameters at Novosibirsk Free Electron Laser Facility

***S.S. Serednyakov**, E.I. Kolobanov, V.R. Kozak, L.E. Medvedev, M.A. Scheglov, P.A. Selivanov, S.V. Tararyshkin (BINP SB RAS)*

Novosibirsk Free electron Laser (FEL) is a source of coherent radiation, based on multi-turn energy recovery linac. As any installation of this type, for its operation it requires a set of engineering systems - electrical power system, water and air cooling system. The stability parameters of FEL facility during operation, such as wavelength and power of coherent radiation depends on time stability of utility system parameters. The main parameters of these systems are: temperature of cooling water and air, speed of cooling water stream, parameters of electrical power system - amplitude and long-term stability of feeding voltage. As time behavior of these parameters is very critical, the system of monitoring of these parameters was introduced. Also, interlock system on some of these parameters was developed. This system was integrated with general FEL control system so all parameters of this system are stored in the same archive as all parameters of FEL operation. The structure, used hardware, main capabilities, of this system are described in this article.

TUPHA095 NSLS-II Beamline Equipment Protection System

***H. Xu** (BNL)*

The National Synchrotron Light Source II (NSLS-II) beamline Equipment Protection System (EPS) delivers a general solution of dealing with various beamline components and requirements. All IOs are monitored and controlled by Allen Bradley PLC. EPICS application and CSS panels provide high level monitoring and control.

TUPHA096 The Machine Protection System for the Injector II

***Y.H. Guo**, Cheng,Y. Cheng (IMP/CAS)*

The IMP takes responsibility for the development of Injector II. The target energy index of it is 20-25Mev , which is an intense beam proton accelerator with high operation risk. In order to implement cutting the ion source beam in time when the beam position offset happened, the Injector II Machine Protection System is developed based on FPGA controller and PLC. This system aims to prevent device damage from continuous impact of intense beam, as well as obtains and stores status data of key devices when failures occur to implement failure location and analysis. The whole system is now operating stable in field, and the beam cutting time is less than 10us.

TUPHA098 The FRIB Run Permit System

***D. Chabot**, M. Ikegami, M.G. Konrad, D.G. Maxwell, G. Shen (FRIB)*

The Facility for Rare Isotope Beams (FRIB) accelerates many different ion species and charge states defining a wide spectrum of operating modes and parameters. The role of the Run Permit System (RPS) here is to examine if a requested state is suitable for the production of beam. The decision to permit beam is based on input from configuration management databases, machine and personnel protection systems, and beam characteristics and destination. Seeded with this information, an appropriate set of operating parameters are deployed to hardware to support the requested mode. This contribution will describe the interfaces, implementation, and behavior of the RPS at FRIB.

TUPHA099 The Radiation Safety Program for Linear Accelerators of FAB Center

***J.W. Lee** (KAERI) Y.S. Choi (Korea Academy of Nuclear Safety) C.Y. Kim (Chonbuk National University) K.B. Lee (Korea Institute of Nuclear Safety)*

The Radiation Equipment Fabrication Center (FAB Center) of ARTI(Advanced

Radiation Technology Institute) in KAERI (Korea Atomic Energy Research Institute) has three accelerator rooms in which 15MV, 9MV and 6MV linear accelerators are operated. And over 20 researchers are working in center. So, the safe operation of accelerators is more important than any other things. One of the key elements of safety in accelerators is the safety interlock system designed to protect the machine and personnel under any abnormal / unsafe condition. The level of safety provided by this system should be appropriate to the hazards expected from the accelerators. Depending upon the nature and extent of radiation hazards, an accelerator facility may be categorized 3 zones for access control systems. Just before the primary particle beam is switched on, a Search and Secure operation should be conducted in inaccessible area during accelerator operation and controlled entry during shutdown or controlled area, accessible with appropriate administrative controls to ensure that no person has remained in the interlocked areas. This report also will introduce the radiation safety program of the FAB Center.

TUPHA101 Strategy for Allocating Highly Distributed Protection Functions at ESS

S. Kövecses, *R. Andersson, E. Bargalló, A. Nordt, M. Zaera-Sanz (ESS) R. Andersson (University of Oslo) C. Hilbes, M. Rejzek (ZHAW)*

The European Spallation Source is being built in Lund, Sweden to compensate for the European decline in available neutrons. ESS will have a proton beam power of 5MW and will be the brightest neutron source upon completion. The high damage potential requires uttermost care when designing the machine and its protection. The machine protection at ESS is designed using the IEC61508 functional safety standard as a guideline. The overall protection requirements allocation is complicated by the complexity of the facility and the distribution of the organization. Each Protection Function spans over multiple systems and in many cases multiple sites. To implement a protection function, numerous design teams are involved, including in kind-contributors, partners and collaborators. To find the most suitable architecture for the protection functions, use case workshops are held. Stakeholders from the relevant systems are invited to the workshops. The feasibility of different implementations is discussed and simulated by going through foreseen operational sequences, use cases. The different architectures and use cases are documented using Enterprise Architect.

TUPHA102 New Complex Proton Synchrotron Beam Permit process

R. Valera Teruel, *F. Chapuis, J.L. Duran-Lopez, C. Gaignant, T. Krastev, E. Matli, K. Pater, A. Patrascoiu, F. Pirotte, R. Steerenberg, M.J.S. Tavlet, A. Wardzinska (CERN)*

Injecting beams in CERN facilities is subject to the CERN safety rules. It is for this reason that the Beam Permit approval procedure was improved by moving away from a paper-based workflow to a digital form. For each facility the Beam Permits are signed by the various responsible specialists (Access systems, safety equipment, radiation protection, etc…). To achieve this, CERN's official Engineering Data Management System (EDMS) is used. The functionality of EDMS was extended to accommodate the additional requirements, whilst keeping a user friendly web interface. In addition, a new webpage within the CERN OP-webtools site was created with the purpose of providing a visual overview of the Beam Permit status for each facility. This new system is used in the CERN Control Centre (CCC) and it allows the operations team and all people involved in the signature process to follow the Beam Permit status in a more intuitive, efficient and safer way.

TUPHA103 LIA-20 Experiment Protection System

A. Panov *(BINP SB RAS)*

In Budker Institute of Nuclear Physics is being developed linear induction accelerator with beam energy 20MeV (LIA-20) for radiography. Distinctive feature of this accelerator in protection scope is existence both machine, person protection and experiment protection system. Main goal of this additional system is timely experiment inhibit in event of some accelerator faults. This system based on uniform protection controllers in VME form-factor which connected to each other by optical fiber. By special lines protection controller fast receive information about various faults from accelerator parts like power supplies, magnets, vacuum pumps and etc. Moreover each pulse power supply (modulator) fast send its current state through special 8 channel interlock processing board, which is base for modulator controller. This system must processing over 4000 signals for decision in several microseconds for experiment inhibit or permit.

TUPHA104 ESS Accelerator Access Control System

***M. Mansouri**, S.L. Birch, A. Nordt, D. Paulic, Y.K. Sin, A. Toral Diez (ESS)*

The European Spallation Source (ESS), currently under construction in Sweden, is a collaboration of 17 European countries to build the world's most powerful neutron source for research. ESS facility incorporates a 600-meter long Linear proton accelerator, a target station and several neutron instruments. Considering hazards associated with proton accelerator operation, such as prompt radiation, oxygen deficiency and high voltage, an access control system is required to protect personnel by limiting access to hazardous areas and ensuring nobody is present in the tunnel when the accelerator is in operation. This paper describes the requirements and design of ESS accelerator access control system as a subsystem to ESS Accelerator Personnel Safety Systems (PSS). We begin with definition of radiation areas in accelerator buildings, and will detail the layout of accelerator tunnel and the PSS access points. The adoption of trapped key interlock system, databases for personnel safety training and received dose information, double-door airlock system to grant access to accelerator tunnel will be presented in this paper as well.

TUPHA105 Development of Pulse Fault Sequence Analysis Application with KSTAR Data Integration System

***T.H. Tak**, J.S. Hong, M.K. Kim, G.I. Kwon, T.G. Lee, W.R. Lee (NFRI)*

The Korea Superconducting Tokamak Advanced Research (KSTAR) interlock related systems are configured with various system such as fast interlock, supervisory interlock, plasma control, central control, and heating using various types of hardware, software, and interface platforms. For each system, monitoring and analysis tools are already well-developed. However, for the analysis of system fault behavior, these heterogeneous platforms do not help finding the relation of failure. When the interlock events are latched or pulse is stopped by PCS, events are transmitted to different actuators and it could make another events via various interface. In other words, it could lead another factor of fault causes on different system. Through this application we will figure out sequence of fault factor during the pulse-by-pulse KSTAR operation. The KSTAR Data Integration System (KDIS) is configured with KSTAR event-driven architecture and data processing environment. This application will be developed on the KDIS environment and synchronized with KSTAR event. This paper will present the development of shot fault sequence analysis logic and application with KDIS.

TUPHA106 Oxygen Deficiency Hazard Detection System Using PLC Controls

***A. Toral Diez**, S.L. Birch, M. Mansouri, A. Nordt, D. Paulic, Y.K. Sin (ESS)*

In European Spallation Source ERIC (ESS), cryogenic cooling is essential for various equipment of the facility that will be provided with nitrogen and helium. The future ESS superconducting LINAC, the ESS cryomodule test stand, the moderator surrounding the target as well as the neutron instruments will require major services in order to be supplied with liquid nitrogen and cold helium. ESS Protection Systems Group will install Oxygen Deficiency detection system in those plants which are connected to PLC system and display the real time data to alarm personnel in hazardous area. This paper describes the architecture and control philosophy for Oxygen Deficiency detection system.

TUPHA107 Technical and Organisational Complexities With a Distributed MP Strategy at ESS

***E. Bargalló**, R. Andersson, S. Kövecses, A. Nordt, M. Zaera-Sanz (ESS)*

The reliable protection of the ESS equipment is important for the success of the project. This requires multiple systems and subsystems to perform the required protection functions that prevent undesired hazardous events. The complexity of the machine, the different technical challenges and the intrinsic organisational difficulties for an in-kind project like ESS impose serious challenges to the distributed Machine Protection strategy. In this contribution, the difficulties and adopted solutions are described to exemplify the technical challenges encountered in the process.

TUPHA108 Upgrade of ALBA Personnel Safety System PLC's and Fieldbus

***J. Villanueva**, G. Cuní, D. Fernández-Carreiras, A. Rubio, S. Rubio-Manrique, N. Serra (ALBA-CELLS Synchrotron)*

The current Personnel Safety System is based on the Pilz PSS3000 PLCs: two CPU's for the Accelerator and seven for the Beamlines. All the CPU's are interfaced between them using SafetyBus for the implementation of Safety Functions and Ethernet for monitoring and diagnostics from the Control Room SCADA. According to Pilz, the PSS3000 are in discontinuation process. In consequence, the upcoming Beamlines will be implemented with different PLCs and the migration of the PLCs currently in production is considered. The use of the Pilz PSS4000 PLC's is proposed, which are equipped with Ethernet interface and SafetyNet protocol instead of SafetyBus. This change in the technology will require the design and development of a communication interface between current PSS3000 and new PSS4000 PLCs (PSS Gateway) and the modification and expansion of the current PSS Ethernet network (PSS Network upgrade).

TUPHA109 ALBA Personnel Safety System Current Status

***J. Villanueva**, G. Cuní, D. Fernández-Carreiras, A. Rubio, S. Rubio-Manrique, N. Serra (ALBA-CELLS Synchrotron)*

The Personnel Safety System prevents people to get a radiation dose higher than the limits given by the law. It surveys radiation levels and provides access to restricted areas, such as Linac, Tunnel and Beamline lead hutches. It is subjected to Ionizing Radiation Regulations. It is independent from any other system in Alba and the Spanish Nuclear Safety Council shall approve it. The PSS is governed by the international norm IEC 61508. The ALBA PSS Safety Integrity Level aims SIL3. The logic is organized in permits and interlocks: a permit is the result of a set of conditions fulfilled and an interlock is a condition for granting or revoking permits. For example, in order to open the front-end, the hutch must be interlocked, emergency-stops armed, the operation keys in place, etc. The system is built around the Pilz PSS SB2 3006-3 ETH-2 CPU; using two of them for the Accelerators, Tunnel and Linac, and one for each Beamline. All CPU's are currently intercommunicated by Pilz SafetyBus.

TUPHA111 A Major Performance Upgrade to the Transverse Feedback System at the Advance Photon Source

***N.P. DiMonte**, C. Yao (ANL)*

With the success and reliability of the transverse feedback system installed at the Advance Photon Source (APS), a major upgrade to expand the system is under way. The existing system is operating at a third of the storage ring bunch capacity, or 324 of the available 1296 bunches. This upgrade will allow the sampling of all 1296 bunches and make corrections for all selected bunches in a single storage ring turn. To facilitate this upgrade a new analog I/O board capable of 352 MHz operation was developed along with a revolution clock cleaning circuit. A 352MHz clock cleaning circuit was also required for the high-speed analog output circuit to maintain data integrity to the receiving DAC unit that is 61m away. This receiving DAC unit will have its transceiver data rate upgraded from 2.3Gbps to about 7Gbps transmitted over a fiber optic link. This paper discusses some of the challenges in reducing the clock jitter from both the system P0 bunch clock and the 352MHz clock along with the necessary FPGA hardware upgrades and algorithm changes, all of which is required for the success of this upgrade.

TUPHA113 **The New Magnetic Control On WEST Facility**

***R. Nouailletas**, E. Nardon, X. Song (CEA) C. Boulbe, H. Heumann (Université de Nice Sophia-Antipolis) P. Moreau, F. Saint-Laurent (Association EURATOM-CEA) W. Treutterer (MPI/IPP)*

The WEST (W -for tungsten- Environment Steady-state Tokamak) project, consisting in a major upgrade of the Tore Supra tokamak, aims at the technology testing of the actively cooled tungsten divertor of the ITER project. The main modification was the installation of 2 in-vessel poloidal coils to shape diverted plasma either with one or 2 X-points and the installation of actively cooled ITER-like plasma facing components. The control of the plasma shape is a key system because testing the ITER-like components requires high heat flux and high fluence regimes where the plasma must be controlled at few centimeters of a component. To be able to control WEST, the magnetic controller has been completely redesigned. It is now based on 2 control stages: The first one is in charge of the in-vessel and ex-vessel coil currents. It takes its references from the 2nd stage that ensures the plasma shape and current control. In this contribution, the development workflow of this new WEST magnetic control algorithm based on FEEQS (a new free-boundary plasma equilibrium solver) will be presented. The controller performances and robustness will be discussed using simulation and plasma discharge data.

TUPHA114 **Fast Orbit Feedback FPGA Firmware Development at Australian Synchrotron**

***S. Chen**, E. Tan (ASCo) B. Dickson, P.F. Savage (Arrayware Pty Ltd) R.B. Hogan, P. Martin, A. Michalczyk (SLSA)*

A Fast Orbit Feedback (FOFB) controller firmware is under development on the Virtex-6 Xilinx FPGA platform at Australian Synchrotron. The controller firmware receives aggregated position data from a Libera Electron, extracts the beam position information, and computes the correction for the fast response power supplies based on dedicated algorithms. The PID handler, harmonic suppressors and a pre-emphasis filter are to be designed in Simulink and their HDL code will be generated by MATLAB HDL coder for better flexibility. In addition it provides an interface to the facility's EPICS control system to control the operation modes of the FOFB controller, send configuration data and algorithm matrices, and receive diagnostic information and status reports of data integrity checks. The aim of the FOFB system is to damp the RMS transverse beam position motion to less than 10% of one sigma of the transverse beam size up to 100Hz.

TUPHA116 **New RF Cavity Tuning System at LNL**

***D. Bortolato**, F. Gelain, D. Marcato, E. Munaron, S. Pavinato, D. Pedretti (INFN/LNL) M.A. Bellato, R. Isocrate (INFN- Sez. di Padova)*

The superconducting linear accelerator at Legnaro National Laboratories (LNL) consists in 96 RF cavities. A new cavity tuning control system has been developed.

Exploiting the stepper motors already present, the driver for the motors and the distributed control system have been upgraded. In particular the driver is based on a commercial terminal, whereas the control system has been migrated on EPICS. Furthermore two routines have been achieved in order to tune the cavity to its own resonance frequency and to keep the cavity tuned when it is already locked. In this paper, the control system and the implementation of the tuning procedures will be described in deep.

TUPHA117 Upgrade of the LLRF Control System at LNL

***S. Pavinato**, D. Bortolato, F. Gelain, D. Marcato, E. Munaron, D. Pedretti (INFN/LNL) M.A. Bellato, R. Isocrate (INFN- Sez. di Padova)*

For the SPES project at Legnaro National Laboratories (LNL), a Low-Level Radio Frequency (LLRF) has been designed to have flexibility, reusability and an high precision. It is an FPGA-based digital feedback control system using RF ADCs for the direct undersampling and it can control at the same time eight different cavities. The LLRF system was tested on the field with an accelerated beam. In the last year some improvements on the firmware, software and hardware of the control system have been done. In this paper the results carried out in the more recent tests, the future works and the upgrades of the system will be detailed.

TUPHA118 Correction of 10hz Orbit Distortion From Diamond's I10 Fast Switching Chicane

***M.J. Furseman**, C.P. Bailey, S. Gayadeen, G. Rehm, W.A.H. Rogers (DLS)*

The I10 beamline at Diamond Light Source is configured to study circular dichroism. To increase signal to noise ratio between the two beam polarisations and increase temporal resolution the beamline is fed by two separate insertion devices that are typically configured with opposite handed polarisations. A chicane of steering magnets with programmable power supplies is used to provide 10Hz switching between the two photon beams by producing a dynamic closed bump that alternates the on-axis trajectory of the electron beam between the two insertion devices. In order to maintain the closed bump and make the switching transparent to the rest of the photon beamlines the phase and amplitude of the sine function applied to the chicane magnets must be exactly correct. In this paper the linear scheme that was used to correct the residual 10Hz orbit distortion is presented. Future work that uses the fully programmable nature of the magnet power supply controllers to correct high order distortions is also discussed.

TUPHA119 Online Coupling Measurement and Correction Throughout the LHC Cycle.

***G.H. Hemelsoet**, A. Calia, K. Fuchsberger, M. Gabriel, M. Hostettler, M. Hruska, D. Jacquet, T. Persson, M.E. Soderen, D. Valuch (CERN)*

With high intensity beams, a precise measurement and effective correction of the betatron coupling is essential for the performance of the Large Hadron Collider (LHC). In order to measure this parameter, the LHC transverse damper(ADT), used as an AC dipole, will provide the necessary beam excitation. The beam oscillations will be recorded by the Beam Positions Monitors and transmitted to dedicated analysis software. We set up the project with a 3-layer software architecture: The central node is a java server orchestrating the different actors: The Graphical User Interface, the control and triggering of the ADT AC dipole, the BPMs, the oscillation analysis (partly in python), and finally the transmission of the correction values. The whole system, is currently being developed in a team using Scrum, an iterative and incremental agile software development framework. In this paper we present an overview of this system, experience from machine development and commissioning as well as how scrum helped us to achieve our goals. Improvement and re-use of the architecture with a nice decoupling between data acquisition and data analysis are also briefly discussed.

TUPHA120 New CERN Proton Synchrotron Beam Optimization Tool

E. Piselli, *A. Akroh (CERN)*

This paper describes a new software tool recently developed at CERN called (New CPS Beam Optimiser). This application allows the automatic optimization of beam properties using a statistical method, which has been modified to suit the purpose. Tuning beams is laborious and time-consuming, therefore, to gain operational efficiency, this new method to perform an intelligent automatic scan sequence has been implemented. The application, written in JavaFX, uses CERN control group standard libraries and is quite simple. The GUI is user-friendly and allows operators to configure different optimization processes in a dynamic and easy way. Different measurements, complemented by simulations, have therefore been performed to try and understand the response of the algorithm. These results are presented here, along with the modifications still needed in the original mathematical libraries.

TUPHA121 Development of the Power Supply Control System for J-PARC Hadron Experimental Facility

K. Agari, *H. Akiyama, Y. Morino, Y. Sato, A. Toyoda (KEK)*

The Hadron Experimental Facility is designed to handle an intense slow-extracted proton beam from the 30-GeV Main Ring of the Japan Proton Accelerator Research Complex (J-PARC). We have developed a new control system of a magnet power supply to work with a Programmable Logic Controller (PLC). The control PLC handles the status of the interlock signals between a power supply and a magnet, and monitors the output voltage and the current. The PLC also controls a programmable reference voltage to regulate the output current. In addition, we have been developing an automatic orbit-correction program with the control system of the magnet power supply. The previous data of the beam profile monitors located on the upstream side of the beam dump and the temperature distribution on the beam dump show a possibility of the automatic correction of the beam orbit to the beam dump. The optimized current for the horizontal steering magnet was calculated from the horizontal displacement of the proton beam measured with the beam profile monitors. This paper reports the current status of the power supply control system which can automatically correct the horizontal beam position at the beam dump.

TUPHA122 LAPS Robot Upgrade for Full Integration into EPICS at the Australian Synchrotron (ANSTO)

G. Conesa Zamora, *B.W. Karnaghan, P. Martin (SLSA) , N. Hauser (ANSTO)*
A. Rhyder, A. Walsh (ASCo)

The LAPS (Large Animal Positioning System) Robot was installed at the Australian Synchrotron in 2014. This robot has been used in several experiments on live animals and proved to be a useful tool with great mechanical characteristics. However, it was implemented as a standalone system and could only be controlled by direct human interaction. This paper describes how the LAPS robot was fully integrated into EPICS, allowing programmatic control and the capability directly seating at the IOC side. This is a major advancement, since the logic is implemented at the EPICS driver level and provides full flexibility in robot operation and increases performance. As a direct result of the upgrade, we are now able to perform CT scans with the robot; this means that we can increase the maximum object height by 6 times (up to 80 cm) and handle much heavier samples. This paper also covers the project complexity due to the expertise required in diverse areas like motion control, safety, equipment protection, robotics and EPICS driver development. Furthermore, this design required a software beta version, from the robot manufacturer, so a collaborative approach with KUKA HQ developers was needed

TUPHA125 The Bunch Arrival Time Monitor at FLASH and European XFEL

M. Viti, *M.K. Czwalinna, H. Dinter, C. Gerth, K.P. Przygoda, R. Rybaniec, H. Schlarb (DESY)*

In modern free electron laser facilities like FLASH I/II and European XFEL at DESY a high resolution intra bunch train arrival time measurement is mandatory, providing a crucial information for the beam based feedback system. For this purpose a Bunch Arrival Time Monitor (BAM) was developed, based on an electro-optical scheme where an ultra-short pulsed laser is employed. A BAM is composed of several subsystems, including stepper motors, power management, dedicated readout board, management board for voltage settings, temperature sensors and temperature controller and optical amplifier. Part of the electronics is developed using the MicroTCA standard. We will present in this poster the basic requirements for the BAM, software design and implementation developed to manage the subsystems and their interactions.

TUPHA126 Applying Control Theory in a Synchrotron's Control System

P. Sagało, *Ł.J. Dudek, W.T. Kitka, T. Szymocha, A.I. Wawrzyniak (Solaris National Synchrotron Radiation Centre, Jagiellonian University)*

Complicated physics processes that are present in a synchrotron's activities are usually overseen by high qualified operators who steer them by hand. However, they can be seen from a perspective of control theory: as problems which require optimal control that can be calculated and applied. At NSRC SOLARIS, we have performed feasibility studies and developed frameworks for optimisation of several processes control that happen every day in our facility, specifically orbit correction and the whole process of injection. We had chosen Python as the language of choice for our control system so we have strived to combine existing solutions for simulation and optimisation in that language with Tango Controls framework. Within this presentation the application of several control system problems will be reported.

TUPHA127 A Dual Arms Robotic Platform Control for Navigation, Inspection and Telemanipulation

M. Di Castro, *L. Buonocore, S.S. Gilardoni, G. Lilli, R. Losito, G. Lunghi, A. Masi (CERN) M. Ferre (ETSII UPM)*

High intensity hadron colliders and fixed target experiments at CERN require an increasing amount of robotic tele-manipulation interventions to prevent and reduce excessive exposure of maintenance personnel to the radioactive environment. Tele-manipulation tasks are often required on dated radioactive devices which were not conceived to be maintained and handled using standard one arm robotic solutions. Robotic platforms with a level of dexterity that often requires using two robotic arms with a minimum of six degrees of freedom are instead needed for these purposes. In this paper, the control of a novel robust robotic platform able to host and to carry safely a dual-arms robotic system is presented. The arms and the vehicle controls are fully integrated in order to guarantee simplicity to the operators during the realization of the robotic tasks. A novel high-level control architecture for the new robot is shown, as well as a novel low-level safety layer for anti-collision and recovery scenarios. Preliminary results of the system commissioning are presented using CERN accelerator facilities as a use case.

TUPHA128 **Using LabVIEW to Build Distributed Control System of a Particle Accelerator**

V.V. Aleinikov, *I.V. Borina, A.I. Krylov, K.P. Sychev (JINR/FLNR) S. Pachtchenko (JINR)*

New isochronous cyclotron DC-280 is being created at the FLNR, JINR. Total amount of the process variables is about 4000. The variety of field devices of different types is 20. This paper describes architecture and basic principles of the distributed control system using LabVIEW DSC module.

TUPHA129 **Motion Control System for the European Spallation Source Target Wheel**

A. Sandström, *D.P. Brodrick, T. Gahl, B. Gallese, K. Jurisic, M. Larsson, K. Sjögreen (ESS)*

The European Spallation Source (ESS) linear accelerator will deliver high energy proton bunches to tungsten sectors on a rotating Target Wheel, which will produce neutrons through a nuclear process. The motion control system of the Target Wheel presents engineering challenges, such as: velocity and phase stability requirements to precisely align individual tungsten sectors with proton bunches from the accelerator; a high moment of inertia due to the composition and distribution of mass on the wheel; limitations on the physical space to integrate control components, and components for associated safety systems; and, some components being exposed to a high radiation environment. The motion control system being prototyped employs components that satisfy the constraints on the physical space and radiation environment. Precise velocity and phasing of the Target Wheel are achieved by generating a series of pulses as each tungsten sector passes a fiducial point in the rotational cycle, and implementing a motion control algorithm to correctly synchronise the Target Wheel with reference signals from the centralised ESS timing system, which also controls the timing of the accelerator.

TUPHA130 **Design and Development of the Control System for a Compact Carbon-14 AMS Facility**

K.N. Li, *Y.W. Bao, M. He, Y.M. Hu, S. Jiang, S.Y. Su, Q.B. You, J.M. Zhou (CIAE)*

A compact AMS facility which is special used for further analyzing atmospheric pollution especially in north China via carbon-14 measurement was developed at CIAE (China Institute of Atomic Energy). This machine is a single acceleration stage AMS, running with the highest accelerate voltage of 200kV. The control system is based on distributed Ethernet control system, using standard TCP/IP protocol as main communication protocol. In order to connect to the main control network freely, device-level data-link layers were developed also. A LabVIEW client, developing virtual machine applied environment, provides friendly graphical user interface for the devices management and measurement data processing.

TUPHA131 **PLC Based Vacuum Controller Upgrade and Integration at the Argonne Tandem Linear Accelerator System (ATLAS)**

C.E. Peters, *C. Dickerson, A.E. Germain, Y. Luo, M.A. Power, R.C. Vondrasek (ANL)*

The installation of a new Electron Beam Ion Source (EBIS) to the Argonne Tandem Linear Accelerating System (ATLAS) at Argonne National Laboratory requires a vacuum system capable of providing pressures in the region of 10^{-10} Torr. Historically, vacuum interlocks have been provided via analog logic chassis which are difficult to upgrade and maintain. In order to provide sufficient interlocks to protect high voltage components of the EBIS, a new PLC based Vacuum control system has been developed and integrated into the rest of the accelerator supervisory control system. The PLC interfaces not only with fast acting relay based interlock signals but also with RS-485 based serial devices to monitor and control lower priority parameters such as pump speeds, vacuum pressure readout and set points, run hours and more. This work presents the structure and interface logic necessary to communicate with a range of vacuum gauges, turbo-molecular pumps and ion pump controllers. In addition, the strategy to interface vacuum control with the rest of the accelerator control system is presented.

TUPHA132 Design and Implementation of Power Supply Control System on HI-13

J.M. Zhou, *K.N. Li (CIAE)*

On the HI-13 tandem accelerator, steer power supply and quadrupole lens power supply provides three different types of control interface,by using S7-1500 PLC, serial server, OPC server and WINCC, we implemented the remote control. Experimental results show that the system is easy to operate and its performance is reliable. Key words:control system;HI-13;WINCC

TUPHA134 Do You Really Need a Low Current Amplifier to Drive a Low Current Motor?

O. Ivashkevych, *A. Munoz, D. Poshka (BNL)*

NSLS2 is standardized on Geo Brick LV Delta Tau 5A motor controller, suitable to drive majority of stepper and servo motors. Standardization allows less spare inventory and common skill set to maintain. However, some applications especially instruments in the space confined endstations require using small, or even miniature motors. The question that we address, what are the options in customizing the 5A unit for driving low current motors, and what are the limitations? In this paper, we present a quantitative comparison of drive currents and performance data collected with Delta Tau PeWin software and external test equipment for a variety of low current steppers and servomotors with and without encoders ranging from 45mA to 250mA. Delta Tau Geo Brick LV comes in different amplifier configurations: a combination of 5A, 1A, and 0.25A amplifiers. While all configurations are tested, research goal is focused on performance and limitations of 5A driver, avoiding using step and direction option with extra hardware. Performance of widely used Newport MFA-PP and MFA-CC also will be discussed.

TUPHA135 Online Simulation Framework Through HTTP Services

K.A. Brown, *M. Harvey, Y.C. Jing, P. K. Kankiya, S. Seletskiy (BNL)*

The development of HTTP service interfaces* to the BNL Collider-Accelerator Department (C-AD) controls system opens up the ability to more quickly and easily adapt existing codes developed for other systems for use at RHIC. A simple particle accelerator online model built for commissioning the NSLS II** was adapted for use with the Low Energy RHIC electron Cooling project (LEReC)*** and the Coherent Electron Cooling (CeC)**** proof of principle experiment. For this project, a set of python modules and a python application were adapted for use in RHIC by replacing NSLS II control system interfaces with python modules that interface to the C-AD controls HTTP services. This paper will discuss the new interfaces and the status of commissioning them for operations.

TUPHA136 ITSnet - An IoT Control System for Accelerator Test Facilities

D.P. McGinnis, *S. Molloy (ESS)*

We have developed a control platform optimized for rapid development at accelerator test facilites. This platform is a quasi-state machine system based on inexpensive, commercial, open source, small form factor microcontrollers and computers. Communication is based on a secure, open source, wireless MQTT protocol. High speed synchronization is accomplished with a spread spectrum wireless timing system. The wireless nature of the platform drastically reduces the cable plant and physical footprint of the system. The state machine and MQTT implementation ensure reliability and security. A platform independent, web based user interface allow for multiple users and easy remote monitoring.

TUPHA137 Framework for Integrating Experiment-Preconditioning Subsystems to Support Downline Shots on the Z Machine

D.W. Johnson, *M. Jones, D.C. Lamppa, S. Radovich (Sandia National Laboratories)*

Sandia National Laboratories' Z Machine is a pulsed power driver that delivers 100ns 27 MA current pulses to support a variety of high energy density physics (HEDP) experiments. Recently, new subsystems have been added to enhance the experiment initial conditions and enable new HEDP thrusts. These capabilities include the Gas-Puff [1] subsystem, which introduces nested columns of gas that the Z current pulse implodes. The Applied B on Z (ABZ [2]) subsystem uses pulsed field coils to pre-magnetize deuterium fuel up to 30T for Magnetized Liner Inertial Fusion (MagLIF) research [3]. These systems have been integrated within the existing control and monitoring (CM) system of the Z Machine. The primary controls of the Z Machine uses Allen Bradley controllers and these subsystems interface using physical channels with O/E and E/O converters and later using direct network I/O addressing. The LabVIEW-based client-server architecture along with timing, control, and permissive techniques will be discussed. Both systems have similar requirements of timing, charging, pretesting, etc. that lead to the designed load conditions for the current pulses to drive experiments on the Z Machine.

TUPHA138 Management of IOCs at ESS

R.N. Fernandes, *T. Korhonen, S. Regnell (ESS) M. Pavleski, S. Sah (Cosylab)*

The European Spallation Source (ESS) is a neutron research facility based in Sweden that will be operation in 2019. It is expected to have around 1000 IOCs controlling both the machine and end-station instruments. To manage these innumerous IOCs, an application called IOC Factory was developed at ESS. It provides a consistent and centralized approach on how IOCs are configured, generated, browsed and audited. The configuration allows end-users to select EPICS modules for IOCs to use to interface devices. The generation allows end-users to generate IOCs according to configurations. The browsing retrieves information on when, how and why IOCs were generated and by whom. Finally, the auditing tracks changes that IOCs may have suffered. To achieve these functionalities, the IOC Factory relies on two other software applications: the Controls Configuration Database (CCDB) and the ESS EPICS Environment (EEE). The first stores information about IOCs and devices controlled by these, while the second stores snippets that are needed to generate IOCs (st.cmd files). Combined, the applications enable ESS to successfully manage IOCs while keeping effort allocated to this task at a minimum level.

TUPHA139 ESRF Ramping Injector Power Supply Controlled by TANGO.

P.V. Verdier, *R. Bourtembourg, J.M. Koch (ESRF)*

A new design of ESRF booster power supply system has been developed and installed. A multiple power supplies control through network including real time control is now operational at ESRF. It manages 4 power supplies to generate 3 waveforms defined with 3x1600 values in a setpoint file. The power supplies states are managed by PLCs. The ramping waveforms are managed by a real time program running on a FPGA board. And a high level control on top of them is assumed by a TANGO multiple classes system. This paper presents how these three levels of controls are interlinked and show the results achieved

TUPHA140 **Controlling the Z Machine Enterprise**

S. Radovich *(Sandia National Laboratories)*

The Z Machine pulsed power facility at Sandia National Laboratories is the largest X-ray generator in the world, capable of delivering 330 terawatts of x-ray power. Every day, energy from 36 Marx generators must be synchronized via laser triggered gas switches and transmitted into a vacuum chamber containing an experimental target to perform cutting edge experiments in the fields of inertial confinement fusion (ICF), materials science, radiation science, and fundamental science. Having origins back to the 1980's, Z has implemented controls on many different control hardware platforms, such as PCs, PLCs, cRIO, cFP, and even physical switch and relay panels. By improving the reliability and maintainability of the facility, the Z Machine will continue to be a leading contributor to pulsed power research.

TUPHA141 **Sample Enviroment Equipment at the European Spallation Source.**

T. Brys, *D.P. Brodrick, A. Pettersson (ESS)*

The European Spallation Source (ESS) will be the brightest neutron source in the world. It will consist of a proton linear accelerator, a spallation target and 22 different instruments for neutron diffraction, scattering, engineering and fundamental research. Each instrument is able to use a large variety of devices to control the environment parameters (temperature, pressure, humidity, fields mixtures, etc.) of the sample during the experiments. Users must be able to control this equipment and the instruments as well as storing and retrieving experiment data. For this purpose, Experimental Physics and Industrial Control System (EPICS) will be used as the backbone control system. This work shows a typical use case where a Closed Cycle Refrigerator (CCR) and spectrometer sample environment equipment setup have been integrated into the ESS control system, from hardware to user interface. The setup is one of the first realizations of the ESS control system for sample environment equipment (SEE). We present an up to date overview of the envisaged control system structure software tools used, network functions, data archiving and distribution of control logic, for SEE at ESS.

TUPHA143 **A Database to Store EPICS Configuration Data**

M. Ritzert *(Heidelberg University)*

The operation of extensive control systems cannot be performed by adjusting all parameters one by one manually. Instead, a set of parameters is loaded and applied in bulk. We present a system to store such parameter sets in a type-safe fashion into and retrieve them from a configuration database. The configuration database is backed by an SQL database. Interfaces to store and retrieve data exist for the C++, Java and Python programming languages. GUIs are available both as a standalone program using C++ and Qt, and integrated into Control System Studio (CSS). The version integrated into CSS supports data validators implemented as Eclipse plugins that are run before each commit. The format of the configuration data that can be stored is XML-like, and export and import to/from XML is implemented. The database can hold several completely independent "files" of configuration data. In each file, several branches can be stored, each branch consisting of a chain of commits. Each commit can easily be retrieved at any time. For each entry, the modification history can easily be queried.

TUPHA146 **Interface Between EPICS and ADO**

A. Sukhanov, *J.P. Jamilkowski (BNL)*

EPICS is widely used software infrastructure to control Particle Accelerators, its Channel Access (CA) network protocol for communication with Input/Output Controllers (IOCs) is easy to implement in hardware. Many vendors provide CA support for their devices. The RHIC Control System provides control of more than

400,000 parameters through Accelerator Data Objects (ADO) software abstraction layer. In this paper we present software bridge, which allows to cross-communicate between ADO and EPICS devices. It consists of two separate programs: an ADO manager, which hosts the ADO parameters and executes caput() request to modify EPICS PV when parameter is changed; and an epics2ado program which monitors the EPICS PVs and notifies the ADO manager. This approach have been implemented in integration of the NSLSII PSC hardware interface into RHIC Controls System.

TUPHA147 First Steps in Automated Software Development Approach for LHC Phase II Upgrades CO2 Detector Cooling Systems

***L. Zwalinski**, J. Daguin, M. Ostrega, P. Petagna, P. Tropea, B. Verlaat (CERN)*

With refrigerating power of the order of 1.5kW at -35°C and full compatibility with Detector Control System standards, Light Use Cooling Appliance for Surface Zones (LUCASZ) is the first movable medium size evaporative CO2 cooling system. By 2017 a small series of 4 LUCASZ units will be prototyped by the EP-DT group at CERN prior to its production outsourcing. LUCASZ is capable to provide CO2 cooling for various needs of detector development and testing required for Phase I and II upgrades of both CMS and LHCb experiments. This paper describes selected software and hardware ideas used to develop the LUCASZ control system as possible solutions for CO2 cooling systems for Phase II upgrade of ATLAS and CMS trackers. The main challenges for future control system development will come from the number of cooling plants, the modularity requirements for production and operation, and the implementation of backup philosophy. The introduction of automated software generation is expected to bring major improvement on the efficiency of control system implementation. In this respect, a unification step between experiments is highly required without neglecting specific needs of ATLAS and CMS.

TUPHA148 Next Generation Control System Using the EtherCAT Technology

***M. Ishii**, Y. Ishizawa, M.T. Takeuchi (JASRI/SPring-8) T. Fukui (RIKEN SPring-8 Center, Innovative Light Sources Division)*

Toward the SPring-8 upgrade, which we call SPring-8-II, new innovative technologies are introduced at a control framework, a platform, and a fieldbus. We adopted EtherCAT having a master/slave topology as a network based fieldbus. Since a cyclic data transfer time is less than 1msec, EtherCAT can be provided enough performance for a fast control and a feedback system. Synchronization between slaves can be realized easily by the distributed clock technology. Controllers and sensors are set near equipment, and input and output data to/from a master via an Ethernet cable. It reduces the number of wires and the working time for wiring. In 2016, we installed EtherCAT into three types of equipment control systems. One was a prototype digital LLRF system in the high power rf test stand at SPring-8. Another was sub-encoder readout for an undulator at SPring-8. The other was a control system for a kicker magnet power supply at SACLA. An XMC typed EtherCAT Master module was implemented into each of these systems and connected to multi vendor slaves. In this paper, we report the status of new control system using the EtherCAT technology and future plan.

TUPHA149 MADOCA to EPICS Gateway

***A. Kiyomichi**, T. Masuda (JASRI/SPring-8)*

MADOCA-to-EPICS gateway has been developed for easy and rapid integration of EPICS ready devices into MADOCA, the control software framework for SPring-8 and SACLA. MADOCA uses equipment control software called Equipment Manager (EM) in the device control layer. The MADOCA-to-EPICS gateway is implemented as a general-purpose EM to handle EPICS IOCs. The gateway consists of EM functions that interact with IOCs using Channel Access (CA) protocol corresponding to EPICS commands such as caget, caput and camonitor. We can build the gateway for the target EPICS device by editing the EM configuration file, without any programming. We have applied the gateway to the Libera Brilliance$^+$ installed in the SPring-8 storage ring for the evaluation towards the SPring-8 upgrade project. In addition, it has been applied to the Libera Brilliance Single Pass and Spark installed in beam transport line, and the Libera Spark and Cavity installed in SACLA. The gateway brings us the benefits to minimize the installation time and effort even for the different platform (CPU and OS) devices. We will report on the development and advantage as well as the performance improvement of the MADOCA-to-EPICS gateway.

TUPHA150 **TangoJS at Bloch Beamline in Max IV Laboratory**

***Ł. Zytniak**, J. Adell, V.H. Hardion, D.P. Spruce (MAX IV Laboratory, Lund University)*

Control systems for accelerator facilities are becoming increasingly complex. This raises a need for more sophisticated methods of control over a growing number of devices. The BLOCH beamline consists of two branchlines, and is dedicated to high resolution photoelectron spectroscopy, encompassing angle-resolved (ARPES), spin resolved (spin-ARPES) and core-level spectroscopy. As TANGO is a CORBA-based software, these client applications can run as desktop applications. Recently, thanks to their numerous benefits over conventional desktop applications, web applications are more and more widely used in different areas. TangoJS is a modular, extensible software stack for building TANGO client applications. Its architecture is layered for increased flexibility and easier maintenance*. Multiple backend modules are supported, which allowing access to TANGO infrastructure using different technologies and protocols. It provides a set of configurable widgets, which are building blocks for more complex user interfaces. End station is not fully automated, TangoJS will be very helpful not only during commissioning but also to decrease time required to prepare beamline before experiment.

TUPHA151 **Linux Universal PCI Express Device Drivers for MTCA**

***L.P. Petrosyan** (DESY) A. Gimenez (RIKEN) D.K. Kalantaryan (DESY Zeuthen)*

The PCI Express standard is currently the most widely used architecture. The MTCA as well the majority of architectures today use the PCI Express as a central bus of data transmissions. In order to take full advantage of PCI Express enhanced features, more robust device drivers are required. Over the time the support of the increasing number of Device Drivers from different providers is becoming cumbersome without taking into account the different API provided which leads to difficulties for programmers. The Linux Device Driver Model allows us to split PCI Express Device Driver into multiple parts. The low level Driver provides all basic PCI Express and MTCA common functionality. The top level Device Driver of the current device uses common part provided by the low level Driver and adds device specific functionality if needed. Such flexibility will facilitate the tasks of creation and supporting of the Device Drivers, on the other hand it will lead to the principle 'write for one use for all' at the level of user programming, as well as the easy integration of the new Hardware into existing software infrastructures.

TUPHA152 **Towards a Time-Constrained Service-Oriented Architecture for Automation and Control in Large-Scale Dynamic Systems**

***G. Chen**, B.R. An (CAEP)*

Rapidly changing demands for interoperability among heterogeneous systems leads to a paradigm shift from pre-defined control strategies to dynamic customization within many automation systems, e.g., large-scale scientific facilities. However, today's mass systems are of a very static nature. Fully changing the control process requires a high amount of expensive human resources and is quite error prone. Hence, flexible reconfiguration will become a key factor in the large-scale dynamic systems. The adoption of Service-Oriented Architecture (SOA) based on web services can provide the requested capability of reconfiguration. Since the adaptation of SOAs to automation systems has to face time-constrained requirements - especially real time requirements, particular attention should be paid to real time web service for deterministic behavior. This paper proposes a novel framework for the integration of a Time-Constrained SOA (TcSOA) into large-scale dynamic systems. Our approach enables document-driven dynamic service cooperation and evaluates how real time technologies can be synthesized with web services to enable deterministic performance in order to meet the real time requirements.

TUPHA153 **Python and MATLAB Interfaces to RHIC Controls Data**

K.A. Brown, *T. D'Ottavio, W. Fu, A. Marusic, J. Morris, S. Nemesure, A. Sukhanov (BNL)*

In keeping with a long tradition in the BNL Collider-Accelerator Department (C-AD) controls environment, we try to provide general and simple to use interfaces to the users of the controls. In the past we have built command line tools, Java tools, and C++ tools that allow users to easily access live and historical controls data. With more demand for access through other interfaces, we recently built a set of python and MATLAB modules to simplify access to control system data. This is possible, and made relatively easy, with the development of HTTP service interfaces to the controls*. While this paper focuses on the python and MATLAB tools built on top of the HTTP services, this work demonstrates clearly how the HTTP service paradigm frees the developer from having to work from any particular operating system or develop using any particular development tool.

TUPHA156 **Controls Configuration Database at ESS**

R.N. Fernandes, *S. Regnell (ESS) S. Sah, M. Vitorovic (Cosylab)*

At ESS, thousands of devices will be in production and executing a wide range of functions to enable both the machine and end-station instruments to perform as expected. Typical examples of such devices are motors, cameras, PLCs, shutters and IOCs. To manage the information of these devices, an application called Controls Configuration Database (CCDB) was developed at ESS. The CCDB enables the collection, storage, and distribution of controls configuration data needed to install, commission and operate ESS control system. Along with single sign-on features, several ways to read/write data from/into, multiple views of the same information, the CCDB provides modeling capabilities: end-users can define device types and associate properties to these, create devices and specify relationships between these, and represent ESS control system in an hierarchical fashion through containers and slots. By centralizing the information in the CCDB, end-users benefit from a holistic view of the control system. It also enables other applications (e.g. IOC Factory) to perform their domain specific businesses and share data amongst them (thus mitigating the risk of data duplication/inconsistency).

TUPHA159 **Malcolm: A Middlelayer Framework for Generic Continuous Scanning**

T.M. Cobb, *M. Basham, G. Knap, C. Mita, M.P. Taylor, G.D. Yendell (DLS) A. Greer (OSL)*

Malcolm is a middlelayer framework that implements high level configure/run behaviour of control system components like those used in continuous scans. It was created as part of the Mapping project at Diamond Light Source to improve the performance of continuous scanning and make it easier to share code between beamlines. It takes the form of a Python framework which wraps up groups of EPICS PVs into modular "Blocks". A hierarchy of these can be created, with the Blocks at the top of the tree providing a higher level scanning interface to GDA, Diamond's Generic Data Acquisition software. The framework can be used as a library in continuous scanning scripts, or can act as a server via pluggable communications modules. It currently has server and client support for both pvData over pvAccess, and JSON over websockets. When running as a webserver this allows a web GUI to be used to visualize the connections between these blocks (like the wiring of EPICS areaDetector plugins). This paper details the architecture and design of framework, and gives some examples of its use at Diamond.

TUPHA161 C/C++ Software Improvement Process at CERN - Status and Lessons Learned

***S. Jensen**, J.C. Bau, A. Dworak, F. Hoguin, J. Lauener, F. Locci, A. Radeva, W. Sliwinski (CERN)*

A C/C++ software improvement process (SIP4C/C++) has been increasingly applied by the CERN accelerator Controls group since 2011, addressing technical and cultural aspects of our software development work. A first paper was presented at ICALEPCS 2013*. On the technical side, a number of off-the-shelf software products have been deployed and integrated, including Atlassian Crucible (code review), Google test (unit test), Valgrind (memory profiling) and SonarQube (static code analysis). Likewise, certain in-house developments are now operational such as a Generic Makefile (compile/link/deploy), CMX (for publishing runtime process metrics) and Manifest (capturing library dependencies). SIP4C/C++ has influenced our culture by promoting integration of said products into our binaries and workflows. We describe our current status for technical solutions and how they have been integrated into our environment. Based on testimony from four project teams, we present reasons for and against adoption of individual SIP4C/C++ products and processes. Finally, we show how SIP4C/C++ has improved development and delivery processes as well as the first-line support of delivered products.

TUPHA162 Enhanced Transport Network for Accelerators

***P.S. Pulvirenti**, S. Aurnia, S. Cavallaro, L. Cosentino, B.F. Diana, E. Furia, G. Vecchio (INFN/LNS) G. Mangioni, S. Micale (DIEEI)*

INFN-LNS is currently working on a major upgrade to its control system architecture. Dated back to almost two decades ago, the current control system is heavily dependent on a proprietary software layer that is very difficult to maintain and basically non-portable. The team in charge for the control systems decided to develop a brand new architecture from scratch, with a NoSQL in-memory database at its heart for increased performances, leveraging on open source software and keeping portability in mind as much as possible. From this point of view adopting REDIS as a data and command transport layer was a key move. This poster presents the early results of the transition to the new architecture in a significant part of the beam lines control system.

TUPHA163 CBNG - The New Build Tool Used to Build Millions of Lines of Java Code at CERN

***L. Cseppento**, V. Baggiolini, E. Fejes, Zs. Kovari (CERN)*

A large part of the CERN Accelerator Control System is written in Java by around 120 developers (physicists, operators, hardware specialists and software engineers). The codebase contains more than 10 million lines of code, which are packaged as 1000+ jars and are deployed as 600+ different client/server applications. All this software are produced using CommonBuild New Generation (CBNG), an enterprise build tool, implemented on top of industry standards, which simplifies and standardizes the way our applications are built. CBNG not only includes general build tool features (such as dependency management, code compilation, test execution and artifact uploading), but also provides traceability throughout the software life cycle, makes releases ready for deployment and enforces our restrictions and naming conventions. The interface is kept as simple as possible: the users declare the dependencies and the deployment units of their projects in one file. Thus, it is more straightforward than learning and using "pure" Maven or Gradle. This article describes the build process, as well as the design goals, the features, and the technology behind CBNG.

TUPHA164 **Evaluation of Model Based Real Time Feedback Control System on Plasma Density**

W.R. Lee*, J.S. Hong, G.I. Kwon, T.G. Lee, T.H. Tak (NFRI) B. Bauvir (ITER Organization)*

TUPHA165=

TUPHA165 **New developments for the TANGO Alarm System**

G. Scalamera*, L. Pivetta (Elettra-Sincrotrone Trieste S.C.p.A.) S. Rubio-Manrique (ALBA-CELLS Synchrotron)*

The TANGO Alarm System, based on an efficient event-driven, higly configurable rule-based engine named AlarmHandler, has undergone a deep refactoring. The dedicated MySQL database has been dropped; the TANGO database now stores all the configuration whereas the HDB++ historical database keeps all the alarms history. Correlating alarms with any other engineering data is now much simpler. A dynamic attribute is provided for each alarm rule; this allows to easily build a hierarchy of AlarmHandlers. The AlarmHandler manages Attribute quality in the alarm rules and provides possible exceptions resulting in alarm evaluation. Mathematical functions, such as sin, cos, pow, min, max and ternary conditionals are available in the alarm formulae. The TANGO AlarmHandler device server is now based on the IEC 62682 standard.

TUPHA166 **New Developments for HDB++ TANGO Archiving System**

L. Pivetta*, G. Scalamera, G. Strangolino, L. Zambon (Elettra-Sincrotrone Trieste S.C.p.A.) R. Bourtembourg, J.L. Pons, P.V. Verdier (ESRF) S. Rubio-Manrique (ALBA-CELLS Synchrotron)*

TANGO HDB++ is a high performance event-driven archiving system which stores data with micro-second resolution timestamps, using archivers written in C++. HDB++ currently supports MySQL and Apache Cassandra back-ends but could be easily extended to support additional back-ends. Since the initial release many improvements and new features have been added to the HDB++. In addition to bug-fixes and optimizations, the support for context-based archiving allows to define an archiving strategy for each attribute, specifying when it has to be archived or not. Temporary archiving is supported by means of a time-to-live parameter, available on a per-attribute basis. The Cassandra back-end is using Cassandra TTL native feature underneath to implement the time-to-live feature. With dynamic loading of specific libraries switching back-ends can be done on-the-fly and is as simple as changing a property. Partition and maintenance scripts are now available for HDB++ and MySQL. The HDB++ tools, such as extraction libraries and GUIs, followed HDB++ evolution to help the user to take full advantage of the new features.

TUPHA167 **Tango Web Access Modules and Web Clients for NICA Control System**

G.S. Sedykh*, V.G. Elkin (JINR/VBLHEP) E.V. Gorbachev (JINR)*

NICA (Nuclotron-based Ion Collider Facility) is a new accelerator complex designed at the Joint Institute for Nuclear Research (Dubna, Russia) to study properties of dense baryonic matter. The report describes Tango-modules designed at JINR to provide web-access to Tango-based control system. 1. RestDS - lightweight Tango REST service (C++, Boost). It implements Tango REST API and Tango JINR REST API; 2. WebSocketDS - lightweight Tango WebSocket service (C++, WebSocket++, Boost). It implements Tango attributes reading and command executing through websockets. The report also gives examples of web client applications for NICA control system, using these services.

TUPHA168 **Improving Throughput and Latency of D-Bus to Meet the Requirements of the Fair Control System**

***D.S. Day**, A. Hahn, C. Prados, M. Reese (GSI)*

In developing the control system for the FAIR accelerator complex we encountered strict latency and throughput contraints on the timely supply of data to devices controlling ramped magnets. In addition, the timing hardware that interfaces to the White Rabbit timing network may be shared by multiple processes on a single front-end computer. This paper describes the interprocess communication and resource-sharing system, and the consequences of using the D-Bus message bus. Then our experience of improving latency and throughput performance to meet the realtime requirements of the control system is discussed. Work is also presented on prioritisation techniques to allow time-critical services to share the bus with other components.

TUPHA169 **Tango Based Software of Control System of LIA-20**

***A.I. Senchenko**, G.A. Fatkin, P.A. Selivanov, S.S. Serednyakov (BINP SB RAS) G.A. Fatkin, **A.I. Senchenko**, S.S. Serednyakov (NSU)*

The linear induction accelerator LIA-20 for radiography is a pulsed machine designed to provide three consecutive electron bunches. Since every pulse is a distinctive experiment, it is of high importance to provide coherence of facility state and experimental data. This paper presents overall system architecture and software. Challenges and particular approaches to designing of a pulsed machine control system using Tango are discussed.

TUPHA170 **Containerized Control Structure for Accelerators**

***I. Arredondo**, J. Jugo (University of the Basque Country, Faculty of Science and Technology)*

Nowadays modern accelerators are starting to use virtualization to implement their control systems. Following this idea, one of the possibilities is to use containers. Containers are highly scalable, easy to produce/reproduce, easy to share, resilient, elastic and low cost in terms of computational resources. All of those are characteristics that fit with the necessities of a well defined and versatile control system. In this paper, a control structure based on this paradigm is discussed. Firstly the technologies available for this task are briefly compared. Starting from containerizing tools and following with the container orchestration technologies. As a result Kubernetes and Docker are selected. Then, the basis of Kubernetes/Docker and how it fits into the control of an accelerator is stated. Following the control applications suitable to be containerized are analyzed. It includes electronic log systems, archiving engines, middleware servers,… Finally, a particular structure for an accelerator based on EPICS as middleware is sketched.

TUPHA171 **Development of NICA Control System: Access Control and Logging**

***E.V. Gorbachev** (JINR) G.S. Sedykh (JINR/VBLHEP)*

NICA (Nuclotron-based Ion Collider fAcility) is a new accelerator complex being constructed at the Joint Institute for Nuclear Research (Dubna, Russia). It will provide heavy ion colliding experiments to study properties of dense baryonic matter.

The TANGO based control system of the NICA complex is under development now. The report describes design of the role-based authorization and logging system. It allows limiting access to any Tango device command or attribute according to a user roles and location. The system also restricts access to the Tango database and records details of its modifications. The authorization is performed on the Tango server side thus complementing the native TANGO client-side access control. First tests of the system were performed during the latest Nuclotron run.

TUPHA173 **A Web-Based Report Tool for Tango Control Systems via Websockets**

M. Broseta*, A. Burgos, G. Cuní, D. Roldán, S. Rubio-Manrique (ALBA-CELLS Synchrotron)*

Beamlines at Synchrotron Light sources operate 24 hours/day requiring Beamline scientists to have tools to monitor the current state of the Beamline without interfering with the measurements being carried out. The previous web report system developed at ALBA was based on cron tasks querying the Tango Control system and generating html files. The new system integrates all those automatic tasks in a Tornado Tango Device letting the users create their own reports without requiring the intervention of the software support groups. This device runs a Tornado web server providing an html5 web interface to create, customize and visualize its reports in real time (via websockets). Originally designed for the vacuum engineers to monitor the vacuum, is actually used by the scientists and engineers involved in the experiment and the different on-call services to remotely check the beamline overall status.

TUPHA174 **Cumbia: A New Library for Multi-Threaded Application Design and Implementation.**

G. Strangolino *(Elettra-Sincrotrone Trieste S.C.p.A.)*

Cumbia is a new library that offers a carefree approach to multi-threaded application design and implementation. Written from scratch, it can be seen as the evolution of the QTango library, because it offers a more flexible and object oriented multi-threaded programming style. Less concern about locking techniques and synchronization, and well defined design patterns stand for more focus on the work to be performed inside Cumbia Activities and reliable and reusable software as a result. The user writes Activities and decides when their instances are started and to which thread they belong. A token is used to register an Activity, and activities with the same token are run in the same thread. Computed results can be forwarded to the main execution thread, where a GUI can be updated. In conjunction with the Cumbia-Tango module, this framework serves the developer willing to connect an application to the Tango control system. The integration is possible both on the client and the server side. An example of a TANGO device using Cumbia to do work in background has already been developed, as well as simple Qt graphical clients relying on the framework.

TUPHA176 **ApplicationCore: A Framework for Modern Control Applications**

M. Hierholzer*, M. Killenberg, T. Kozak, N. Shehzad, G. Varghese, M. Viti (DESY)*
S. Marsching (Aquenos GmbH)

ApplicationCore is part of the ChimeraTK software suite and facilitates the development of abstract and reusable control applications. It integrates with ChimeraTK's DeviceAccess library and thus already supports a number of protocols for accessing hardware, including PCI Express as used inside MicroTCA.4 crates. On the other hand it makes use of the ControlSystemAdapter, so applications written using ApplicationCore can intrinsically run on a number of control system middlewares like EPICS 3, DOOCS and OPC-UA. The ApplicationCore encourages structuring the applications by using a hierarchical and modular data model. This helps to simplify the design of applications which can be further developed for increasing demands and still stay maintainable. Special emphasis has been put on a clean and modern C++ API which allows rapid development of applications without having to deal with implementation details.

TUPHA177 **Status of the Development of the Experiment Data Acquisition Pipeline for the European Spallation Source**

A.H.C. Mukai, *M.J. Christensen, J.M.C. Nilsson, T.S. Richter, M. Shetty (ESS) F.A. Akeroyd, M.J. Clarke (STFC/RAL/ISIS) M. Brambilla, M. Koennecke, D. Werder (PSI) M.D. Jones (Tessella)*

The European Spallation Source will produce more data than existing neutron facilities, due to higher accelerator power and to the fact that all data will be collected in event mode with no hardware veto. Detector data will be acquired and aggregated with sample metadata coming from sources such as sample environment, choppers and motion control. As aggregation data broker we will use Apache Kafka with FlatBuffers serialisation. A common schema repository defines the formats to be used by the data producers and consumers. The main consumers we are prototyping are a file writer for NeXus files and live reduction and visualisation via Mantid. A Jenkins-based setup using virtual machines is being used for integration tests, and physical servers are available in an integration laboratory alongside real hardware. We present the current status of the data acquisition pipeline and results from the testing and integration work going on at the ESS Data Management and Software Centre in collaboration with in-kind and BrightnESS partners.

TUPHA178 **Abstracted Hardware and Middleware Access in Control Applications**

M. Killenberg, *M. Hierholzer, T. Kozak, N. Shehzad, G. Varghese, M. Viti (DESY) S. Marsching (Aquenos GmbH) A. Piotrowski (FastLogic Sp. z o.o.)*

Hardware access often brings implementation details into a control application, which are subsequently published to the control system. Experience at DESY has shown that it is beneficial for the software quality to use a high level of abstraction from the beginning of a project. Some hardware registers for instance can immediately be treated as process variables if an appropriate library is taking care of most of the error handling. Other parts of the hardware need an additional layer to match the abstraction level of the application. Like this development cycles can be shortened and the code is easier to read and maintain because the logic focuses on what is done, not how it is done. We present the abstraction concept we are using, which is not only unifying the access to hardware but also how process variables are published via the control system middleware.

TUPHA179 **Management Software and Data Exchange Protocol for the INFN-LNS Accelerators Beamlines**

G. Vecchio, *S. Aurnia, S. Cavallaro, L. Cosentino, B.F. Diana, E. Furia, P.S. Pulvirenti (INFN/LNS)*

This paper describes the design and the development of an innovative management software for the accelerators beamlines at INFN-LNS. The Graphical User Interface, the data exchange protocol, the software functionality and the hardware will be illustrated. Compared to traditional platforms for the accelerators console, at INFN-LNS we have developed a new concept of control system and data acquisition framework, based on a data structures server which so far has never been used for supervisory control. We have chosen Redis as a highly scalable data store, shared by multiple and different processes. With such system it is possible to communicate cross-platform, cross-server or cross-application in a very simple way, using very lightweight libraries. A complex and highly ergonomic Graphic User Interface allows to control all the parameters with a user-friendly interactive approach, ensuring high functionality so that the beam operator can visually work in a realistic environment. All the information related to the beamline elements involved in the beam transport, can be stored in a centralized database, with suitable criteria to have a historical database.

TUPHA180 **Development of Post-mortem Viewer for the Taiwan Photon Source**

C.Y. Liao, *K.T. Hsu (NSRRC)*

The Taiwan Photon Source (TPS) is a 3-GeV third-generation synchrotron light source located in Hsinchu, Taiwan. The post-mortem (PM) system acts as an important tool to diagnostic the cause of trip events caused by beam loss. A MATLAB-based PM Viewer was developed to plot each event to understand the cause and effect of the event. The post-mortem viewer architecture, plans and implementation are presented in this report.

TUPHA181 **Web Extensible Display Manager**

R.J. Slominski *(JLab)*

Jefferson Lab's Web Extensible Display Manager (WEDM) allows staff to access EDM control system screens from a web browser in remote offices or from mobile devices. Native browser technologies are leveraged to avoid installing and managing software on remote clients such as browser plugins, tunnel applications, or a full EPICS and EDM environment. Since standard HTTP ports are used network firewall exceptions are minimized. To avoid security concerns from remote users modifying a control system WEDM exposes read-only access and basic web authentication can be used to further restrict access. Updates of monitored EPICS Channel Access PV record fields are delivered via WebSocket using a web gateway. Screens are translated to HTML with SVG following the EDM's EDL file vector drawing rules to create faithful screen renderings. The WEDM server parses EDL files directly in real-time allowing existing screens to work as is. Alternatively, the familiar drag and drop EDM screen creation tool can be used to create optimized screens sized specifically for smart phones and then rendered by WEDM.

TUPHA183 **An Interactive Workflow to Manage Tomography Experiments at ESRF**

H. Payno, *C. Nemoz (ESRF)*

At the ESRF the activity of several beamlines is based upon tomography X-ray imaging in various fields such as Paleontology, Medical Imaging and Materials Science. The instrument control and data processing systems are cloned on all the relevant beamlines, however the steps of the processing pipeline from the data acquisition to their full exploitation in premier quality publications are based upon a heterogeneous software scenario comprised of e.g. SPEC, Python, Octave, PyHST2 and MATLAB modules. The need has thus clearly appeared to logically sequence the operations performed by these different actors into user-friendly workflows. At the ESRF we selected a generic workflow tool, Orange, which was originally developed at the University of Ljubljana and designed for data mining in collaboration with the open source community. The graphical interface enables the easy inclusion/exclusion of functionalities represented by individual boxes. Each box can be managed by simple pieces of Python code generating graphical interfaces via the PyQT5 library and is defined by a set of inputs and outputs which can be linked together to produce consistent data processing workflows.

TUPHA184 **Inspector, a Zero Code IDE for Control Systems User Interface Development**

V. Costa, *B. Lefort (CERN)*

Developing operational User Interfaces (UI) can be challenging, especially during machine upgrade or commissioning where many changes can suddenly be required. An agile Integrated Development Environment (IDE) with enhanced refactoring capabilities can ease the development process. Inspector is an intuitive

UI oriented IDE allowing for development of control interfaces and data processing. It features a state of the art visual interface composer fitted with an ample set of graphical components offering rich customization. It also integrates a scripting environment for soft real time data processing and UI scripting for complex interfaces. Furthermore, Inspector supports many data sources. Alongside the short application development time, it means Inspector can be used in early stages of device engineering or it can be used on top of a full control system stack to create elaborate high level control UIs. Inspector is now a mission critical tool at CERN providing agile features for creating and maintaining control system interfaces. It is intensively used by experts, machine operators and performs seamlessly from small test benches to complex instruments such as LHC or LINAC4.

TUPHA186 **JavaFX Charts: Implementation of Missing Features**

G. Kruk *(CERN)*

JavaFX, the GUI toolkit included in the standard JDK, provides charting components with commonly used chart types, a simple API and wide customization possibilities via CSS. Nevertheless, while the offered functionality is easy to use and of high quality, it lacks a number of features that are crucial for scientific or controls GUIs. Examples are the possibility to zoom and pan the chart content, superposition of different plot types, data annotations, decorations or a logarithmic axis. The standard charts also show performance limitations when exposed to large data sets or high update rates. The article will describe the how we have implemented the missing features and overcome the performance problems.

TUPHA187 **Enhancing the MxCuBE User Interface by a Finite State Machine (FSM) Model**

I. Karpics*, G. Bourenkov, T.R. Schneider (EMBL)*

The acquisition of X-ray diffraction data from macromolecular crystals is major activity at many synchrotrons. While most data collections are considered as 'measurements' and are often conducted by non-experts, frequently data collections can be considered as 'experiments' in which a precise choice of data collection parameters is required to obtain usable data. Both aspects require the user interface to be robust and easy-to-use while still providing flexibility and deeper control for experiments. To make the control of the beamline more robust and intuitive we describe the interaction of the user with the beamline as a finite state machine (FSM). At the MX beamlines P13 and P14 operated by EMBL Hamburg on PETRA III (DESY, Hamburg) MXCuBE (Gabadinho et al., 2010) as the user interface is used. Technically, the modularity and clear separation between low-level hardware access and the graphical interface within MXCuBE allows implementing an FSM model into the main experimental cycle. Important features of using FSM are the ability to have an overview of all beamline components, to keep track of user actions and to guide users and/or beamline staff in case of failure or alarm.

TUPHA188 **SOLARIS Digital User Office**

T. Szymocha*, A. Górkiewicz, M.J. Stankiewicz, J. Szota-Pachowicz (Solaris National Synchrotron Radiation Centre, Jagiellonian University) A. Pulapa, R. Rozanska, T. Szepieniec (Cyfronet)*

Polish National Center for Synchrotron Radiation SOLARIS UJ is being prepared for first users. In order to facilitate process of user management, proposal submission, review and beam time allocation the SOLARIS Digital User Office project has been started. The DUO is developed in collaboration with Academic Computer Center CYFRONET AGH. The DUO consists of several main components. The user management component allows user registration and user affiliation management. The proposal submission component facilitate filling proposal form, indicating co-proposers and experimentalist. The review component supports process of decision making, including the Review Meeting event and grading proposals process. Apart of managing the main processes, the application provides an additional functionalities (e.g. experimental reports, trainings, feedbacks). DUO was designed as an open platform to face the challenges related to continually changing Solaris facility. Therefore, the business logic is described as an easily maintainable rule-based specification. To achieve good user experience modern web technologies were used including: Angular for the front-end part and Java Spring for server.

TUPHA189 Automating Operation Statistics at PETRA-3

P. Duval, *H. Ehrlichmann, M. Lomperski (DESY) J. Bobnar (Cosylab)*

The quoted machine availability of a particle accelerator over some time range is usually hand-generated by a machine coordinator, who pores over archived operations parameters and logbook entries for the time period in question. When the machine is deemed unavailable for operations, 'blame' is typically assigned to one or more machine sub-systems. With a 'perfect' representation of all possible machine states and all possible fatal alarms it is possible to calculate machine availability and assign blame automatically and thereby remove any bias and uncertainty that might creep in when a human is involved. Any system which attempts to do this must nevertheless recognize the de-facto impossibility of achieving perfection and allow for 'corrections' by a machine coordinator. Such a system for automated availability statistics was recently presented* and we now report on results and improvements following a half year in operation at PETRA-3 and its accelerator chain.

TUPHA190 Adaptations to CS-Studio for Use at Diamond Light Source

W.A.H. Rogers, *N.W. Battam, T.M. Cobb, M.J. Furseman, G. Knap (DLS)*

CS-Studio is one of the most widely-used display managers for EPICS. It is based on the Eclipse Rich Client Platform (Eclipse RCP), allowing for coherent integration of interfaces for different systems with common graphical elements and preferences. However, this user interface presents a different way of working to those from the previous generation of EPICS tools such as EDM and Striptool. At Diamond Light Source, EDM has been used since commissioning in two different ways: for machine operations and for beamline controls. Both uses of EDM will eventually be replaced with CS-Studio and significant effort has gone into this transition. Two kinds of change proved necessary: adaptations to CS-Studio itself, and changes to the typical user workflows. This paper presents both types of changes that were needed to make CS-Studio a productive tool at Diamond.

TUPHA191 Inventory/Pools 2.0: Introducing Self-Managed Warehouses

D. Salvat, *A. Burgos, A.G. Camps, I. Costa, X. Fariña, D. Fernández-Carreiras, T. Fernández Maltas, D. Lopez Nonell, O. Matilla, R. Monge (ALBA-CELLS Synchrotron)*

A common requirement form different groups of the ALBA Synchrotron is a tool to manage stocks, and make them available to users, easing the work-flow process from the warehouse responsible and to the user. The Management Information System section of the Computing Division, undertook a new project to accomplish those requirements. The use of Agile methodologies helped significantly to get user feedback in an early project stage, involve customers in the decision-making process, prioritise tasks and manage user expectations. As the users belong to groups with different purpose warehouses, the project had to be highly focused on the customer journey to deliver a standard tool with a high level of user acceptance. Two user interfaces have been delivered. The Desktop interface offers the full set of features to manage each inventory, from schedule a booking to adjust stocks. The Warehouse interface validates the booking with no interaction needed by the warehouse responsible. The final user provided with a barcode scanner and its identification card is able to borrow and take away any item from the warehouse.

TUPHA192 **Cabledb 2.0: The Evolution Towards an Efficient Spare and Stock Management System for a Large Research Facility**

D. Salvat*, A.G. Camps, I. Costa, D. Fernández-Carreiras, D. Lopez Nonell, O. Matilla, A. Rubio (ALBA-CELLS Synchrotron)*

CableDB is a widely used tool which started managing the installation of cables and is today the central repository containing information of cables, connectors, plugs, racks, pieces of equipment and the documentation and interventions associated. Nowadays, the application manages more than 400 racks, 7500 instruments and 20000 cables. The tool has been shared and exported to other institutes, such as MAX IV, where it is already in use. Along with many other needs related to stock and spare parts management, the MIS Section developed the Inventory/Pools that allows self-service borrowing items from pools, managing inventories and stocks, among many other features. CableDB and Inventory/Pools offer complementary features to improve life-cycle traceability of instrumentation and equipment, improve the prediction of stocks, and the maintenance activities in the installation. This paper describes the upgrade of the CableDB tool with the management of stocks and the integration of maintenance processes.

TUPHA193 **Vacuum Control System of SSC-Linac**

X.J. Liu*, S. An, J.J. Chang, Y. Chen, J.Q. Wu, W. Zhang (IMP/CAS)*

SSC-Linac is a linear accelerator injector of SSC in HIRFL. The vacuum control system is based on EPICS which is a real-time distributed control software. The Labview real-time VIs and EPICS VIs were used to design Input/Output Controller(IOC). The different kinds of CRIO modules were adopt in device layer,which can monitor the serial port data from vacuum gauges and contol vacuum valves. The whole control system can acquire vacuum data, control vacuum devices remotely, make the pressure value of the vacuum gauge and vacuum valve interlocked. It also keep the equipment work stable and the beam has a high quality.

TUPHA194 **LIMA: Library for IMage Acquisition a Worldwide Project for 2D Detector Control**

L. Claustre*, A. Homs, R. Homs Regojo, E. Papillon, S. Petitdemange (ESRF) F. Langlois (SOLEIL) A. Noureddine (MEDIANE SYSTEM)*

The LIMA project started in 2009. The goal was to provide a software library for the unified control of 2D detectors. LIMA is a collaborative project involving synchrotrons, research facilities and industrial companies. LIMA supports most detectors used for X-ray detection or other scientific applications. Live display is supported via a video interface and most of the native video camera image formats are supported. LIMA provides a plug-in architecture for on-line processing which allows image pre-treatment before saving e.g. noise reduction algorithm or automatic X-ray beam attenuation during continuous scans. The library supports many file format including EDF, CBF, FITS, HDF5 and TIFF. The paper will describe how HDF5 developments like the Single-Writer Multiple-Readers (SWMR) features will be integrated. To cope with increasing detector acquisition speed, the latest LIMA release includes multi-threaded, parallelized image saving with data compression (gzip or lz4). For even higher throughput a new design, based on a distributed multi-computer architecture, of the LIMA framework is envisaged. The paper will describe the LIMA roadmap for the coming years.

TUPHA195

ESPRESSO Instrument Control Electronics and Software: final phases before the installation in Chile

***V. Baldini**, G. Calderone, R. Cirami, I. Coretti, S. Cristiani, P. Di Marcantonio (INAF-OAT) D. Mégevand (Université de Genève, Observatoire Astronomique) M. Riva (INAF-Osservatorio Astronomico di Brera)*

ESPRESSO, the Echelle SPectrograph for Rocky Exoplanet and Stable Spectroscopic Observations, is undergoing the final testing phases before being shipped to Chile and installed in the Combined Coudé Laboratory (CCL) at the ESO Very Large Telescope site. The integration of the instrument takes place at the Astronomical Observatory of Geneva. It includes the full tests of the Instrument Control Electronics (ICE) and Instrument Control Software (ICS), designed and developed at the INAF-Astronomical Observatory of Trieste. ESPRESSO is the first ESO-VLT permanent instrument which electronics is based on Beckhoff PLCs. Two PLC CPUs shares all the workload of the ESPRESSO functions and through the OPC-UA protocol the PLC communicates with the instrument control software based on VLT control software package. In this phase all the devices and subsystems of ESPRESSO are installed, connected together and verified, mimicking the final working conditions in Chile. This paper will summarize the features of the ESPRESSO control system, the tests performed during the integration in Europe and the main performance obtained before the integration of the whole instrument "on sky" in South America.

TUPHA196

The Design for CSNS Instrument Control

***J. Zhuang** (State Key laboratory of Particle Detection and Electronics of China)*

In this paper we introduced the design and implementation of the neutron instrument experiment control system in CSNS. The task of the control system is to complete the spectrometer experiment, and meanwhile provides experimental data for physical analysis. The control system of instrument in CSNS coordinate device control, data acquisition and analysis software, electronics, detector, sample environment and many other subsystems. This paper descibres the system architecture, timing system, device control and software of instrument control in CSNS

TUPHA197

Control and First Data Acquisition Using Tango and Sardana at the Nanomax Beamline at MAX IV

***P.J. Bell** (MAX IV Laboratory, Lund University)*

The MAX IV synchrotron radiation facility in Lund, Sweden, received its first external commissioning users in November 2016 at the Nanomax hard X-ray beamline on the 3 GeV storage ring. All components of the beamline, including motors and vacuum and diagnostic elements, were integrated in the TANGO-based controls system, which through the Sardana layer also managed the collection of diffraction and fluorescence data from one- and two-dimensional detector channels. Hardware-synchronised continuous scanning ("fly-scanning") of the sample, mounted on a piezo stage, was achieved with a system built around a standard pulse counter/generator and acquisition board controlled by a dedicated TANGO device. Sardana macros were used to configure and execute the continuous scanning and position data from the piezo controller were buffered in synchronization with external triggers sent to the detectors, with all data subsequently written to HDF5 files. After successful initial operation, the system is currently being revised and expanded for the first users in 2017.

TUPHA198 **Software Applications for Beam Traceability and Machine Documentation at ISOLDE**

E. Fadakis *(CERN)*

The ISOLDE facility at CERN requires a wide variety of software applications to ensure maximum productivity. It will be further enforced by two new and innovative applications; Automatic Save After set uP (ASAP) and Fast Beam Investigation (FBI). ASAP saves crucial time for the engineers in charge (EIC) during the physics campaign. It automatizes and standardizes a repetitive process. In addition, for each new set up, the EIC is required to document the settings of all important elements before delivering beam to the users. FBI will be serving two different needs. First, it will be used as a beam traceability tool. The settings of every element of ISOLDE that could obstruct, stop or affect the beam will be tracked by the application. This will allow to understand better the presence of radioactive contaminants after each experiment at every possible point in the facility. The second functionality will allow real time monitoring of the machine status during a physics run. FBI will be the most efficient way to visualize the status of the machine and find the reason that prevents the beam from arriving to the experimental station.

TUPHA199 **Software Applications Used at the REX/HIE-ISOLDE Linac**

E. Fadakis *(CERN)*

The HIE-ISOLDE Linac (High Intensity and Energy) is a recent upgrade to the ISOLDE facility of CERN, increasing the maximum beam energy and providing means to explore even more scientific opportunities. The main software tools required to set up the new superconducting post-accelerator and to characterise the beam provided to the experimental stations will be presented in this paper. Emphasis will be given to the suite of applications to control all beam instrumentation equipment which are far more complex compared to the ones in the low energy part of ISOLDE. A variety of devices are used (Faraday cups, collimators, scanning slits, striping foils and silicon detectors). Each serves its own purpose and provides different information concerning the beam characteristics. Every group of devices required a specific approach to be programmed.

TUPHA200 **Control of Emittance Measurement Unit (ESS)**

J.F. Denis*, F. Senée (CEA/DSM/IRFU) B. Cheymol (ESS) T.J. Joannem, V. Silva (CEA/IRFU) O. Tuske (CEA/DRF/IRFU)*

The European Spallation Source (ESS) is a European Research Infrastructure Consortium (ERIC). It is based on the world's most powerful neutron source. Source requirements are a providing of a 2.86 ms long proton pulse at 2 GeV at repetition rate of 14 Hz. On the first phase, the injector is installed at Catania (Sicilia). CEA Irfu-Saclay has developed the control system for several work packages like the injector, and a set of diagnostics in particular the Emittance Measurement Unit (Vertical and Horizontal). The control system relies on COTS and an EPICS software platform. The EMU control provides two running modes: online and offline. During the online mode, in addition to control timing system, motor and acquisition at 1 MSample per second , all useful waveforms are saved with Archive Appliance at each pulse. These data could be retrieved after the measure in order to do post analysis.

TUPHA201 **UNICOS Framework and EPICS: A Possible Integration**

M. Ritzert *(Heidelberg University) E. Blanco Viñuela, M. Ostrega, L. Zwalinski (CERN)*

UNICOS (UNified Industrial Control System) is a CERN-made framework to develop industrial control applications. It follows a methodology based on ISA-88 and provides components in two layers of a control system: control and supervision. The control logic is running in the first layer, in a PLC (Programmable

Logic Controller), and, in the second layer, a SCADA (Supervisory Control and Data Acquisition) system is used to interface with the operators and numerous other features (e.g. alarms, archiving, etc.). UNICOS supports SIEMENS WinCC OA as the SCADA system. In this paper, we propose to use EPICS (Experimental Physics and Industrial Control System) as the supervision component of the UNICOS framework. The use case is the control system of a CO2 cooling plant developed at CERN following the UNICOS methodology, which had to be integrated in a control system based on EPICS. The paper describes the methods and actions taken to make this integration feasible, including automatic EPICS database generation, PLC communications, visualization widgets, faceplates and synoptics and their integration into CSS and EPICS, as well as the integration with the BEAST alarm system.

TUPHA202 **The Control System of the CERN Platform for the Test of the High Luminosity LHC Superconducting Magnets**

***H. Reymond**, M.F. Gomez De La Cruz, I.T. Matasaho, A. Rijllart (CERN)*

A new generation of superconducting magnets is being developped, in the framework of the HL-LHC upgrade project. Several laboratories in Europe, USA, Japan and Russia collaborate on this project. One of the tasks assigned to CERN is to conduct the optimization tests and later the series tests, for the MQXF and SQXF magnets. A new dedicated test bench has been built at the CERN superconducting magnet test facility (SM18), where these magnets will be evaluated under their operational conditions in the LHC tunnel. To fulfill the test conditions on these high performance magnets, a new high frequency data acquisition system (DAQ) has been designed, associated to new software used to control two 15 kA power converters. This article presents all the technical aspects of these two major components of the test platform, from the PXIe hardware selection of the DAQ system to the operational applications deployment and the data analysis tools. The commissioning phase and results of the first measurement campaign are also reported.

TUPHA203 **Automation Solutions and Prototypes for the X-Ray Tomography Beamline of Sirius, the New Brazilian Synchrotron Light Source**

***G.S.R. Costa**, N. Lopes Archilha, F.P. O'Dowd, G.J.Q. Vasconcelos (LNLS)*

Brazil is building Sirius, the new Brazilian synchrotron light source which will be the largest scientific infrastructure ever built in Brazil and one of the world's first 4th generation light sources. Mogno, the future X-ray nano and microtomography beamline is being designed to execute and process experiments in only few seconds. For this reason, prototypes and automated systems have being tested and implemented in the current LNLS imaging beamline (IMX). An industrial robot was installed to allow fast sample exchange through an easy-to-use graphical user interface (building using CS-Studio). Also, scripts using Python and Epics control system were implemented for automatic sample alignment, measurement and reconstruction. Remote operation of the beamline, allowing the users to control the system from any convinient place (labweb) is being tested. In adition, a flow cell for study dynamics and behavior of fluids at the rock pore scale in time resolved experiments (4D tomography) is being projected.

TUPHA204 **Automatic Angular Alignment of LHC Collimators**

***G. Azzopardi**, S. Redaelli, B. Salvachua, G. Valentino (CERN) A. Muscat (University of Malta, Information and Communication Technology)*

The LHC makes use of a collimation system to intercept potentially dangerous beam halo particles in order to protect its superconducting magnets and other sensitive areas. The collimation system works optimally only if a strict transverse hierarchy is respected (multi-stage cleaning). The operational settings of the betatron cleaning hierarchy in IR7 currently envisage a 2 sigma retraction margin in case of beam orbit drifts. In order to achieve a lower beta-star, then this margin will need to be reduced. So far, collimators were aligned and operated with jaws parallel to the nominal orbit (zero tilt angle). Recent beam test indicated that this approach will not be adequate to operate the system with retractions below 2 sigma. This gave rise to the need of having an automatic procedure to establish an appropriate tilt angle in the jaws to correct for these tank misalignments. This may be performed by aligning each collimator using an established beam-based technique at different angles whilst using a primary collimator as a reference. The angular alignment procedure was first tested without beam using a dedicated test-stand and then with beam in the SPS and LHC.

`TUPHA205` **Control in Epics for Different Ess Test Stands.**

A. Gaget *(CEA/DRF/IRFU)*

CEA Irfu Saclay is taking part of ESS (European Spallation Source) construction through several packages: control of cryomodule demonstrator, cavities couplers and RFQ couplers test stands. At the end, there will be 3 different set up at Saclay to condition around 120 couplers and 30 cavities. Due to the high number of components, it was important to automatize the complete process. In this paper, we describe how we created generic EPICS modules to use it for similar and future platforms and developments. For the controls of all these test stands, we are using ESS EPICS Environment with COTS solutions: IOxOS FMC ADC 3111 acquisition cards, Beckhoff EtherCAT modules , the MRF timing system and associated drivers.

`TUPHA206` **Upgrade of the ISIS Muon Front End Magnets: Old and New Instrument Control Systems Working in Harmony**

K.V.L. Baker*, F.A. Akeroyd, M.J. Clarke, G.D. Howells, D.P. Keymer, T. Löhnert, C. Moreton-Smith, D.E. Oram (STFC/RAL/ISIS) J.R. Holt, A.T. Potter, I.H. Rey, K. Woods (Tessella) J.S. Lord (STFC/RAL)*

When the European Muon beamlines at the ISIS pulsed neutron and muon source upgraded their front end magnets, it was desired that these new magnets should be controllable remotely. This work was undertaken by the team responsible for instrument control, who are in the process of a phased upgrade of beamline control software from a locally developed system (SECI) to an EPICS based one (IBEX). To increase the complexity, parts of the front end needed to be controlled only by an individual instrument beamline, whilst some values needed to be tuned to the best compromise available for all three beamlines, and the muon instruments were not ready for an upgrade to IBEX at that time. By combining SECI, IBEX and the Mantid data reduction package the required control and tuning has been achieved. This paper will give details of the challenges, the topology of the solution, how the current mixed system is performing, and what will be changed when the muon instruments are converted to IBEX.

`TUPHA207` **TM Service: An Architecture for Monitoring and Controlling the SKA Telescope Manager**

M. Di Carlo*, M. Canzari, M. Dolci (INAF - OA Teramo) R. Smareglia (INAF-OAT)*

The SKA Telescope Manager (TM) is the core package of the SKA Telescope: it is aimed at scheduling observations, controlling their execution, monitoring the telescope health status, diagnosing and fixing its faults and so on. To do that, TM directly interfaces with the Local Monitoring and Control systems (LMCs) of the various SKA Elements (e.g. Dishes, Low-Frequency Aperture Array, etc.), but it also needs to be monitored and controlled, in order to ensure its continuous and proper operation (and therefore that of the whole SKA Telescope). In addition to this higher responsibility, a local monitoring and control system for TM has to collect and display logging data directly to operators, perform lifecycle management of TM applications and directly deal - when possible - with management of TM faults (which also includes a direct handling of TM status and performance data). In this paper, the architecture for the TM monitoring and control, called TM services, are addressed and discussed.

`TUPHA208` Evolving a LabVIEW End-Station Software to a TANGO-Based Solution at the TwinMic Elettra Beamline

***R. Borghes**, M. Altissimo, V. Chenda, A. Gianoncelli, G. Kourousias (Elettra-Sincrotrone Trieste S.C.p.A.)*

Developing and deploying software systems for data acquisition and experiment control in a beamline laboratory can be a very challenging task. In certain cases there is the need to replace and modernize an existing system in order to accommodate substantial beamline upgrades. DonkiOrchestra is a TANGO-based framework for data acquisition and experiment control developed at Elettra Sincrotrone Trieste. The framework is based on an advanced software trigger-driven paradigm developed in-house. DonkiOrchestra is meant to be general and flexible enough to be adapted to the development needs of different laboratories and their data acquisition requirements. This presentation outlines the upgrade of the LabVIEW-based TwinMic beamline control system which hosts a unique soft X-ray transmission and emission microscope. Other than the technical demanding tasks of interfacing and controlling old and new instrumentation with DonkiOrchestra, this presentation discusses the various challenges of upgrading the software in a working synchrotron beamline.

`TUPHA209` MEDICIS High Level Control Application

***C. Charrondière**, K. Develle, T. Stora (CERN)*

CERN MEDICIS is a research facility that will make radioisotopes for medical applications using the primary proton beam at ISOLDE. It will start operating later in 2017. The high level application for the new beam line is responsible for the control of various equipment, such as power supplies, Faraday cups and scanners, as well as the monitoring of environmental parameters such as the vacuum level. It is characterized by a single user friendly interface to facilitate the operators tasks. In this paper we provide arguments for the chosen solution and give the latest update on the status of the project.

`TUPHA210` A Bunch-Synchronized Data Acquisition System for the European XFEL Accelerator

***T. Wilksen**, A. Aghababyan, L. Fröhlich, O. Hensler, R. Kammering, V. Rybnikov (DESY)*

The linear, super-conducting accelerator at the new European XFEL facility will be able to produce up to 2700 electron bunches for each shot at a repetition rate of 10 Hz. The bunch repetition rate might vary initially between 100 kHz and 4.5 MHz to accommodate the various needs of experiments at three different SASE beam lines. A solution, which is able to provide bunch-resolved data of multiple data sources together in one place for each shot, has been implemented at the E-XFEL as an integral part of the accelerator control system. This will serve as a framework for high-level control applications, including online monitoring and slow feedback services. A similar system has been successfully run at the FLASH facility at DESY for more than a decade now. This paper presents design, implementation and first experiences from commissioning the XFEL control system data acquisition.

`TUPHA211` X-Live: Data Acquisition and Visualization at the NSLS-II ISS Beamline

***B.V. Luvizotto**, K. Attenkofer, H. Bassan, E. Stavitski (BNL)*

Asynchronous data acquisition at the Inner-Shell Spectroscopy beamline at NSLS-II is performed using custom FPGA based I/O devices ("pizza-boxes"), which store and time stamp data using GPS based clock *. During motor scans, Incremental encoder signals corresponding to motion as well as analog detector signals are stored using EPICS IOCs. As each input creates a file with different timestamps, the data is first interpolated onto a common time grid. The energy scans are performed by a direct-drive monochromator, controlled with a Power PMAC controller. The motion is programmed to follow the trajectory with speed profiles corresponding to desired data density. The "pizza-boxes" that read analog signals are typically set to oversample the data stream, digitally improving the ADC resolution. Then the data is binned onto a energy grid with data spacing driven by desired point spacing. In order to organize everything in an easy-to-use platform, we developed XLive, a Python based GUI application. It can be used from the pre-experiment preparation to the data visualization and exporting, including beamline tuning and data acquisition.

TUPHA212

Odin - a Control and Data Acquisition Framework for Excalibur 1M and 3M Detectors

***G.D. Yendell**, U.K. Pedersen, N. Tartoni, S. Williams (DLS) A. Greer (OSL) T.C. Nicholls (STFC/RAL)*

Detectors currently being commissioned at Diamond Light Source (DLS) bring the need for more sophisticated control and data acquisition software. The Excalibur 1M and 3M are modular detectors comprised of rows of identical stripes. The Odin framework emulates this architecture by operating multiple file writers on different server nodes, managed by a central controller. The low-level control and communication is implemented in a vendor supplied C library with a set of C-Python bindings, providing a fast and robust API to control the detector nodes, alongside a simple interface to interact with the file writer instances over ZeroMQ. The file writer is a C++ module that uses plugins to interpret the raw data and provide the format to write to file, allowing it to be used with other detectors such as Percival and Eiger. At DLS we implement an areaDetector driver to integrate Odin with the beamline EPICS control system. However, because Odin provides a simple HTTP Rest API, it can be used by any site control system. This paper presents the architecture and design of the Odin framework and illustrates its usage as a controller of complex, modular detector systems.

TUPHA213

Experience and Prospects of Real-Time Signal Processing and Representation for the Beam Diagnostics at COoler SYnchrotron (COSY) at Forschungszentrum Jülich

***I. Bekman**, M. Thelen (FZJ)*

Diagnostics of beam parameters is vital for the operation of any particle accelerator and contributes to the precision of the physics experiments. At COoler SYnchrotron of the Forschungszentrum Jülich there are several beam instrumentation components with data acquired and processed in real-time for machine and operator use to ensure safe and efficient performance. Here are presented current development for the Ionization Profile Monitor (IPM) and Beam Loss Monitor (BLM) with regard to usage of field programmable gate arrays (FPGAs) to achieve fast data processing and integration into the Experimental Physics and Industrial Control System (EPICS) used at COSY. Also presented is a way to create and run Graphical User Interfaces based on EPICS variables with Control System Studio (CSS) connected to a data archiving system to display and use previously collected data.

TUPHA214

Current Status of IPM Linac Control System

__S. Haghtalab__, F. Ghasemi, M. Lamehi (IPM) F. Abbasi Davani (Shahid Beheshti University)

This paper reports the progress of the control system for IPM 10 MeV accelerator. As an electron linac, it consists of beam injection acceleration tube, radio frequency production and transmission, target, diagnostics and control and safety. In support of this source, an EPICS-based integrated control system has been designed and being implemented from scratch to provide access to the critical control points and continues to grow to simplify operation of the system. In addition to a PLC-based machine protection component and IO interface, a CSS-based suite of control GUI monitors systems including Modulator and RF, Vacuum, Magnets, and electron gun. An overview of this system is presented in this article.

THPHA — Poster Session

THPHA001 **CEA Irfu EPICS Environment for the SARAF-LINAC Project**

***F. Gougnaud**, Y. Lussignol (CEA/DSM/IRFU) J.F. Denis, T.J. Joannem (CEA/IRFU)*

Our Institute CEA Saclay Irfu was in charge of the EPICS based control system platform for the accelerator projects Spiral2 at Ganil in Normandy and IFMIF/LIPAc at JAEA/Rokkasho (Japan). Our 3-year collaboration with ESS[*] has given us the opportunity to use new COTS hardware. We have made our CEA Irfu control platform evolve by retaining relevant and evolutive ESS solutions. Currently, CEA Irfu is in charge of the design, construction and commissioning at SNRC of the project SARAF-LINAC[**] (MEBT and Super Conducting Linac) including its control. This paper will present our proposition of architecture for the SARAF Linac as well as the new CEA Irfu hardware and software platforms.

THPHA002 **LCLS-II Injector Source Controls Collaboration Between LBNL and SLAC**

***D. Rogind**, M. Boyes, H. Shoaee (SLAC)*

The SLAC LCLS-II injector section that comprises low energy (<1 MeV) from the gun up to the location of the first cryomodule is based on a subset of APEX, the LBNL Advanced Photo-Injector Experiment. The Controls and LLRF systems for APEX were designed as stand-alone systems since APEX is intended to be a demonstration injector with no future connection to a larger accelerator system. In 2015, responsibility for the design and fabrication of Injector Source Controls was transferred from LBNL to SLAC to promote commonality with the rest of the SLAC LCLS-II control subsystems. An added challenge was a decision to commission the injector source along with the drive laser in Fall, 2017, approximately 1.5 years ahead of the rest of the machine. This paper discusses the strategies used to transition the controls from LBNL to SLAC and to meet the early commissioning schedule.

THPHA003 **Installation and the Hardware Commissioning of the European Xfel Undulator Systems**

***M. Yakopov**, S. Abeghyan, S. Karabekyan, J. Pflüger (XFEL. EU)*

This article describes in detail the steps of hardware installation and commissioning of components for undulator systems at European XFEL. The sequence is identical for both undulator systems SASE1 and SASE3. In general, the work can be divided into 3 different steps: installation, alignment, and commissioning. During installation step, the following main components were rolled into the tunnel: - undulators with the control cabinets, intersection control cabinets, phase shifters, quadruple movers, air coils. They have been mounted according to the designed positions. Then all mentioned components have been aligned according to the specifications given by the installation plan. Finally, the cabling has been done and basic tests were performed. As part of the commissioning, the calibration of the temperature sensors has been done, as well as the quadrupole mover travel distance for software limiting the movement range. Afterwards, the undulator limit switches and hard stops were adjusted to secure the vacuum chamber by closing the undulator gap up to 10mm. Eventually, the system was handed over to the global control system in order to perform more thorough functional tests.

THPHA004 Challenges and Solutions for the SKA TM Architectural Team

__M. Di Carlo__ (INAF - OA Teramo) A. Bridger (ROE, UTAC) S. Roy Chaudhuri (Tata Research Development and Design Centre) G.M. le Roux (SKA South Africa, National Research Foundation of South Africa)

The SKA Telescope Manager (TM) is the core package of the SKA Telescope: it is aimed at scheduling observations, controlling their execution, monitoring the telescope health status, diagnosing and fixing its faults and so on. Following the adoption of the SEI approach, it was discussed and agreed upon to take the opportunity to set-up a TM Architecture Team (TMAT) that has a combination of team members who will be leading much of the work towards the main deliverables agreed upon and others who can help shape the architectural design. The TMAT has to make sure that the main deliverables are well aligned with the overall TM architecture (including ensuring that the SEI approach is followed to the level agreed upon), and that there no gaps and that cross-cutting issues are taken care of properly. This paper wants to analyze the challenges that the team has to face together with the solutions proposed to ensure that the quality of the deliverables are reached.

THPHA006 Challenges Integrating Low Level Controls Systems at FRIB

__K.D. Davidson__, C. Dudley, L. Hodges, S. Stanley (FRIB)

FRIB, is a new heavy ion accelerator facility currently under construction at Michigan State University. It is being built to provide intense beams of rare isotopes. The low level controls system integrates a wide variety of hardware into an EPICS/PLC based control system. This paper will present the challenges encountered with resulting hardware interfaces, and lessons learned that can be applied to future projects. These challenges include both technical design and project management challenges that are encountered when integrating hardware from other departments.

THPHA007 Git Workflow for EPICS Collaboration

__B.L. Hill__ (SLAC)

Presenting a sample git based workflow for managing EPICS module and module releases and facilitating collaboration w/ other sites. To facilitate this, this workflow introduces conventions for naming the github branch, local development branches, local release branches and release tags. Python and shell scripts are also provided to help automate and streamline the workflow.

THPHA009 Using a Common Collaborative Approach With Industrial Partners to Develop Hardware/Software Interfaces for the LHC Experiments Controls

__B. Farnham__, F. Varela, N. Ziogas (CERN)

Industrial power supplies deliver high and low voltage to a wide range of CERN's detector and accelerator components. These power supplies, sourced from external companies, are integrated into control systems via industry standard OPC servers. The servers are now being modernized. A key lesson learnt from running the previous generation of OPC servers is that vendor specific, black-box implementations can be costly in terms of support effort, particularly in diagnosing problems in large production-site deployments. This paper presents the projects producing the next generation of OPC servers; following an open, collaborative approach and a high degree of homogenization across the independent partners. The goal is to streamline development and support costs via code re-use and a template architecture. The collaborations aim to optimally combine CERN's OPC and production operations knowledge with each company's experience in integrating their hardware. This paper describes the considerations and constraints taken into account, including legal aspects, product commercialization and technical requirements to define a common collaborative approach across three hardware manufacturers.

THPHA010 Upgrade the Control System of HIRFL-CSR Based-on Epics

S. An *(IMP/CAS)*

Control system of HIRFL-CSR accelerator is now upgrading to new architecture based on Experimental Physics and Industrial Control System (EPICS). Design and implement power supply subsystem, data distribution subsystem, data acquisition subsystem, etc. This paper describes the design and implementation of the control system and introduce the next work for upgrading synchronization subsystem and middle/high level applications.

THPHA012 Upgrade of Vacuum Control System for KOMAC Linac and Beamlines

J.H. Kim *(KAERI) Y.-S. Cho, H.-J. Kwon, Y.G. Song (Korea Atomic Energy Research Institute (KAERI))*

At Korean Multi-purpose Accelerator Complex (KOMAC), we have been operating a proton linac since 2013. It consists of a 100 MeV accelerator and 4 operational target rooms. Beam operation at KOMAC is carried out by a home-grown control system with a machine protection system. The main goal of the control systems depends on the technical details of the accelerator. In our case, already having a reliable operational control, we intend to have a machine protection system (MPS) which affects the accelerator the least when the machine suddenly fails. Our work is mainly concentrated on interlock sequence of vacuum related equipment based on a programmable logic controller (PLC). This helps us to isolate a failed part so that rest of the parts of the accelerator remains under vacuum. Then the MPS receives a signal to safely stop the beam operation to protect the accelerator. We describe in this paper architecture of our PLC on interlock sequence of vacuum related equipment and its implementation.

THPHA013 Control System Projects at the Electron Storage Ring DELTA

D. Schirmer*, A. Althaus, P. Hartmann, D. Rohde (DELTA)*

Data logging and archiving is an important task to identify and investigate malfunctions during storage ring operation. In order to enable a high-performance fault analysis, very large amounts of data must be processed effectively. For this purpose a fundamental redesign of the SQL database was necessary. The VME/VxWorks-driven CAN bus has been used for many years as the main field bus at the DELTA control system. Unfortunately, the corresponding CAN bus knots (I/O modules) were discontinued by the manufacturer. Thus, the CAN field bus is currently replaced subsequently by a more up to date Modbus/TCP-IP communication (WAGO), which largely obviates the VME/VxWorks layer. After hard- and software integration into the EPICS environment, several projects have been realized using this powerful field bus communication. The server migration to a 64-bit architecture was already carried out in the past. By now, all client programs and software tools have also been converted to 64-bit versions. In addition, the fast orbit feedback system project, using a self developed FPGA-based hardware, has been resumed. This report provides an overview of the developments and results of each project.

THPHA014 Evolution in the Development of the Italian Single-dish COntrol System (DISCOS)

A. Orlati*, M. Bartolini, S. Righini (INAF - IRA) M. Buttu, A. Fara, C. Migoni, S. Poppi (INAF - OAC)*

DISCOS [*] is a control system developed by the Italian National Institute for Astrophysics (INAF) and currently in use at three radio telescope facilities of Medicina, Noto and the Sardinia Radio Telescope (SRT) [**]. DISCOS development is based on the adoption of the ALMA Common Software (ACS) framework. During the last two years, besides assisting the astronomical commissioning of the newly-built SRT and enabling its early science program, the control system has undergone some major upgrades. The long-awaited transition to a recent ACS version was performed, migrating the whole code base to 64 bit operative system and compilers, addressing the obsolescence problem that was causing a major technical debt to the project. This opportunity allowed us to perform some refactoring, in order to implement improved logging and resource management. During this transition the code management platform was migrated to a git-based versioning system and the continuous integration platform was modified to accommodate these changes. Further upgrades included the system completion at Noto and the expansion to handle new digital backends.

THPHA015 Instrumentation and Software Upgrades of the HZB Macromolecular Crystallography Beamlines

M. Hellmig *(HZB)*

After more than 10 years of successful user operation, the experimental endstation of the BL14.2 MX beamline was replaced by a completely refurbished setup mainly featuring (i) a fast Nanodiff air-bearing goniometer, (ii) a hybrid photon counting Pilatus3 detector and (iii) a GROB sample-transfer robot that is well suited for data acquisitions in fragment-screening studies while still offering the option to collect very high-resolution crystallographic data of small molecules. Since mid 2016, MXCuBE2 is used as the experimental control software for this fragment-screening beamline as well as HZB's second tunable MX beamline. MXCuBE2 at the HZB features (i) standard and advanced data-collection protocols, (ii) integration of important ancillary tasks like sample centring, robot-assisted sample exchange and beamline optimisation, and (iii) a sample-processing queue that is especially valuable for data collections of large batches of samples. An overview of the experiences in terms of user acceptance and operational stability with the new instrumentation, its TANGO-based control-system layer and the extended experimental capabilites of MXCUBE2 will be presented.

THPHA016 The UNICOS-CPC Vacuum Controls Package

S. Blanchard*, M. Bes, E. Blanco Viñuela, W. Booth, B. Bradu, R. Ferreira, P. Gomes, A. Gutierrez, A.P. Rocha, T.H. van Winden (CERN) L. Kopylov (IHEP)*

The vacuum control of the Large Hadron Collider and its injectors is based on PLC and SCADA off-the-shelf components. Since late '90s, CERN's vacuum group has developed a dedicated control framework to drive, monitor and log the more than 10 000 vacuum instruments. Also, in 1998, CERN's industrial controls group developed the UNICOS framework (UNified Industrial Control System), becoming a de facto standard of industrial control systems and gradually deployed in different domains at CERN (e.g. Cryogenics, HVAC…). After an initial prototype applying the UNICOS-CPC (Continuous Process Control) framework to the controls of vacuum installations, both teams have been working on the development of vacuum-specific objects and their integration, together with new features, into the UNICOS framework. Such convergence will allow this generic framework to better fit the vacuum systems, while offering the advantages of using a widespread and well-supported framework. This paper reports on the experience acquired in the development and deployment of vacuum specific objects in running installations, as a prototype for the full vacuum controls convergence to UNICOS.

THPHA017 A Consistent Approach to Motion Control for CLARA

***P.W. Heath**, G. Cox, J.T.G. Wilson (STFC/DL) B.P. Withers (STFC/RAL/ISIS)*

STFC Daresbury Laboratory has recently commissioned Phase I of CLARA (Compact Linear Accelerator for Research and Applications), a novel FEL (Free Electron Laser) test facility focussed on the generation of ultra-short photon pulses of coherent light with high levels of stability and synchronisation. Various accelerator components will require motion control. Previous projects have used a variety of manufacturers custom interfaces, sometimes re-using dated technology to minimize costs. The CLARA project will require several hundred axes of motion control. Consequently it is desirable to have a consistent approach throughout; similar technology should be used to serve a wide range of requirements from the positioning of diagnostic screens, electron beam conditioning equipment, laser transport mechanisms, to magnet array positioning in undulators. Following an evaluation exercise a solution based on Beckhoff TwinCAT 3, the Beckhoff Modbus (TCP) server, and EPICS was selected. This paper describes the chosen system and its benefits and discusses lessons learnt during commissioning together with plans for future development during CALAR Phases II and III.

THPHA018 Upgrade of Control System of the Booster Power Supplies

***R. Petrocelli**, D. Alloza, S. Blanch-Torné, O. Matilla (ALBA-CELLS Synchrotron)*

ALBA is a 3 GeV third generation synchrotron light source operating with users since 2012. The injection system is composed of a 100 MeV Linac as pre-injector followed by a full energy booster synchrotron. The booster requires AC power converters (PC) operating at 3.125 Hz with a sinusoidal-like current waveform. Due to different problems found in the performance of the power supplies that will be briefly described later a complete redesign of the power part is needed. The challenge arises in the inherent indivisibility of the control and power parts of the hardware, purchased as a custom design to a third party. This paper presents a brief description of the booster power supplies and its control/regulation system, the several options for the upgrade that are being evaluated and the different possible architectures that are being considered to avoid this control upgrade problem in the future.

THPHA019 Control System Evolution on the ISIS Spallation Neutron Source

***R. Brodie**, I.D. Finch (STFC/RAL/ISIS)*

The ISIS spallation neutron source has been a production facility for over 30 years, with a second target station commissioned in 2008. Over that time, the control system has had to incorporate several generations of computer and embedded systems, and interface with an increasingly diverse range of equipment. We discuss some of the challenges involved in maintaining and developing such a long lifetime facility.

THPHA020 LCLS-II Undulator Motion Control

***K.R. Lauer**, C.J. Andrews, S. Babel, J.D. Bong (SLAC) G. Janša, Ž. Oven (Cosylab)*

At the heart of the LCLS-II are two undulator lines; one for generating hard x-rays (HXR) and one for generating soft x-rays (SXR). The SXR line is comprised of 21 variable gap undulator segments separated by an interspace stands with a cam positioning system able to position with 5 degrees of freedom (DOF). The undulator segment motion control is implemented using the Aerotech Ensemble motion controller through an EPICS soft IOC. Its drive system consists of a harmonic drive servo system with feedback from two full-gap encoders. To control the cam-positioning system of the interspace stand, an additional set of Aerotech motion controllers are used. The HXR line is comprised of 32 undulator segments which include an integrated interspace assembly. The girder is placed on two stands with a similar cam-positioning system as in the SXR line allowing for movement in 5 DOF. Since one of the goals of the design of the HXR line was to reuse the original LCLS girder positioning system, the motion control system is an updated version of that original system. The motion control system is VME-based with Animatics SmartMotors used for the translational stages.

THPHA021 Large-Scale Upgrade Campaigns of SCADA Systems at CERN - Organisation, Tools and Lessons Learned

***R. Kulaga**, J.A.R. Arroyo Garcia, M. Boccioli, E. Genuardi, P. Golonka, M. Gonzalez-Berges, J-C. Tournier, F. Varela (CERN)*

The paper describes the planning and execution of large-scale maintenance campaigns of SCADA systems for CERN's accelerator and technical infrastructure. These activities, required to keep up with the pace of development of the controlled systems and rapid evolution of software, are constrained by many factors, such as availability for operation and planned interventions on equipment. Experience gathered throughout the past ten years of maintenance campaigns for the SCADA Application Service at CERN, covering over 200 systems distributed across almost 120 servers, is presented. Further improvements for the procedures and tools are proposed to adapt to the increasing number of applications covered and reduce maintenance effort and required downtime.

THPHA022 Roadmap for Slac Epics-Based Software Toolkit for the LCLS-I/II Complex

***D. Rogind**, M.L. Gibbs, B.L. Hill, T.J. Maxwell, A. Perazzo, M.V. Shankar, G.R. White, E. Williams, S. Zelazny (SLAC)*

With the advent of LCLS-II, SLAC must effectively and collectively plan for operation of its premiere scientific production facility. LCLS-II presents unique new challenges for SLAC, with its electron beam rate of up to 1MHz, complex bunch patterns, and multiple beam destinations. These machine advancements, along with long-term goals for automated tuning, model dependent and independent analysis, and machine learning provide strong motivation to enhance the SLAC software toolkit based on augmenting EPICS V3 to take full advantage of EPICS V4 - which supports structured data and facilitates a language-agnostic middle-ware service layer. The software platform upgrade path in support of controls, online physics and experimental facilities software for the LCLS-I/II complex is described.

THPHA024 SLAC Klystron Test Lab Bake Station Upgrade

***S.C. Alverson**, K.J. Mattison (SLAC)*

The Klystron Bake Station at SLAC is a facility for baking out klystrons (high power RF amplifiers) among other equipment in preparation for installation in the linac. The scope of this project was to upgrade the 30 year old controls (based on VMS and CAMAC) to utilize PLC automation and an EPICS user interface. The new system allows for flexible configuration of the bake out schedule which can be saved to files or edited real time both through an EPICS soft IOC as well as a local touch panel HMI. Other improvements include active long term archiving of all data, COTS hardware (replacing custom-built CAMAC cards), email notification of fault states, and graphical user interfaces (old system was command line only). The first station upgraded came online in November 2016 and two more stations are planned to follow this year. Year poster discusses the improvements made and problems encountered in performing the upgrade.

THPHA025 **LCLS-II Injector Laser System**

S.C. Alverson *(SLAC)*

The Linac Coherent Light Source II (LCLSII) is a new Free Electron Laser (FEL) facility being built as an upgrade to the existing LCLS-I and is planned for early commissioning this year (2017) and full operation in 2020. The injector laser which hits the cathode to produce the electrons for this FEL source is conceptually similar to LCLS-I, but will utilize an upgraded controls architecture in order to be compatible with the faster repetition rate (1 MHz) of the beam. This includes moving to industrial PCs from VME and utilizing SLAC designed PCIe timing cards and camera framegrabbers. This poster discusses the overall architecture planned for this installation and discusses the reasoning behind the choices of hardware and control scheme.

THPHA026 **Control System Development of the TLS**

J. Chen*, Y.-S. Cheng, K.T. Hsu (NSRRC)*

Control system of the 1.5 GeV Taiwan Light Source was working near 25 years. The TLS control system is a proprietary design. Limited resource allocation prevent major revise impossible. It was performed minor upgrade several times to avoid obsolete of some system components and keep up-to-date since its delivery. To avoid obsolete of some system components and keep up-to-date, various minor updates were performed during these days. These efforts allow new devices installed, obsoleted parts replacement, add new software components and functionality. Strategic and efforts will summary in this report.

THPHA027 **Improvements of the ELBE Control System Infrastructure and SCADA Environment**

M. Justus*, K.-W. Leege, P. Michel, A. Schamlott, R. Steinbrück (HZDR)*

The ELBE Center for High-Power Radiation Sources comprises a 40 MeV c.w. electron linear accelerator, driving diverse secondary beams, both electromagnetic radiation and particles. Its control system is based on PLCs, fast data acquisition systems and the industrial SCADA system WinCC. In the past three years, requirements for availability and reliability increased, while at the same time changes of the machine configuration and instrumentation need to be handled permanently. Improvements of the control system infrastructure concerning power supply, IT and systems monitoring have been realized and are still under way. Second, along with the last major SCADA system upgrade, we implemented a more redundant SCADA infrastructure, improved long term data storage and continuously improved our standards for software development.

THPHA028 **Status Update for the Hit Accelerator Control System**

J.M. Mosthaf *(HIT)*

Changes in the accelerator beamline of the Heidelberg Ionbeam Therapy-Center necessitated a relevant change in the accelerator control system. Specifically the addition of a third ion source to the LEBT beamline dictated an expansion of the Virtual Accelerator structure both in the database and the DCU software. The decision to go to a virtual server infrastructure to meet the demands for better redundancy and performance prompted an overhaul of the ACS software and hardware base. Two new redundant virtualization servers and doubled storage systems helped to increase safety and system performance. To take advantage of the newer hardware and 64-bit operating systems, all software was converted to a 64 bit base. Additionally, as a quality of life and security improvement, the download and flash functionality of the ACS were updated to enhance performance and security checks for quality assurance measures. The new virtualization host server and infrastructure hardware in conjunction with the 64 bit update and ensuing efficiency increases have resulted in a safer and significantly faster ACS with higher redundancy in case of hardware failure.

THPHA030 Online an Online Analysis for Anticipated Failure Diagnostics of the Cern Cryogenic Systemsalysis for Anticipated Failure Diagnostics and Process Optimisation

***Ph. Gayet**, E. Blanco Viñuela, B. Bradu, R. Cirillo (CERN)*

(LHC) and its associated experiment ATLAS and CMS. In the past years, the cryogenic team has improved the maintenance plan and the operation procedure and achieves a very high reliability. However, as the recovery time after failure remains the major issue for the cryogenic availability new developments must take place. A new online diagnostic tool is developed to identify and anticipate failures of cryogenics field equipment, based on the acquired knowledge on dynamic simulation for the cryogenic equipment and on previous data analytic studies. After having identified the most critical components, we will develop their associated models together with the signature of their failure modes. The proposed tools will detect deviation between the actual systems and their model or identify preliminary failure signatures. This information will allow the operation team to take early mitigating actions before the failure occurrence. This contribution will present the overall architecture of the proposed tool, the methods used to identify critical components, the characteristic failure model to recognize together with the implementation plan and the achieved results.

THPHA031 Fast Image Analysis for Beam Profile Measurement at the European XFEL

***J. Wilgen**, B. Beutner (DESY)*

At the European XFEL, images of scintillator screens are processed at a rate of 10 Hz. Dedicated image analysis servers are used for transversal beam profile analysis as well as for longitudinal profile and slice emittance measurement. This contribution describes the setup and the algorithms used for image analysis.

THPHA032 DiamoniCA : EPICS and Open Source Data Analytics Platforms

***C.R. Haskins** (CSIRO ATNF)*

SKA scale distributed control and monitoring systems present challenges in hardware sensor monitoring, archiving, hardware fault detection and fault prediction. The size and scale of hardware involved and Telescope high availability requirements suggest the Machine learning and other automated methods will be required for fault finding and fault prediction of hardware components. Modern tools are needed leveraging open source time series database & data analytic platforms. We describe DiaMoniCA for The Australian SKA Pathfinder Radio Telescope which integrates EPICS, our own monitoring archiver MoniCA with an open source time series database and web based data visualisation and analytic platform.

THPHA033 Development of Status Analysis System Based on ELK Stack at J-PARC MLF

***K. Moriyama** (CROSS) T. Nakatani (JAEA/J-PARC) H.O. Ohshita, T. Tomohiro, Y. Yasu (KEK)*

In recent neutron scattering experiments, a large quantity and various kinds of experimental data are generated. In J-PARC MLF, it is possible to conduct many experiments under various conditions in a short time with high-intensity neutron beam and high-performance neutron instruments with a wealth of sample environmental equipment. Therefore, it is required to make an efficient and effective data analysis. Additionally, since it has been almost nine years from the beginning of operation in MLF, there are many equipment and system being up for renewal resulting in failure due to aging degradation. Since such kind of failure can lose precious beam time, failure or its sign should be early detected. MLF status analysis system based on the Elasticsearch, Logstash and Kibana (ELK) Stack, which is one of the web-based framework rapidly growing for big data analysis, ingests various data from neutron instruments in real time. It realizes to gain insight for decision-making such as data analysis and experiment as well as instrument maintenance by flexible user-based analysis and visualization. In this paper, we will report the overview and development status of our status analysis system.

THPHA034 A Survey of Big Data Tools Usage in Synchrotrons and Applicability Study in ILSF

***S. Alizada**, A. Khaleghi, J. Rahighi (ILSF) , A. Khaleghi (IKIU)*

In today's world, there is plenty of data being generated from various sources in different areas across economics, engineering and science. For instance, accelerators are able to generate 3 PB data just in one experiment. Synchrotrons industry is an example of the volume and velocity of data which data is too big to be analyzed at once. While some light sources can deal with 11 PB, they confront with data problems. The explosion of data become an important and serious issue in today's synchrotrons world. Totally, these data problems pose in different fields like storage, analytics, visualisation, monitoring and controlling. To override these problems, they prefer HDF5, grid computing, cloud computing and Hadoop/ Hbase and NoSQL. Recently, big data takes a lot of attention from academic and industry places. We are looking for an appropriate and feasible solution for data issues in ILSF basically. Contemplating on Hadoop and other up-to-date tools and components is not out of mind as a stable solution. In this paper, we are evaluating big data tools and tested techniques in various light source around the world for data in beamlines studying the storage and analytics aspects.

THPHA035 High Level Control System Code With Automatic Parametric Characterization and Neural Network Optimization Capabilities

***L. Neri**, L. Celona, S. Gammino (INFN/LNS)*

To increase the probability to satisfy the European Spallation Source accelerator requirement the design of the proton source and the LEBT made at INFN-LNS was driven by the insertion of an high flexibility for several working parameters. The little time available for the beam commissioning was optimized developing a custom Matlab code able to interact with the EPICS control system framework. The code is able to change all source parameters and read all beam diagnostics output data. With this code we was able to test the source for a wide range of parameters values seamlessly 24 our per day with a little human supervision. The capability to connect Matlab to EPICS enabled also the developing of a neural network optimization code able to automatic tune the source towards a precise current value and stability. Unexpected benefit come out from this approach that we think to extend to all the sources under developing at INFN-LNS.

THPHA036 Multi Criteria Partitioning on Distributed Filesystems for Efficient Accelerator Data Analysis and Performance Optimization

***S. Boychenko**, J.C. Garnier, M. Zerlauth (CERN) M. Zenha-Rela (University of Coimbra)*

Since the introduction of the map-reduce paradigm, relational databases are being increasingly replaced by more efficient and scalable architectures, in particular in environments where a query will process TBytes or even PBytes of data in a single execution. The same tendency is observed at CERN, where data archiving systems for operational accelerator data are already working well beyond their initially provisioned capacity. Most of the modern data analysis frameworks are not optimized for heterogeneous workloads such as they arise in the dynamic environment of one of the world's largest accelerator complex. This contribution presents a Mixed Partitioning Scheme Replication (MPSR) as a solution that will outperform conventional distributed processing environment configurations for almost the entire phase-space of data analysis use cases and performance optimization challenges as they arise during the commissioning and operational phases of an accelerator. We will present results of a statistical analysis as well as the benchmarking of the implemented prototype, which allow defining the characteristics of the proposed approach and to confirm the expected performance gains.

THPHA037 Future Archiver for CERN SCADA Systems

***P. Golonka**, M. Gonzalez-Berges, J. Guzik, R. Kulaga (CERN)*

The paper presents the concept of a modular and scalable archiver (historian) for SCADA systems at CERN. By separating concerns of archiving from specifics of data-storage systems at a high abstraction level, using a clean and open interface, it will be possible to integrate various data handling technologies without a big effort. The frontend part, responsible for business logic, will communicate with one or multiple backends, which in turn would implement data store and query functionality employing traditional relational databases as well as modern NOSQL and big data solutions, opening doors to advanced data analytics and matching the growing performance requirements for data storage. Initial experience with a prototype of the Big Data backend for timestamped data will also be presented.

THPHA038 Upgrade of the CERN Rade Framework Architecture Using RabbitMQ and MQTT

***O.Ø. Andreassen**, F. Marazita, M.K. Miskowiec (CERN)*

AMQP was originally developed for the finance community as an open way to communicate the vastly increasing over-the-counter trace, risk and clearing market data, without the need for a proprietary protocol and expensive license. In this paper, we explore the possibility to use AMQP with MQTT extensions in a cross platform, cross language environment, where the communication bus becomes an extendible framework in which simple/thin software clients can leverage the many expert libraries at CERN.

THPHA039 Online Data Reduction for the Materials Beamline at the European Synchrotron

***J. Kieffer**, S. Petitdemange, V. Valls, G. Vaughan, M. di Michiel (ESRF)*

The European synchroton (ESRF) situated in Grenoble, France has been upgraded since 2009. A set of new beam-lines have been build, among those the materials science beam-line which is optimized for high-energy powder-diffraction, diffraction contrast tomography and pair-distribution function analysis, thanks to a large pixel-detector with Cd-Te sensor working at high speed (Dectris Pilatus 2M- CdTe). This contribution presents the data management and data reduction pipeline developed for ESRF-ID15 to cope for the 250 images per second produced by the detector, which includes: * the transfer of the images from the detector to a data-analysis computer * the compression schemes tested and selected for the raw images * the networking infrastructure selected * the data-reduction pipeline running on GPU * the transfer from the data analysis computer to the central storage * the metadata exchange.

THPHA040 Generic Beamline Data Acquisition and Data Management Systems and the Leap to Public Data, Metadata Standards and Open Science

***D. Fernández-Carreiras**, F. Becheri, G. Cuní, C. Pascual-Izarra, S. Pusó Gallart, Z. Reszela, M. Rodriguez, S. Rubio-Manrique, D. Salvat (ALBA-CELLS Synchrotron)*

Managing different experimental techniques, detectors and data streams to produce comprehensive public access data that can enable open science, require the definition of ontologies, the standardization of metadata, the creation of data repositories and laboratory information management systems. Some X-ray techniques like macromolecular crystallography achieved remarkable results on automation of data acquisition and data management. Generic Beamline control software packages enable macro execution environments in multi-client command-line and graphical human machine interfaces capable of complex synchronization outlines and storing experimental data in standardized formats such as Nexus and hdf5. Federated storage systems, reusability of open data and compatibility with analysis software and computing resources in private or public clouds are the breakthroughs and the challenges for the future. This paper analyzes the interoperability of data acquisition and data management systems across X-ray sources and assesses the leap to open data and open science.

THPHA041 Information System for ALICE Experiment Data Access

__J. Jadlovsky__, J. Cabala, J. Cerkala, E. Hanc, A. Jadlovska, S. Jadlovska, M. Kopcik, M. Oravec, M. Tkacik, D. Voscek (Technical University of Kosice) P.M. Bond, P.Ch. Chochula (CERN)

The main goal of this paper is the presentation of Dcs ARchive MAnager for ALICE Experiment detector conditions data (DARMA), which is the updated version of the AMANDA 3 software currently used within ALICE experiment at CERN. The typical user of this system is either a physicist who performs further analysis on data acquired during the operation of the ALICE detector or an engineer, who analyzes the detector status between iterations of experiments. Based on the experience with the current system, the updated version aims to simplify the overall complexity of the previous version, which leads to simpler implementation, administration and portability of the system without sacrificing the functionality. DARMA is realized as an ASP. NET web page based on Model-View-Controller architecture and this paper provides a closer look at the design phase of the new backend structure in comparison to previous solution as well as the description of individual modules of the system.

THPHA042 ASCI: A Compute Platform for Researchers at the Australian Synchrotron

__J. Marcou__, R.R.I. Bosworth, R. Clarken (ASCo) , P. Martin, A. Moll (SLSA)

The volume and quality of scientific data produced at the Australian Synchrotron continues to grow rapidly due to advancements in detectors, motion control and automation. This makes it critical that researchers have access to computing infrastructure that enables them to efficiently process and extract insight from their data. To facilitate this, we have developed a compute platform to enable researchers to analyse their data in real time while at the beamline as well as post-experiment by logging in remotely. This system, named ASCI, provides a convenient web-based interface to launch Linux desktops running inside Docker containers on high-performance compute hardware. Each session has the user's data mounted and is preconfigured with the software required for their experiment. This poster will present the architecture of the system and explain the design decisions in building this platform.

THPHA043 Lightflow - a Lightweight, Distributed Workflow System

__A. Moll__, P. Martin (SLSA) R. Clarken (ASCo)

The Australian Synchrotron, located in Clayton, Melbourne, is one of Australia's most important pieces of research infrastructure. After more than 10 years of operation, the beamlines at the Australian Synchrotron are well established and the demand for automation of research tasks is growing. Such tasks routinely involve the reduction of TB-scale data, realtime analysis of the recorded data to guide experiments, and fully automated data management workflows. In order to meet these demands, a generic, distributed workflow system was developed. It is based on well-established Python libraries and tools such as Celery, NetworkX, Redis and MongoDB. The individual tasks of a workflow are arranged in a directed acyclic graph. Workers consume the tasks, allowing the processing of a workflow to scale horizontally. Data can flow between tasks and a variety of specialised tasks is available. The motivation for the development of Lightflow and interrelated design decisions will be presented in the context of existing Python libraries and workflow systems. Lightflow, its concepts and use cases will demonstrate how clever software design can solve problems across various domains.

THPHA044 REALTA and pyDART: A Set of Programs to Perform Real Time Acquisition and On-Line Analysis at the FERMI Free Electron Laser

__E. Allaria__, E. Ferrari, E. Roussel, L. Vidotto (Elettra-Sincrotrone Trieste S.C.p.A.)

During the optimization phase of the FERMI Free Electron Laser (FEL) to deliver the best FEL pulses to users, many machine parameters have to be carefully tuned, like e.g. the seed laser intensity, the dispersion strength, etc. For that purpose, a new python-based acquisition tool, called REALTA (Real Time Acquisition program), has been developed to acquire various machine parameters, electron beam properties and FEL signals on a shot-by-shot basis thanks to the real time capabilities of the TANGO control system. The data are saved continuously during the acquisition in a HDF5 file. The pyDART (Python Data Analysis Real Time) program is the post-processing tool that enables a fast analysis of the data acquired with REALTA. It allows to study the correlations and dependences between the FEL and electron beam properties and the machine parameters. In this work, we present the REALTA and pyDART toolkit developed for the FERMI FEL.

THPHA045 Packaging and High Availability for Distributed Control Systems

__M.A. Araya__, L. Pizarro, H.H. von Brand (UTFSM)

The ALMA Common Software (ACS) is a distributed framework used for control of astronomical observatories, which is built and deployed using roughly the same tools available at its design stage. Due to a shallow and rigid dependency management, the strong modularity principle of the framework cannot be exploited for packaging, installation and deployment. Moreover, life-cycle control of its components does not comply with standardized system-based mechanisms. These problems are shared by other instrument-based distributed systems. The new high-availability requirements of modern projects, such as the Cherenkov Telescope Array, tend to be implemented as new software features due to these problems, rather than using off-the-shelf and well-tested platform-based technologies. We present a general solution for high availability strongly-based on system services and proper packaging. We use RPM Packaging, oVirt and Docker as the infrastructure managers, Pacemaker as the software resource orchestrator and life-cycle process control through Systemd. A prototype for ACS was developed to handle its services and containers.

THPHA047 Network System Operation for J-PARC Accelarators

__N. Kamikubota__ (KEK) N. Kikuzawa (JAEA/J-PARC) H. Nemoto (ACMOS INC.) K.C. Sato, S. Yamada, N. Yamamoto (J-PARC, KEK & JAEA) S.Y. Yoshida (Kanto Information Service (KIS), Accelerator Group)

The network systems for J-PARC accelerators have been operated over ten years. This report gives: a) an overview of the control network system, b) discussion on relationship between the control network and the office network, and c) recent security issues (policy for antivirus) for terminals and servers. Operation experiences, including troubles, are also presented.

THPHA048 New IT-Infrastructure of Accelerators at BINP

***P.B. Cheblakov**, D. Bolkhovityanov, F.A. Emanov (BINP SB RAS)*

In 2017 the Injection Complex at Budker Institute, Novosibirsk, Russia began to operate for its consumers - colliders VEPP-4 and VEPP-2000. For successful run on of these installations is very important to ensure a stable operation of their control systems and IT-infrastructure. The present paper is about new IT-infrastructures of two accelerators: Injection Complex and VEPP-4. IT-infrastructure for accelerators consist of servers, network equipment and system software with average operation life about 10^{-20} years and it needs support, maintenance and periodical upgrade. The reasons to create IT-infrastructure with the same principles are minimization of cost and simplification of support. The following points where laid down during designing: high availability, flexibility and low cost. High availability is achieved through redundancy of hardware - doubling of servers, disks and network interconnections. Flexibility is caused by extensive use of virtualization that allows easy migration from one hardware to another in case of fault and gives to users an ability to use custom system environment. Low cost results from minimization of using of proprietary solutions.

THPHA050 Development, Commissioning and Operation of the Large Scale CO2 Detector Cooling Systems for CMS Pixel Phase I Upgrade

***M. Ostrega**, J. Daguin, S. Pavis, P. Petagna, P. Tropea, B. Verlaat, L. Zwalinski (CERN)*

During the 2017 Year-end Technical Stop of the Large Hadron Collider at CERN, the CMS experiment has successfully installed a new pixel detector in the frame of Phase I upgrade. This new detector will operate using evaporative CO2 technology as its cooling system. Carbon Dioxide, as state of the art technology for current and future tracking detectors, allows for significant material budget saving that is critical for the tracking performance. The road towards operation of the final CO2 cooling system in the experiment passed through intensive prototype phase at the CMS Tracker Integration Facility (TIF) for both cooling process hardware and its control system. This paper briefly describes the general design of both the CMS and TIF CO2 detector cooling systems, and focuses on control system architecture, operation and safety philosophy, commissioning results and operation experience. Additionally, experience in using the Ethernet IP industrial fieldbus as distributed IO is presented. Various pros and cons of using this technology are discussed, based on the solutions developed for Schneider Premium PLCs, WAGO and FESTO IOs using the UNICOS CPC 6 framework of CERN.

THPHA051 Present Status of the Daejeon Ion Accelerator Complex at KAERI

***S.-R. Huh**, D.S. Chang, C.K. Hwang, J.-T. Jin, S.K. Lee, B.H. Oh (KAERI)*

The Daejeon ion accelerator complex (DIAC) is being constructed at Korea Atomic Energy Research Institute (KAERI) in order to fulfill an increasing demand for heavy ion beam facilities for various purposes including material study and biological research. Based on devices of the Tokai radioactive ion accelerator complex received from high energy accelerator research organization (KEK), Japan, the dedicated accelerators in the DIAC are designed to produce stable heavy ion beams with energies up to 1 MeV/u. To date, (1) assembly of the electron cyclotron resonance (ECR) ion source and linacs delivered in pieces from the KEK (2) installation of the power supply, coolant circulation system, and vacuum pump system, (3) operation test of the ECR ion source, (4) full-power tests of the interdigital H-type

(IH) and radio-frequency quadrupole (RFQ) linacs, (5) construction of a radiation shielded walls for the DIAC, (6) tests of tuners in the RFQ, IH, and rebuncher, and (7) reorganization of the integrated control system have been completed. In the presentation, current status, plans, and test results for the DIAC construction will be presented and discussed in detail.

THPHA052 LIA-20 Control System Project

***G.A. Fatkin**, A.O. Baluev, A.M. Batrakov, E.S. Kotov, Ya.M. Macheret, V.R. Mamkin, A.V. Ottmar, A. Panov, A.V. Pavlenko, A.N. Selivanov, P.A. Selivanov, A.I. Senchenko, S.S. Serednyakov, K.S. Shtro, S.R. Singatulin, M.Yu. Vasilyev (BINP SB RAS) **G.A. Fatkin**, E.S. Kotov, A.V. Pavlenko, A.I. Senchenko, S.S. Serednyakov, M.Yu. Vasilyev (NSU)*

The project of the control system of linear induction accelerator LIA-20 for radiography is presented in this paper. The accelerator is a complex pulsed machine designed to provide a series of three consecutive electron pulses with an energy up to 20 MeV, current 2 kA and lateral beam size less then 1 mm. To allow reliable operation of the whole complex, coordinated functioning of more then 700 devices must be guaranteed in time frames from milliseconds to several nanoseconds. Total number of control channels exceeds 6000. The control system is based on a variety of specially developed VME and CAN modules and crates. Tango program infrastructure is used. The first stage of commissioning will take place in the end of 2017 and will include launching 5 MeV version of the accelerator.

THPHA053 Status of the Lipac Mebt Local Control System

***E. Molina Marinas**, A. Guirao, L.M. Martinez Fresno, I. Podadera, V. Villamayor (CIEMAT) A. Marqueta (IFMIF/EVEDA)*

The Linear Ifmif Prototype Accelerator (LIPAc), is being commissioned in Rokkasho, Japan. The Medium Energy Beam Transport (MEBT) line has already been installed and connected to the ancillary systems, while the mechanical connections to the adjacent systems, the Radio Frequency Quadrupole (RFQ) and the Diagnostics Plate (DP), are under way. The status of the MEBT Local Control System (LCS) was presented in the previous edition of ICALEPCS [*]. Since then, the functional specifications of the MEBT components controls have been completed, the control cabinets have been designed and are now being installed and the software has been written. In this paper, the final architecture and functionality of the MEBT LCS will be described and the preliminary results of its commissioning will be presented.

THPHA054 PS & LEBT Controls Integration at the European Spallation Source

***N. Levchenko**, D.P. Brodrick, J. Cereijo García, B. Gallese, J.H. Lee, D.P. Piso (ESS) J.F. Denis, F. Gougnaud, T.J. Joannem, V. Nadot (CEA/IRFU) N. Senaud (CEA/DRF/IRFU)*

The European Spallation Source (ESS) are currently finishing the commissioning of the control system for the Proton Source (PS) & Low Energy Beam Transfer (LEBT) sections of the newly constructed linear accelerator. The control system consists of multiple layers such as PLCs for local slow control and interlocking, EPICS for fast data acquisition, control, beam diagnostics, and a data archiving system. The EPICS layer is also responsible for the integration of PS&LEBT control system into the overall ESS Integrated Control System (ICS). The control system has been developed and commissioned by CEA, France with the help of ESS, Sweden, at the location of the currently assembled PS&LEBT equipment in INFN Catania, Italy. It has successfully demonstrated the functionality required, enough flexibility to allow for improvements and modifications, and robustness to allow safe and reliable end-user interaction. Commissioning and using the control system on the real PS&LEBT allowed for a very thorough testing and will greatly assist in better commissioning experience in Lund, Sweden.

THPHA055 Status of the NSRC Solaris Control System

***W.T. Kitka**, Ł.J. Dudek, M.K. Falowski, P. Galuszka, K. Kedron, A. Kisiel, G.W. Kowalski, P. Kurdziel, M. Ostoja-Gajewski, P. Sagało, M.J. Stankiewicz, T. Szymocha, A.I. Wawrzyniak, K. Wawrzyniak, I.S. Zadworny, Ł. Zytniak (Solaris National Synchrotron Radiation Centre, Jagiellonian University)*

A National Synchrotron Radiation Centre Solaris is a first synchrotron light source in Poland. Solaris consists of a linear accelerator , 1.5 GeV storage ring and 2 beamlines (PEEM and UARPES). The beamlines are in commissioning phase and should be ready for the first users in 2018. Additionally there are plans for a few next beamlines. The control system is based on Tango Controls. The system is fully operational. An archiving system uses HDB, TDB and HDB++ tools. PLC system consists of two parts: MPS (Machine Protection System) and PSS (Personal Safety System). The control system has been upgraded recently and it is constantly being improved to meet expectations of its users. The status of the Solaris Control System will be presented.

THPHA056 The Linac4 Vacuum Control System

***S. Blanchard**, J. De La Gama, R. Ferreira, P. Gomes, A. Gutierrez, G. Pigny, A.P. Rocha (CERN) L. Kopylov, M.S. Mikheev (IHEP)*

Linac4 is 160 MeV H^- linear accelerator replacing Linac2 as the first injector to the CERN accelerator complex, that culminates with the Large Hadron Collider. This new linac will increase the beam brightness by a factor of two. The vacuum installation consists of 235 remotely controlled pumps, valves and gauges. These instruments are either controlled individually or driven by pumping stations and gas injection processes. Valves and pumps are interlocked according to gauge pressure levels and pump statuses. The vacuum control system communicates with the beam interlock system, the ion source electronics and the Radio Frequency control system, through cabled digital and analog signals. The vacuum control system is based on commercial Programmable Logical Controllers (Siemens PLCs) and a Supervisory Control And Data Acquisition application (Siemens SCADA: WINCC OA). This paper describes the control architecture and process, and reports on the control requirements and the implemented solutions.

THPHA059 Design and Implementation of SESAME's Storage Ring Control System

***I. Saleh**, A.A. Abbadi, A. Al-Dalleh, A. Ismail (SESAME)*

SESAME is a synchrotron light source located in Allan, Jordan. It is expected to become operational in late 2017. Storage ring is currently under commissioning. SESAME's control systems are based on EPICS used for developing both soft and hard IOCs. Control System Studio (CSS) is used to build the graphical user interfaces. PLCs are used in machine protection and personal safety systems. VME is used in timing and power supplies control systems. This paper presents progress made in design and development of the Storage ring's control systems including: vacuum, power supplies, RF, diagnostics, MPS, PSS and timing systems.

THPHA060 Conceptual Design of the Cryogenic Control System of CFETR TF Coil Test Facility

***M. Zhuang**, L.B. Hu, Z.G. Zhu (ASIPP)*

China Fusion Engineering Test Reactor (CFETR) is superconducting Tokamak device which is next-generation engineering reactor between ITER and DEMO. It is now being designed by China national integration design group. In the present design, its magnet system consists of 16 Toroidal Field (TF) coils, 6 Center Solenoid (CS) coils and 8 Poloidal Field (PF) coils. A helium refrigerator with an equivalent cooling capacity of 5kW at 4.5K for CFETR TF coil test facility is proposed. It can provide 3.7K & 4.5K supercritical helium for TF coil, 50K cold helium with a 10g/s flow rate for High Temperature superconducting (HTS) current leads and 50K cold helium with a cooling capacity of 1.5kW for thermal shield. This paper presents the conceptual design of cryogenic control system for CFETR TF coil test including of architecture, hardware design and software development.

THPHA061 Control System Architecture of the CERN LHC Autonomous Train Inspection Monorail

M. Di Castro*, M.L. Baiguera Tambutti, S.S. Gilardoni, R. Losito, G. Lunghi, A. Masi (CERN)*

Intelligent robotic systems are becoming essential for inspection and measurements in harsh environments, such as the CERN accelerator complex. Aiming at increasing safety and machine availability, robots can help to perform repetitive or potentially dangerous tasks, thus reducing the risk for the personnel. The LHC tunnel has been equipped with trains on monorail able to perform autonomously different missions as: radiation survey, civil infrastructures monitoring through photogrammetry, fire detection as well as survey measurements of accelerator devices as the collimators. In this paper, the entire control architecture and the design of the low-level control to fulfil the requirements and the challenges of the LHC tunnel are described. The train low-level control is centered on a PLC based controller that communicates with the surface via the 4G network through VPN. A user-friendly graphical user interface allows the operation of the robot. The low-level controller includes a PLC fail-safe program to ensure the safety of the system. The paper presents also the results of the commissioning and the operational experience of the missions performed in the LHC last two years.

THPHA062 First Production Use of the New Settings Management System for FAIR

J. Fitzek*, H.C. Hüther, R. Müller, A. Schaller (GSI)*

With the successful commissioning of CRYRING, the first accelerator being operated using the new control system for FAIR (Facility for Antiproton and Ion Research), also the new settings management system is now used in a production environment for the first time. Development effort is ongoing to realize requirements necessary to support accelerator operations at FAIR. At CRYRING, parts of these new concepts for scheduling parallel beams are being evaluated. After this first successful use, the focus now is to include major parts of the existing facility (synchrotron SIS18, storage ring ESR and transfer lines) into the system in the context of the control system retrofit project. First dry runs are planned for Q4 this year. The settings management system is based on the LSA system, that was started at CERN in 2001 and is being developed and enhanced together in a collaboration. Notwithstanding all successes of LSA at both institutes, a review study was set up with the goal to make the LSA system fit for the future. Outcomes of this study and impacts on the settings management system for FAIR are being presented.

THPHA063 Status of the CLARA Control System

G. Cox*, R.F. Clarke, M.D. Hancock, P.W. Heath, N. Knowles, B.G. Martlew, A. Oates, P.H. Owens, W. Smith, J.T.G. Wilson (STFC/DL)*

STFC Daresbury Laboratory has recently commissioned Phase I of CLARA (Compact Linear Accelerator for Research and Applications), a novel FEL (Free Electron Laser) test facility focussed on the generation of ultra-short photon pulses of coherent light with high levels of stability and synchronisation. The main motivation for CLARA is to test new FEL schemes that can later be implemented on existing and future short wavelength FELs. Particular focus will be on ultra-short pulse generation, pulse stability, and synchronisation with external sources. Knowledge gained from the development and operation of CLARA will inform the aims and design of a future UK-XFEL. The control system for CLARA is a distributed control system based upon the EPICS software framework. The control system builds on experience gained from previous EPICS based facilities at Daresbury including ALICE and VELA. This paper presents the current status of the CLARA control system and discusses the successes and difficulties encountered during the early phases of commissioning.

THPHA064 Control System Status of SuperKEKB Injector Linac

M. Satoh *(KEK)*

The Phase I beam commissioning of SuperKEKB has been conducted from February to June in the last year. The injector linac has successfully delivered the electron and positron beams to the SuperKEKB main ring. The linac beam studies and subsystem developments are also intensively going on together with the daily normal beam injection to both rings of the SuperKEKB and two light sources. Towards Phase II and III beam commissioning of SuperKEKB, one of key issues is a fine beam control with the new beam position monitor readout system, a positron capture system based on the flux concentrator, a pulsed quadrupole and steering magnets, and a low emittance photo-cathode rf electron source. In this paper, we report the control system status of SuperKEKB injector linac together with the commissioning result of Phase I. In addition, the improvement plant of injector control system is also mentioned.

THPHA065 Operation Experiences and Development of the TPS Control System

K.T. Hsu*, J. Chen, Y.-S. Cheng, P.C. Chiu, K.H. Hu, C.H. Huang, D. Lee, C.Y. Liao, C.Y. Wu (NSRRC)*

Control system was operated near three years to support commissioning and operation of the TPS. Experiences accumulated in last three years in hardware, software have been confirmed it can fulfil its mission. Functionality and reliability were improved during last three years. Long term strategic for performance improvement and maintenance are revised. Efforts will be summarized in this reports.

THPHA066 MeerKAT Project Status Report

L.R. Brederode*, L. Van den Heever (SKA South Africa, National Research Foundation of South Africa)*

The MeerKAT radio telescope is currently in full production in South Africa's Karoo region and will be the largest and most sensitive radio telescope array in the centimeter wavelength regime in the southern skies until the SKA1 MID telescope is operational. This paper identifies the key telescope specifications, discusses the high-level architecture and current progress to meet the specifications. The MeerKAT Control and Monitoring subsystem is an integral component of the MeerKAT telescope that orchestrates all other subsystems and facilitates telescope level integration and verification. This paper elaborates on the development plan, processes and roll-out status of this vital component. Key risks and associated mitigations are described.

THPHA067 EtherCAT Based Systems at ESS

J. Etxeberria*, D.P. Brodrick, J.H. Lee (ESS)*

The European Spallation Source (ESS) is a multi-disciplinary research facility based on what will be the world's most powerful-pulsed neutron source. The Integrated Control System Division (ICS) is responsible of defining and providing control systems for the ESS facility. This control system will be based on the EPICS and it must be high performance, cost-efficient, safe, reliable and easily maintainable. At the same time there is a strong need for standardization. To fulfill these requirements ICS has chosen different hardware platforms, like MicroTCA, PLC, EtherCAT, etc. EtherCAT, a Ethernet-based real-time fieldbus will be analyzed, and different questions will be answered: -Why has EtherCAT been chosen? -In which cases is it deployed? -How is it integrated into EPICS? -What is the installation process? Along with data acquisition purposes, the ESS Motion Control and Automation Group decided to use EtherCAT hardware to develop an Open Source EtherCAT Master Motion Controller, for the control of all the actuators of the accelerator within the ESS project. Hence, an overview of the open Source Motion Controller and its integration in EPICS will be also presented.

THPHA068 PandABlocks Open FPGA Framework and Web Stack

C.J. Turner*, M.G. Abbott, T.M. Cobb, I.J. Gillingham, I.S. Uzun (DLS) Y.-M. Abiven (SOLEIL) G. Thibaux (MEDIANE SYSTEM)*

PandABlocks is the open source firmware and software stack that powers PandABox, a Zynq SoC based "Position and Acquisition" platform for delivering triggers during multi-technique scanning. PandABlocks consists of a number of FPGA functional blocks that can be wired together at run-time according to application specific requirements. Status reporting and high speed data acquisition is handled by the onboard ARM processor and exposed via a TCP server with a protocol suitable for integration into control systems like "EPICS" or "TANGO". Also included in the framework is a webserver and web GUI to visualize and change the wiring of the blocks. The whole system adapts to the functional blocks present in the current FPGA build, allowing different FPGA firmware be created to support new FMC cards without rebuilding the TCP server and webserver. This paper details how the different layers of PandABlocks work together and how the system can be used to implement novel triggering applications.

THPHA069 Control System for Atlas Tilecal HVremote Boards

J.A. Soares Augusto*, G.G. Evans, A. Gomes, A. Maio, C. Rato, J.M. Sabino (FCUL) G.G. Evans (BioISI) A. Gomes, L. Gurriana, A. Maio, F. Martins, L. Seabra (LIP)* ***J.A. Soares Augusto*** *(Inesc-ID)*

One of the proposed solutions for upgrading the high voltage (HV) system of Tilecal, the ATLAS hadron calorimeter, consists in removing the HV regulation boards from the detector and deploying them in a low-radiation room where there is permanent access for maintenance. This option requires many ~100m long HV cables but removes the requirement of radiation hard boards. That solution simplifies the control system of the HV regulation cards (called HVRemote). It consists of a Detector Control System (DCS) node linked to 256 HVRemote boards through a tree of Ethernet connections. Each HVRemote includes a smart Ethernet transceiver for converting data and commands from the DCS into serial peripheral interface (SPI) signals routed to SPI-capable devices in the HVRemote. The DCS connection to the transceiver and the control of some SPI-capable devices via Ethernet has been tested successfully. It was fabricated a test board (HVRemote-ctrl) with the interfacing sub-system of the HVRemote. It is being tested through SPI-interfaces and several devices were already validated. A next version adds a few more ADC/DAC devices for checking their suitability for the final design.

THPHA070 Multiplexer for the EM# Electrometer

P. Sjöblom*, A. Milan-Otero, A.G. Persson (MAX IV Laboratory, Lund University)*

Small currents need to be measured from a number of devices at a synchrotron and its beamlines. To meet this demand, MAX IV have joined a collaboration with ALBA to develop an electrometer that will ensure low current measurement capabilities and seamless integration into our Tango control system. The electrometers 4 independent channels can measure accurately in the fA range. Many devices produce larger currents and only need low sample rate. To make the electrometer more flexible, MAX IV have therefore developed a multiplexer with 8 independent channels. The multiplexer is both powered and controlled by the electrometer through its multipurpose IO interface. At most, an electrometer can control 4 multiplexers simultaneously giving a system with 32 channels, but the number of multiplexers can be chosen freely. The offset current introduced by the multiplexer is 45 pA and the noise is 3 pA. The offset is eliminated by settings in the electrometer. Current sweeps shows that currents steps as small as 10 pA can easily be measured and that switching time between channels before a steady signal is achieved is limited by the filter needed by the electrometer and not the multiplexer.

THPHA071 Plans at CERN for Electronics and Communication in the Distributed I/O Tier

G. Daniluk, *E. Gousiou (CERN)*

Controls and data acquisition in accelerators often involve some kind of computing platform (VME, PICMG 1.3, MTCA.4…) connected to Distributed I/O Tier electronics using a fieldbus or another kind of serial link. At CERN, we have started a project to rationalize this tier, providing a modular centrally-supported platform which allows equipment groups to focus on solving their particular problems while benefiting from a set of well-debugged building blocks. The paper describes the strategy, based on so-called "pizza boxes" featuring space for mezzanines and rear-transition modules. Different mezzanines allow communication using different protocols. There are two variants of the electronics, to deploy in environments with and without radiation tolerance requirements. The plans we present are the result of extensive discussion at CERN among all stakeholders. We present them here with the hope of gathering further feedback and potential interest in inter-lab collaborations.

THPHA072 A Position Encoder Processing Unit

R. Hino, *P. Fajardo, N. Janvier, T. Le Caër, F. Le Mentec (ESRF)*

Typical motion controllers rely on a feedback position encoder to detect the actuator output and correct for external factors. Recent advancements in positioning systems increased the demand for the ability to process a variety of sensors and direct the result to feedback the motion controller. In addition, data acquisition tools are necessary for metrology purposes to diagnose and ana-lyse the behaviour of the system. To address these re-quirements, the ESRF has developed an encoder pro-cessing unit that interfaces with up to six sensors, acquires and processes the incoming data and synthetizes the feedback information for the motion controller. Here we describe the main features of this unit, its internal archi-tecture, and few examples of application.

THPHA075 FPGA-based BPM Data Acquisition for LCLS-II

T. Straumann, *S. L. Hoobler, J.J. Olsen, C. Xu, A. Young (SLAC)*

The LCLS-II facility currently under construction at SLAC will be capable of delivering an electron beam at a rate of up to almost 1MHz. The BPM system (and other diagnostics) are required to acquire time-stamped readings for each individual bunch. The high rate mandates that the processing algorithms as well as data exchange with other high-performance systems such as MPS or bunch-length monitors are implemented with FPGA technology. Our BPM-processing firmware builds on top of the SLAC "common-platform" [*] and integrates tightly with core services provided by the platform such as timing, data-buffering and communication channels.

THPHA076 A Novel General Purpose Data Acquisition Board with a DIM Interface

***J. Jadlovsky**, J. Cabala, A. Jadlovska, S. Jadlovska, M. Kopcik, M. Oravec, M. Tkacik, D. Voscek (Technical University of Kosice) P.Ch. Chochula, O. Pinazza (CERN)*

A new general purpose data acquisition and control board (Board51) is presented in this paper. Board51 has primarily been developed for use in the ALICE experiment at CERN, but its open design allows for a wide use in any application requiring flexible and affordable data acquisition system. It provides analog I/O functionalities and is equipped with software bundle, allowing for easy integration into the SCADA. Based on the Silicon Labs C8051F350 MCU, the board features a fully-differential 24-bit ADC that provides an ability to perform very precise DAQ at sampling rate up to 1kHz. For analog outputs two 8-bit current-mode DACs can be used. Board51 is equipped with UART to USB interface that allows communication with any computer platform. As a result the board can be controlled through the DIM system. This is provided by a program running on a computer publishing services that include measured analog values of each ADC channel and accepts commands for setting ADC readout rate and DACs voltage. Digital inputs/outputs are also accessible using the DIM communication system. These services enable any computer on a common network to read measured values and control the board.

THPHA079 Application of Soc Based Applications in the TPS Control System

***Y.-S. Cheng**, K.T. Hsu (NSRRC)*

System on a chip (SoC) based system widely apply for accelerator control recently. These system with small footprint, low-cost with powerful CPU and rich interface solution to support many control applications. SoC based system running Linux operation system and EPICS IOC embedded to implement several applications. TPS adopt some SoC solutions in control system includes, alarm announcer, RadFET reader, post-mortem data acquisition, frequency and divider control, etc. The efforts for implementing are summarized in this paper.

THPHA080 Development Status of a Precision Logarithmic Ammeter

***W.R. Araujo**, D.B. Beniz, M.B. Errada, S. Figueroa, D. Galante, F.C. Santanna (LNLS) R. Arthur (UNICAMP)*

It was accomplished preliminary tests for performance of a precision ammeter for the acquisition of sensor signals such as photodiodes and gold mesh (by photoelectron effect) that presented good results [*]. The ammeter in development is based on a different methodology than present on most commercial systems, using a logarithmic amplifier. This choice can provide a logarithmic response output in the range of pico to milli-ampers and proved to be a good option to current measurements because shows the capacity of measuring ranges of currents without the necessity of scale change. An electronic board is in development using a Field-programmable gate array (FPGA) to read an Analog Digital Converter (ADC), to signal analysis and apply a digital filtering for remove noise interference. The data will be send for a personal computer for store of data. It is intended to perform tests of electronic board in the Brazilian Synchrotron Light Laboratory (LNLS), and will be is being installed and tested at the Toroidal Grating Monochromator (TGM) Beamline and X-Ray Absorption Fine Structure (XAFS1) for tests using Ionization Chamber.

THPHA081 LO RTM for 704.42 MHz LLRF Control System for ESS

***I. Rutkowski**, K. Czuba, M.G. Grzegrzolka (Warsaw University of Technology, Institute of Electronic Systems)*

A low level radio frequency (LLRF) control system stabilizes the electromagnetic field inside accelerating modules. A field detection has critical influence on the regulations quality. This paper describes the requirements, architecture, and measurements results of the MTCA-complaint local oscillator (LO) rear transition module (RTM) board prototype. The design will provide low phase noise clock and heterodyne signals for the 704.42 MHz LLRF control system at the European Spallation Source (ESS). The clock frequency is a subharmonic of the reference frequency and choice of the frequency divider generating the clock signals is discussed. The performance of selected frequency dividers was evaluated. The LO frequency synthesis schemes are investigated. Critical components used in the direct analog scheme are identified and their selection criteria are given. Influence of the intermediate frequency (IF) amplifier on the phase noise of the heterodyne signal was measured. Diagnostic and monitoring circuits, as well as the logic used to set the operating parameters via Zone3 connector, are described.

THPHA082 Progress of SESAME Motion Control System

Y.R. Momani*, F. Omari, I. Saleh (SESAME)*

SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East) is a "third-generation" synchrotron light source under construction in Allan, Jordan. Big-scale projects, like SESAME require standardization of its systems and subsystems as much as possible. This standardization will facilitate and reduce the costs of operation, maintenance, support, integration and future development, as well as it will minimizes control software development efforts. These reasons led us to design and build a standard motion box containing a motion controller and up to eight stepper and servo motor drivers.

THPHA084 Analog Master Frequency Reconstruction for Pump-Probe Experiments

B. Molas*, L. Aballe, D. Fernández-Carreiras, A. Fontsere Recuenco, O. Matilla, J. Moldes, M.J. Ulrich (ALBA-CELLS Synchrotron)*

The timing and synchronization system at ALBA synchrotron facility is based on the mature and well-established event-based model broadly used in the new particle accelerator facilities built in the last decade. In previous systems, based on signal model architecture, the master frequency was distributed using direct analog signal and delayed at each target where the triggers were required. However, this strategy has proven to be extremely expensive and non-scalable. In the event-based model, the data stream is generated at a continuous rate synchronously with the master clock oscillator of the accelerator. This strategy improves the flexibility for tuning the trigger parameters remotely and reduces the costs related to maintenance tasks. On the other hand, the absence of the pure RF signal distributed in the experimental stations implies much more complexity in the performance of pump and probe experiments. This abstract explains how these difficulties have been overcome in the ALBA timing system to allow the signal reconstruction of the RF master frequency at CIRCE beamline.

THPHA085 SKA Synchronization and Timing - Local Monitor and Control Project Status

R. Warange*, Y. Gupta (National Centre for Radio Astrophysics, Tata Institute of Fundamental Research) , R.E. Braddock, K. Grainge, J. Hammond (University of Manchester) U.P. Horn (SKA Organisation) G.R. Mant (STFC/DL)*

The Square Kilometre Array (SKA) project aims to build a large radio telescope consisting of multiple dishes and dipoles, in Australia (SKA1-Low) and South Africa (SKA1-Mid). The Synchronization and Timing (SAT) system of SKA provides frequency and clock signals from a central clock ensemble to all elements of the radio telescope, critical to the functionality of SKA acting as a unified large telescope using interferometry. The local monitor and control system for SAT (SAT. LMC) will monitor and control the working of the SAT system consisting of the timescale generation system, the frequency distribution system and the timing distribution system. SAT. LMC would also enable Telescope Manager to carry any SAT maintenance and operations. As part of Critical Design Review phase, SAT. LMC is getting close to submitting its final architecture and design. This paper discusses the architecture, interfaces with the heterogeneous SAT equipment, technology, and the outcomes of prototyping activities.

THPHA086 LCLS-II Timing System

***M. Weaver**, C. Bianchini, J. Browne, K.H. Kim, S. Zelazny (SLAC)*

The Linac Coherent Light Source II (LCLS-II) is an upgrade of the SLAC National Accelerator Laboratory LCLS facility to a superconducting LINAC with multiple destinations at different power levels. The project is scheduled to start operations in 2020. The challenge in delivering timing to a superconducting LINAC is dictated by the stability requirements for the beam power to be fixed. This specification drives the overall design of both Hardware and Software. The Timing System rate for LCLS-II is 1MHz. A timing generator will produce patterns instead of events because of the large number of event codes required. The Timing Pattern Generator (TPG) generates the patterns, which get propagated to the Timing Pattern Receiver (TPR)distributed along the beam line for each device. The TPG and TPR are implemented using an FPGA solution, which is configured by EPICS. The high-level interface will program Sequence Engines in the FPGA to deliver the beam rate configuration requested by the user. The poster shows an overall design of the hardware and software SLAC customized solutions that meet the physics requirements for LCLS-II.

THPHA088 A time stamping TDC for SPEC and ZEN platforms based on White Rabbit

***M. Brückner** (PSI) R. Wischnewski (DESY Zeuthen)*

Sub-nsec precision time synchronization is requested for data-acquisition components distributed over up to tens of km2 in modern astroparticle experiments, like upcoming Gamma-Ray and Cosmic-Ray detector arrays, to ensure optimal triggering, pattern recognition and background rejection. The White-Rabbit (WR) standard for precision time and frequency transfer is well suited for this purpose. We present two multi-channel general-purpose TDC units, which are firmware-implemented on two widely used WR-nodes: the SPEC (Spartan 6) and ZEN (Zynq) boards. Their main features: TDCs with 1 nsec resolution (default), running deadtime-free and capable of local buffering and centralized level-2 trigger architectures. The TDC stamps pulses are in absolute TAI. With off-the-shelve mezzanine boards (5ChDIO-FMC-boards), up to 5 TDC channels are available per WR-node. Higher density, customized simple I/O boards allow to turn this into 8 to 32-channel units, with an excellent price to performance ratio. The TDC units have shown excellent long-term performance in a harsh environment application at TAIGA-HiSCORE/Siberia, for the Front-End DAQ and the central GPSDO clock facility.

THPHA089 Pulsed Quadrupole and Steering Magnet Control System for SuperKEKB Injector Linac

***M. Satoh** (KEK)*

Toward SuperKEKB project, the injector linac upgrade is ongoing for aiming at the stable beam operation with low emittance and high intensity bunch charge. One of the key challenges is a low emittance preservation of electron beam because the vertical emittance of 20 mm x mrad or less should be transported to the main ring without a damping ring. In addition, the simultaneous top up injection is strongly demanded for four independent storage rings. For this reason, the pulsed quadrupole and steering magnets and power supplies will be installed in this summer shutdown. The pulsed magnet control system will be also deployed, and they are based on the fast PXI bus based system. For the pulse by pulse control up to 50 Hz, they should cooperatively act with the event based timing system. In this paper, we will present the system description of pulsed magnet control system in detail together with some preliminary test results.

THPHA090 Channel Selection Switch for the Redundant 1.3 GHz Master Oscillator of the European XFEL

B. Gąsowski, *K. Czuba, L.Z. Zembala (Warsaw University of Technology, Institute of Electronic Systems) H. Schlarb (DESY)*

The phase reference signal reliability is of utmost importance for continuous operation of the European XFEL machine. Since even very short interruption or glitch in the reference signal might break the precise synchronisation between subsystems, it is desirable to minimize probability of such events. While master oscillators often have a hot-spare to speed-up recovery after a failure, whether switched manually or electronically, it does not save from time-consuming resynchronisation. Our experience from testing and commissioning E-XFEL 1.3 GHz Master Oscillator (MO) shows that a struggle to achieve demanding phase-noise requirements might negatively impact reliability of the system. In this paper we present an approach which allows for quick switching between independent reference generation channels while maintaining continuity of the output signal. This is a first step towards autonomous redundancy solution for the E-XFEL MO which will maintain continuous reference signal even in case of a failure of one of the generation channels.

THPHA092 Optimisation of a Low-Noise 1.3 GHz PLL Frequency Synthesizer for the European XFEL

S. Hanasz, *K. Czuba, B. Gąsowski, L.Z. Zembala (Warsaw University of Technology, Institute of Electronic Systems) H. Schlarb (DESY)*

The Master Oscillator system of the European XFEL was built using frequency synthesis techniques that were found to have the best phase noise performance. This includes low noise frequency multipliers and non-multiplying phase lock loops, incorporated in the system to shape its output phase noise spectrum. Jitter of the output signal strongly depends on phase noise transmittance of the PLL suboptimal design can worsen it by orders of magnitude. Taking into consideration that the PLL open loop transmittance usually has multiple degrees of freedom, and that the accurate phase noise measurements can easily take more than 30 minutes, designing an automated tool becomes a necessity. For this purpose an approach to model construction and optimisation was chosen. This paper describes the optimisation of PLL synthesizer phase noise, done to improve the performance of the European XFEL MO. We present model design process, measurements of its parameters and obtained results.

THPHA093 Towards a Femtosecond Timing and Synchronization System for a 1MHz Repetition Rate X-Ray Free-Electron Laser

K. Gumerlock, *R.N. Coffee, J.C. Frisch, A.R. Fry, L. Ma, J. May, C. Xu (SLAC)*

The upgrade of the Linac Coherent Light Source (LCLS) at SLAC National Accelerator Laboratory to LCLS-II, a superconducting, 1MHz repetition rate, pulsed soft X-ray source, presents both an opportunity to design a femtosecond-stability timing and synchronization system, as well as a unique challenge in aggregating, parsing, and discriminating timing data from dozens of heterogeneous sources. A novel design is detailed, based on complementary distributed fiber-based information systems: (1) a drift-detecting and drift-compensating RF-over-fiber distribution system, (2) a multi-gigabit timing data aggregation system, and (3) a femtosecond fiber pulse synchronization system. System stability, design performance, robustness against component failure, and algorithm details are discussed.

THPHA096 ALBA Equipment Protection System, Current Status

A. Rubio*, G. Cuní, D. Fernández-Carreiras, S. Rubio-Manrique, N. Serra, J. Villanueva (ALBA-CELLS Synchrotron)*

ALBA is the name of Barcelona's 3GeV Synchrotron Lightsource. In operation since 2012, it currently hosts experiments 24/7 in its 8 beamlines with 3 more in development. The aim of ALBA Equipment Protection System is to avoid damage of hardware by managing sets of permits and interlock signals. The EPS scope covers not only ALBA accelerators and its beamlines but also the accessory laboratories like RF, Optics, Vacuum, etc. It is built on B&R PLCs with CPUs installed in cabinets in ALBA service and experimental areas and a network of remote I/O modules installed in shielded boxes inside the tunnel and other irradiated zones. CPU's and Remote models are interconnected by the X2X field-bus. Signals managed by PLC's include interlocks, temperature readouts, flow-meters, flow-switches, thermo-switches, shutters, pneumatic actuators, fluorescence screens, etc. This paper describes the design and the architecture of the Equipment Protection System, the current status, the tools used by the EPS team and the recent improvements in terms of reaction time and interaction with other systems via Powerlink and fast interlock systems.

THPHA097 Machine Protection at European Spallation Source ERIC: An Overview and Status Report

A. Nordt*, R. Andersson, E. Bargalló, T. Korhonen, S. Kövecses, M. Zaera-Sanz (ESS) R. Andersson (University of Oslo) C. Hilbes, M. Rejzek (ZHAW)*

The European Spallation Source ERIC in Lund, Sweden is currently under construction and first proton beam is expected early 2018. This contribution will provide an overview of how we prepare for early beam commissioning from the point of view of Machine Protection (MP). Further we will describe major challenges and mitigation strategies for Machine Protection in such phase of a project, where schedule is the most pressing criteria from a project perspective. The novel concept of the Fast BIS for ESS, being one important system for Machine Protection, will be described in the second part of the paper.

THPHA098 Development of a PXI Based Test Stand for Automatization of the Quality Assurance of the Patient Safety System in a Proton Therapy Centre

P. Fernandez Carmona*, M. Eichin, M. Grossmann, F. Heimann, H.A. Regele, D.C. Weber, R. van der Meer (PSI)*

At the Centre for Proton Therapy at the Paul Scherrer Institute a cyclotron, two gantries and a fixed beamline are being used to treat tumours. In order to prevent non-optimal beam delivery, an interlock patient safety system (PaSS) was implemented that interrupts the treatment if any sub-system reports an error. To ensure correct treatment, the PaSS needs to be thoroughly tested as part of the regular quality assurance as well as after each change. This typically required weeks of work, extensive beam-time and may not comprehensively detect all possible failure modes. With the opportunity of the installation of a new gantry, an automated PaSS test stand was developed that can emulate the rest of the facility. It consists of a NI PXI chassis with virtually unlimited IOs synchronously stimulated or sampled at 1MHz, a set of adapters to connect each type of interfaced signal and a runtime environment. We have also developed a VHDL based formal language to describe stimuli, assertions and specific measurements. We present the use of our test stand in the verification and validation of the PaSS, showing how its full quality assurance, including report generation was reduced to minutes.

THPHA099 New Concepts for Access Devices in the SPS Personnel Protection System

T. Ladzinski*, F. Havart, P. Ninin, E. Sanchez-Corral Mena, F. Valentini, D. Vaxelaire (CERN)*

The accelerator facilities at CERN span large areas and the personnel protection systems consist of hundreds of interlocked doors delimiting the accelerator zones. Entrance into the interlocked zones from the outside is allowed only via a small number of access points. These are no longer made of doors which have left their place to turnstiles and then to mantraps or Personnel Access Devices (PAD). Originally meant for high security zones, the commercially available PADs have a number of CERN-specific additions. This paper presents in detail the purpose and characteristics of each piece of equipment constituting the access devices and its integration within the personnel protection system. Key concepts related to personnel safety (e.g. interlocked safety tokens, patrols) and to access control (e.g. access authorisation, biometric identity verification, equipment checks) are introduced and solutions discussed. Three generations of access devices are presented, starting from the LHC model put in service in 2008, continuing with the PS devices operational since 2014 and finally introducing the latest model under development for the refurbishment of the SPS Personnel Protection System.

THPHA100 Integration of Personal Protective Equipment Checks in Access Control

P. Pok*, F. Havart, T. Ladzinski (CERN)*

Access to the interlocked zones of the CERN accelerator complex is allowed only for personnel wearing standard personal protective equipment. This equipment is complemented by specialised personal protective devices in case of specific hazards related to the remnant radiation or the presence of cryogenic fluids. These complex devices monitor the environment in the vicinity of the user and warn the user of the presence of hazards such as radiation or oxygen deficiency. The use of the devices is obligatory, but currently only enforced by procedures. In order to improve the safety of the personnel it has been proposed to verify that users are carrying their devices switched on when entering. This paper describes the development of a specialised multi-protocol terminal, based on Texas Instruments digital signal processor and integrated in the personnel protection system. The device performs local checks of the presence and status of operational dosimeter prior to allowing access to the interlocked zones. The results of the first tests in the Proton Synchrotron accelerator complex will be presented.

THPHA101 Review of Personnel Safety Systems at Diamond

M.C. Wilson *(DLS)*

Diamond Light Source is celebrating 10 years of "users" at its facility in Oxfordshire, England. It’s safety systems have been designed to the standard EN61508, with the facility constructed in 3 phases, which are just concluding. The final "phase 3" beamline Personnel Safety System has been signed-off; hence it is timely to review our experience of the journey with these systems.

THPHA105 ESS Target Safety System Design

A. Sadeghzadeh*, L. Coney, O. Ingemansson, A. Malm, M. Olsson (ESS)*

The purpose of the Target Safety System (TSS) is to protect the public from exposure to unsafe levels of radiation, prevent the release of radioactive material beyond permissible limits, and bring the neutron spallation function into a safe state. In order to fulfill the necessary safety functions, the TSS continually monitors critical parameters within target station systems. If any parameter exceeds an acceptable level, the TSS actuates contactors to cut power to components at the front end of the accelerator and prevent the beam from reaching the target. The TSS is classified as a safety structure, system and component, relevant for the safety of the public and the environment. As such, it requires the highest level of rigor in design and quality for interlock systems at the ESS. Standards are applied to provide a guideline for building the TSS architecture and designing in resistance to single failures and common cause failures. This paper describes the system architecture and design of the TSS, including interfaces with target station and accelerator systems, and explains how the design complies with authority conditions and requirements imposed by development standards.

THPHA106 Commissioning of a New Dose Rate Monitoring System at the S-DALINAC

***J. Birkhan**, M. Arnold, U. Bonnes, J. Conrad, M. Hess, L. Marc, N. Pietralla, L. Stobbe, P. von Neumann-Cosel (TU Darmstadt)*

Recently a new radiation protection interlock system has been established at the Darmstadt superconducting linear electron accelerator S-DALINAC [*]. It prevents the staff from entering radiation protection areas during operation and allows a systematic scanning of these areas for workers before running the accelerator. As an extension of the new interlock, a new dose rate monitoring system has been developed using PIN diodes and self-made ion chambers. These detectors will be used to perfom online dose rate measurements in order to switch automtically the status of illuminated radiation protection panels, which show the current level of protection area. Furthermore, they will be used to characterize systematically the radiation fluxes inside the accelerator facility and to support the beam diagnostics. The readout electronics consists ofμcontrollers with ethernet interfaces using TCP/IP based serial communication. The data acquisition is integrated into the EPICS based control system. First results of the commissioning will be presented.

THPHA107 Safety Control of the Spiral2 Radioactive Gas Storage System

***Q. Tura**, C. Berthe, O. Danna, M. Mamadou, A. Savalle, J. Suadeau (GANIL)*

The phase 1 of the SPIRAL2 facility, extension project of the GANIL laboratory, is under construction and the commissioning had started. During the run phases, radioactive gas, mainly composed of hydrogen, will be extracted from the vacuum chambers. The radioactive gas storage system function is to prevent any uncontrolled release of activated gas by storing it in gas tank during the radioactive decay, while monitoring the hydrogen rate in the tanks under a threshold. This confinement of radioactive materials is a safety function. The filling and the discharge of the tanks are processed with monostable valves, making the storage a passive safety system. Two separate redundant control subsystems, based on electrical hardware technologies, allow the opening of the redundant safety valves, according to redundant pressure captors, redundant di-hydrogen rate analyzers and limit switches of the valves. The redundancy of the design of the control system meets the single failure criterion. The monitoring of the consistency of the two redundant safety subsystems, and the non-safety control functions of the storage process, are then managed by a Programmable Logic Controller.

THPHA108 Versatile Service for the Protection of Experimental Areas at CERN

***F. Valentini**, M. Munoz-Codoceo, P. Ninin (CERN)*

In addition to the large LHC experiments, CERN hosts a number of other experimental areas with a rich research program ranging from fundamental physics to medical applications. The risk assessments have shown a large palette of potential hazards (radiological, electrical, chemical, laser, etc.) that need to be properly mitigated in order to ensure the safety of personnel working inside these areas. A Personnel Protection System, typically, accomplishes this goal by implementing a certain number of heterogeneous functionalities as interlocks of critical elements, management of a local HMI, data monitoring and interfacing with RFID badge readers. Given those requirements, reducing system complexity and costs are key parameters to be optimized in the solution. This paper is aimed at summarizing the findings, in terms of costs, complexity and maintenance reduction, offered by a technology from National Instruments® based on cRIO controllers and a new series of SIL-2 certified safety I/O modules. A use case based on a service for the protection of Class 4 laser laboratories will be described in detail.

THPHA109 Improving the Safety and Protective Automatic Actions of the CMS Electromagnetic Calorimeter Detector Control System

R.J. Jiménez Estupinan *(ETH)*

The CMS ECAL Detector Control System (DCS) features several monitoring mechanisms able to react and perform automatic actions based on pre-defined action matrices. The DCS is capable of early detection of anomalies inside the ECAL and on its off-detector support systems, triggering automatic actions to mitigate the impact of these events and preventing them from escalating to the safety system. The treatment of such events by the DCS allows for a faster recovery process, better understanding of the development of issues, and in most cases, actions with higher granularity than the safety system. This paper presents the details of the DCS automatic action mechanisms, as well as their evolution based on several years of CMS ECAL operations.

THPHA110 Machine Protection System Research and Development for the Fermilab PIP-II Proton Linac

L.R. Carmichael*, A. Warner (Fermilab)*

PIP-II is a high intensity proton linac being design to support a world-leading physics program at Fermilab. Initially it will provide high intensity beams for Fermilab's neutrino program with a future extension to other applications requiring an upgrade to CW linac operation (e.g. muon experiments). The machine is conceived to be 2 mA CW, 800 MeV H^- linac capable of working initially in a pulse (0.55 ms, 20 Hz) mode for injection into the existing Booster. The planned upgrade to CW operation implies that the total beam current and damage potential will be greater than in any present HEP hadron linac. To mitigate the primary technical risk and challenges associated PIP-II an integrated system test for the PIP-II front-end technology is being developed. As part of the R&D a robust machine protection system (MPS) is being designed. This paper describes the progress and challenges associated with the MPS.

THPHA114 CLARA Gun Temperature Control Using Omron PLC

A. Oates *(STFC/DL)*

STFC Daresbury Laboratory has recently commissioned Phase I of CLARA (Compact Linear Accelerator for Research and Applications), a novel FEL (Free Electron Laser) test facility focused on the generation of ultra-short photon pulses of coherent light with high levels of stability and synchronization. In order to maintain phase stability the CLARA gun requires a precision water temperature control system to maintain a gun cavity temperature within 0.028C. This is achieved by mixing two water circuits with temperatures close to the desired set point. Two temperature measurement systems were evaluated for precision and reliability, the resultant system uses a single Omron PLC which provides all the precision read back and control loops. High resolution input modules and averaging achieve precision temperature monitoring while two PID loops control the coarse and fine temperature control. EPICS control is achieved using the FINS protocol communicating with a Linux IOC. This paper gives details of the system requirements and implementation and also describes the performance of the system in an operational environment.

THPHA115 A New Transverse and Longitudinal Bunch by Bunch Feedback Processor

***M.G. Abbott**, G. Rehm, I.S. Uzun (DLS)*

We describe the development of firmware to support Longitudinal Bunch by Bunch Feedback at Diamond Light source. As well as feedback, the system supports complex experiments and the capture of detailed diagnostics. In this paper we describe the firmware development and some details of the processing chain. We focus on some of the challenges of FPGA development from the perspective of a software engineer. Another interesting challenge was posed by the decision to develop the entire signal processing chain to run at 500 MHz. This does work well enough, but presents numerous challenges; it would probably have been simpler to run at half the clock speed!

THPHA116 Emittance Measurement and Optics Matching at the European XFEL

***S.M. Meykopff** (DESY)*

Electron beam quality described by the emittance or phase space moments are important for the operation of FEL facilities like the European XFEL. For the operation these parameters need to be routinely measured. Based on such measurements machine setup can be optimized to match beam requirements. The beam parameters depend on parameters like quadrupole magnet strength or RF settings. While manual tuning is possible, we aim for highly automatized procedures to obtain such optimizations. In this paper we will present and discuss an overview of the different subsystems which are involved. These include image acquisition, analysis, and optics calculations as well as machine control user interfaces.

THPHA118 Temperature Monitoring Program for Undulator Systems at European XFEL

***S. Abeghyan**, S. Karabekyan, J. Pflüger, M. Yakopov (XFEL. EU)*

The magnetic field produced by NdFeB permanent magnets, which are used in the undulators for European XFEL, has a temperature dependency. Thus the temperature of the magnets has an influence on the energy of the emitted photons. Therefore the temperature stabilization in tunnels, where undulators are installed, is essential for stability of the photon beam wavelength. In order to ensure that temperature in each tunnel is satisfying requiring conditions, a program to continuously monitor temperatures in each cell of system was developed. Important is, that existing hardware was re-used, and no redesign was required to establish monitoring. The monitoring part of the program is installed in each global control node and running as a Windows Service. It is using Beckhoff ADS communication protocol in order to read data. It then continuously stores data into a local database. The program can plot data in different modes. It can also export data into different file formats. With all data collected it is possible to see how the temperature is regulated in each cell, and point out potential problems.

THPHA119 Undulator Systems Tester

***S. Abeghyan**, S. Karabekyan, J. Pflüger, M. Yakopov (XFEL. EU)*

The undulator control system is consisting of numerous hardware and software components, responsible for smooth functioning of the system. During the operation phase, the access to tunnels will be mostly restricted, therefore we have to ensure that all components are functioning properly before the operation starts.

Testing each component manually is tedious work and virtually impossible to perform in a suitable time frame. A program has been developed, which can test each hardware unit individually in all cells of the system simultaneously. The software can be highly customized and is easily extendable. It can generate a report with the test results. The number of passes for each test can be specified. Various tests of the components are currently implemented to test the Undulators, Phase Shifters, Quadrupole movers and Air coils and control systems in various ways. The software is using the Beckhoff ADS communication protocol in order to perform these tests and read the results. The software is running on each global control node of the system, which makes use of routines on the local control nodes, where no special code is required.

THPHA120 Compensation Controls for an Elliptically Polarizing Undulator

J. Willard *(CLS)*

At the Canadian Light Source (CLS) synchrotron, the addition of the Quantum Materials Spectroscopy Centre (QMSC) beamline requires the addition of an Elliptically Polarizing Undulator (EPU) insertion device to produce photons from the stored electron beam. Unlike the majority of such insertion devices, this EPU is capable of producing photons of simultaneous arbitrary elliptical and linear phases, in addition to a range of energies. This EPU is also capable of creating perturbations of the stored electron beam sufficient to cause an interruption of an injection. In order to prevent this, compensation controls have been developed. These controls are accomplished with a combination of Experimental Physics and Industrial Control System (EPICS), mathematical models, and algorithms written in C and MATLAB.

THPHA121 Using Simulink and Beckhoff Integration for Closed-Loop Control Systems at LCLS

T.A. Wallace*, J.M. D'Ewart (SLAC)*

It is common to find closed-loop control systems designed with external controllers, and tuned by heuristic methods. In such designs, advanced control techniques such as Model Predictive Control (MPC), or other relatively new developments cannot be easily applied to existing closed-loop control systems. In an effort to future-proof our closed-loop controls systems and definitively optimize their operation, we have begun to use Simulink to develop more advanced control schemes for vacuum pressure control systems. Beckhoff PLC software includes a plugin for easily deploying and running compiled Simulink controller code in the realtime TwinCAT environment. This allows us to deploy and run optimized closed-loop controllers of any variety supported by Simulink on the same hardware platform as our vacuum system controller in realtime. Using standard system-identification techniques, and EPICS archiver data, we are developing a workflow for creating optimized controllers for various closed-loop control systems on the LCLS beamline, and preparing for the challenges of LCLS II.

THPHA122 Optimization and Upgrade of Slow Extraction Control System for HITFiL CSR Main Ring

Y.C. Chen *(Chen Yucong) J.M. Dong, Y.C. Feng, M. Li, S. Li, W.L. Li, R.S. Mao (IMP/CAS)*

The heavy ion beam from HITFiL (Heavy Ion Therapy Facility in Lanzhou) CSR Main Ring is slow extracted by using a third integer resonance and delivered to various experimental facilities. The slow extraction is driven by the transverse RF-knockout exciter. Many physics and radiation medicine experiments require high-quality spill-structure. In other words, the extracted spill should have flat structure and low ripple noise.[*] We have designed a flexible new signal generation and handling system for beam extraction and spill feedback control. The system comprises output waveform control, spill feedback control, and real time calculation module.

THPHA123 Concept of a Cavity Simulator for the European Spallation Source

***M.G. Grzegrzolka**, K. Czuba, I. Rutkowski (Warsaw University of Technology, Institute of Electronic Systems)*

About 80 superconducting cavities will be used for the linac of the European Spallation Source . Each cavity will require an individual LLRF control system, that needs to be tested before the installation inside the accelerator. Testing of all systems using the real superconducting cavities would be very expensive and in case of a failure can lead to serious damages. To lower the testing cost and avoid potential risks it is planned to design and build a device that will simulate the behavior of a superconducting cavity. The cavity simulator will utilize fast data converters equipped with an RF front-end and a digital signal processing unit based on a high performance FPGA. In this paper conceptual design of the cavity simulator hardware and firmware will be presented.

THPHA126 Synchronized Beam Position Measurement for SuperKEKB Injector Linac

***M. Satoh** (KEK)*

Toward SuperKEKB project, the injector linac upgrade is ongoing for aiming at the stable beam operation with low emittance and high intensity bunch charge. One of the key challenges is a low emittance preservation of electron beam because the vertical emittance of 20 mm x mrad or less should be transported to the main ring without a damping ring. For this purpose, the fine alignment of accelerator components is a crucial issue since the linac alignment was badly damaged by the big earthquake in 2011. From the simulation results of emittance growth, the alignment of the quadrupole magnets and accelerating structures should be conducted at the level of 300 um in rms along the 600-m-long linac. In addition, we are aiming at the level of 100 um alignment in rms within the short range distance of 100 m long. Even after the fine component alignment can be achieved, the fine beam orbit manipulation is necessary for low emittance preservation. For these reasons, we have developed the new BPM readout system based on VME64x. The new system has improved the precision of beam position measurement up to 3 um from 25 um. We will describe the software development of the new BPM readout system.

THPHA127 Status of the Fast Orbit Feedback System for the TPS

***P.C. Chiu**, K.T. Hsu, K.H. Hu, C.H. Huang (NSRRC)*

TPS started its user service in 2016. To ensure stable beam can delivery to user, the fast orbit feedback system were deploy to ensure stable orbit. The system have been commissioning in the second quarter of 2016. Improvement of the system since then solved various problems unexpected. This report will summarizes system configuration of the fast orbit feedback and the operation experiences.

THPHA128 Applications of Kalman State Estimation in Current Monitor Diagnostic Systems

***J.O. Hill** (LANL)*

Traditionally, designers of transformer-based beam current monitor diagnostic systems are constrained by fundamental tradeoffs when reducing distortion in time-domain beam-pulse facsimile waveforms while also attempting to preserve information in the frequency-domain. When modeling the sensor system with a network of linear time-invariant passive components, and a state-based representation based on first-order differential equations, we identify two internal dynamical states isolated from each other by the finite resistance in the transformer windings.

They are the capacitance voltage across the transformer's primary winding, and the transformer inductor current. These states are typically imperfectly observed due to noise, component value variance, and sensor component network topology. We will discuss how feedback-based Kalman State Estimation implemented within digital-based signal-processing might be employed to reduce negative impacts of noise along with component variance, and how Kalman Estimation might also optimize the conflicting goals of beam-pulse facsimile waveform fidelity together with preservation of frequency domain information.

`THPHA129` X-Ray Split and Delay Automated Mirror Alignment

A.P. Rashed Ahmed *(SLAC)*

The hard x-ray split and delay system was designed at the Linear Coherent Light Source (LCLS) at SLAC National Laboratories to allow for experiments requiring two-pulse based x-ray photon correlation spectroscopy. The system consists of eight crystals split between two optical branches, to generate picosecond delays between pulses. To align the system, we extended our Python based beam-alignment automation suite, Skywalker to include branching mirror systems. Using a set of competing optical models, we can achieve robust system alignment with minimal prior knowledge. In our presentation, we will walk through the details and performance analysis of our split and delay alignment algorithm followed by future plans of improvement.

`THPHA130` Control and Interlock Systems for the LIGHT Prototype

R. Moser*, M. Cerv, S. Magnoni, P. Pablo, H. Pavetits, K. Stachyra (ADAM SA)*

LIGHT (Linac Image Guided Hadron Technology) is a particle therapy system developed by Advanced Oncotherapy plc. Accelerator, control and interlock systems are developed by its subsidiary A.D.A.M. SA, a CERN spin-off. The system is being designed to accelerate protons up to 230 MeV using a modular and compact 25-meter-long linear accelerator. It is being designed to operate in pulsed mode where beam properties (energy, pulse charge and spot size) can be changed at 200 Hz. A proof-of-concept accelerator is being assembled and tested at CERN (Geneva, Switzerland). Control and interlock systems are developed using an exploratory prototyping approach and COTS hardware. Requirements for the final LIGHT control and interlock systems are iteratively clarified through creation and refinement of these prototypes. We will continue to support the proof-of-concept accelerator activities while starting to design the final LIGHT control and interlock systems in parallel, building upon the knowledge acquired with the proof-of-concept accelerator. The matured final LIGHT control and interlock systems will gradually replace the prototypes to automate procedures and test the system before deployment

`THPHA132` Motorization System Integration at MAX IV Beamlines.

J.J. Jamróz*, P.J. Bell, J. Forsberg, J. Lidón-Simon (MAX IV Laboratory, Lund University)*

MAX IV facility is in a stage when beamlines start utilizing step and continuous scans. This paper considers our different motion and timing hardware, and configuration, acquisition and supervision software solutions. The integration scale is presented on our two beamlines - Femtomax and Nanomax.

`THPHA133` MicroTCA.4 Integration at ESS: From the Front-End Electronics to the EPICS OPI

J.P.S. Martins*, S. Farina, J.H. Lee, D.P. Piso (ESS)*

The European Spallation Source (ESS) is a collaboration of 17 European countries that is building a leading neutron research center in Lund, Sweden. The ESS facility will have the most powerful neutron source in the world, providing 5 MW of beam power. The Integrated Control Systems Division (ICS) is responsible for all the control systems for the whole facility. For the accelerator control system, ICS will provide different hardware platforms according to the requirements of each specific system. For high performance systems, demanding high data throughput, the hardware platform is the MicroTCA.4 standard. This work presents the software stack that makes the integration of a high-end MicroTCA.4 hardware into the ESS Control System, with the implementation details of the FPGA firmware framework, kernel and userspace drivers, EPICS device support and finally the EPICS IOC that controls the MicroTCA.4 boards. Integration with ESS EPICS Environment (EEE) and EPICS 7 features will also be covered.

THPHA134 CERN Seismic DAQ

C. Charrondière, *M. Cabon, K. Develle, M. Guinchard (CERN)*

The civil engineering activities in the framework of the High Luminosity LHC project, the Geneva GEothermie 2020 and the continuous monitoring of the LHC civil infrastructures triggered the need for the installation of a seismic network at CERN. A 24 bits data acquisition system has been deployed in 3 places at CERN: ATLAS, CMS and the Prévessin site. The system is sending all the raw data to the Swiss Seismological Service and performs FFT on the fly to be stored in the LHC database. The system has shown a good sensitivity of 10^{-16} (m/s)2/Hz at 1 Hz.

THPHA135 Wall Current Monitor Using PXI and LabVIEW at CERN

C. Charrondière, *M. Delrieux, S.S. Gilardoni, R. Limpens, R.E. Rossel (CERN)*

The new data acquisition system for the PS ring wall current monitors installed in the PS is able to perform higher frequency measurements of a beam bunch up to a frequency of 2.7 GHz. This is an important improvement, since the oscillating signal within the bandwidth 500-700 MHz, is related to losses of a beam bunch. The losses can be reduced by measuring the frequency and classifying the cause of the oscillations. The PXI-5661 is used to carry out spectral analysis of this signal. The acquisition is performed on a PXI running LabVIEW Real-Time and synchronized using a trigger from the accelerator timing system.

THPHA136 A Facility-Independent Low-Level RF Server for MicroTCA.4-Based Systems

M. Hierholzer, *M. Killenberg, T. Kozak, N. Shehzad, G. Varghese, M. Viti (DESY) C.P. Iatrou, J. Rahm (TU Dresden) M. Kuntzsch, R. Steinbrück (HZDR) S. Marsching (Aquenos GmbH) A. Piotrowski (FastLogic Sp. z o.o.)*

The DESY low-level RF system based on MicroTCA.4 is used at several accelerators like the European XFEL and FLASH. Some facilities like ELBE at Helmoltz-Zentrum Dresden-Rossendorf, FLUTE at Karlsruhe Institute of Technology and the Turkish Accelerator and Radiation Laboratory in Ankara (TARLA) start using the same system. Since the software of the low-level RF system contains complex algorithms and logic, a single software solution was developed to satisfy the needs of all facilities. The server is based on the ChimeraTK ApplicationCore and can natively run in different control system environments like DOOCS, WinCC with OPC-UA and EPICS 3. This poster shows the status of the server implementation and first experiences with its operation at the ELBE accelerator.

THPHA137 Distributing Near Real-Time Monitoring and Scheduling Data for Integration With Other Systems at Scale

F. Joubert, *M.J. Slabber (SKA South Africa, National Research Foundation of South Africa)*

The MeerKAT radio telescope control system generates monitoring and scheduling data that internal and external systems require to operate. Distributing this data in near real-time, requires a scalable messaging strategy to ensure optimal performance regardless of the number of systems connected. Internal systems include the MeerKAT Graphical User Interfaces, the MeerKAT Science Data Processing subsystem and the MeerKAT Correlator Beamformer subsystem. External systems include Pulsar Timing User Supplied Equipment, MeerLICHT and the Search for Extraterrestrial Intelligence (SETI). Many more external systems are expected to join MeerKAT in the future. This paper describes the strategy adopted by the Control and Monitoring team to distribute near real-time monitoring and scheduling data at scale. This strategy is implemented using standard web technologies and the publish/subscribe design pattern.

THPHA138 YCPSWASYN: EPICS Driver for FPGA Register Access and Asynchronous Messaging

J.A. Vásquez, *J.M. D'Ewart, K.H. Kim, T. Straumann, E. Williams (SLAC)*

The Linac Coherent Light Source II (LCLS-II) is a major upgrade of the LCLS facility at SLAC, scheduled to start operations in 2020. The High Performance Systems (HPS) defines a set of LCLS-II controls sub-systems which are directly impacted by its 1 MHz operation. It is formed around a few key concepts: ATCA based packaging, digital and analog application boards, and 10G Ethernet based interconnections for controls. The Common Platform provides the common parts of the HPS in term of hardware, firmware, and software. The Common Platform Software (CPSW) provides a standardized interface to the common platform's FPGA for all high-level software. YAML is used to define the hardware topology and all necessary parameters. YCPSWASYN is an AsynDriver based EPICS module for FPGA register access and asynchronous messaging using CPSW. YCPSWSYN has two operation modes: an automatic mode where PVs are automatically created for all registers and the record's fields are populated with information found in YAML; and a manual mode where the engineer can choose which register to expose via PVs and freely choose the record's filed information.

THPHA140 A Control System for SuRF Lab - Integrating Diverse Sub-Systems

B.G. Martlew, *M.D. Hancock, R.J. Harding, D.H. Jakeman, A. Oates, J.T.G. Wilson (STFC/DL)*

SuRF Lab is a new facility currently under construction at STFC's Daresbury Laboratory to support the testing and performance qualification of super-conducting RF cavities at temperatures down to 2K. Once it has been fully commissioned it will be used to process 88 high-beta Niobium RF cavities being manufactured for the European Spallation Source (ESS). The main element of SuRF Lab is a vertical test stand designed to hold 3 RF cavities in a cryostat cooled to 2K. The cavities will be fed with up to 400W of RF power at 402 MHz allowing their characteristics to be measured and checked before delivery to ESS. The major subsystems include vacuum, high and low power RF, 4K and 2K cryogenics, safety interlocks and data collection and storage. Each of these areas is the responsibility of a separate team each with its own strategy for implementing low-level controls. EPICS has been chosen to provide high-level integration. This paper describes the overall architecture of the control system and discusses some of the benefits and disadvantages of using such diverse techniques for integrating sub-systems.

THPHA141 Design of the Front-End Detector Control System of the ATLAS New Small Wheels

P.V. Moschovakos, *A. Koulouris (NTUA)*

The foreseen upgrades of the LHC accelerator and the experiments will drastically increase the data and trigger rates. To cope with the vast and low latency data flow, the ATLAS small wheel muon detector will be replaced with a New Small

Wheel. Among the upgrades needed, is a radiation tolerant Slow Control Adapter (GBT-SCA) ASIC dedicated for the on-detector control and monitoring. The ASIC employs various interfaces, making it flexible to match the needs of the different operations. On the backend, the Front-End Link eXchange system will be the interface between the data handling system and the detector front-end and trigger electronics. A dedicated slow control data component was developed as the middleware from FELIX to the end users. It is based on the OPC Unified Architecture protocol and it is comprised of an OPC-UA server, that will handle the slow control traffic from the control room to the GBT-SCA and vice versa. Ultimately, various scope-oriented OPC-UA clients, connected to the OPC-UA server, will be employed to configure and calibrate the ASICs, program the FPGAs, oversee the well-functioning of the boards and monitor the environmental parameters of the detector.

THPHA142 The SKA Dish SPF and LMC Interaction Design: Interfaces, Simulation, Testing and Integration

A. Marassi *(INAF-OAT) S. Riggi, F. Schillirò (INAF-OACT) T.J. Steyn (EMSS Antennas)*

The Square Kilometre Array (SKA) project is responsible for developing the SKA Observatory, the world's largest radio telescope ever built: eventually two arrays of radio antennas - SKA1-Mid and SKA1-Low - will be installed in the South Africa's Karoo region and Western Australia's Murchison Shire respectively, each covering a different range of radio frequencies. In particular, the SKA1-Mid array will comprise of 133 15m diameter dish antennas observing in the 350 MHz-14 GHz range, each locally managed by a Local Monitoring and Control (LMC) system and remotely orchestrated by the SKA Telescope Manager (TM) system. All control system functionality run on the Tango Controls platform. The Dish Single Pixel Feed (SPF) work element will design the combination of feed elements, orthomode transducers (OMTs), and low noise amplifiers (LNAs) that receive the astronomical radio signals. Some SPFs have cryogenically cooled chambers to obtain the sensitivity requirements. This paper gives a status update of the SKA Dish SPF and LMC interaction design, focusing on SPF, LMC simulators and engineering/operational user interfaces, prototypes being developed and technological choices.

THPHA143 Synchronous Motion with S7-1500 PLCs in Neutron Instruments

H. Kleines *(FZJ)*

Control systems of neutron instruments are responsible for the movement of a variety of mechanical axes. In the TANGO based control systems developed by Forschungszentrum Jülich for neutron instruments, Siemens S7-300 PLCs with single axis stepper motor controllers from Siemens or Phytron have been used for this purpose in the past. Synchronous coordinated movement of several axes has been implemented with dedicated 4-axes NC modules (FM357) for the S7-300. In future, the recent S7-1500 PLC family shall be used for motion tasks. With the S7-1500, stepper motor control is possible with low-cost fast digital outputs, so called PTOs (pulse trade outputs). The integrated motion functions of the S7-1500 directly support synchronous movement. The function block interface defined by PLCopen serves as a homogeneous programming interface which is independent of a specific motion controller. For the single crystal diffractometer HEiDi at the research reactor FRM-II a replacement for a S7-300 with FM357 has been implemented based on a S7-1500 PLCs and a PTO module.

THPHA144 Industrial Stepping Motors Integration in UNICOS

J. Fernandez Cortes*, E. Blanco Viñuela, L.A. Gonzalez (CERN)*

A large number of movable devices are present in the field of accelerators and must often be integrated in a control system. Typical examples of these systems are phase shifters and magnetic dipoles among others. The standard industrial control system UNICOS-CPC (UNified Industrial COntrol System for Continuous Process Control) provides a set of generic device types which matches the majority of the industrial equipment employed in process control. This new development extends it with additional device types for precise positioning equipment based on stepping motors. The paper focuses on how the integration on UNICOS was fulfilled, the potential use of the solution and the automatic integration with the CERN real-time FESA (FrontEnd Software Architecture) framework. Finally, it illustrates a couple of use cases that already incorporate the solution: the CTF3 facility, the two-beam acceleration scheme envisioned for CLIC (Compact Linear Collider) and the EuroCirCol project for the measurements of the beam screen prototype for the FCC-hh (Future Circular Collider proton-proton).

THPHA145 Integration of PLC and PXI Control Systems

A. Antoine, *C. Boucly, T. Gharsa (CERN)*

Engineers are often confronted with the need to use several technologies to identify optimal solutions when designing new control architectures. Generally, the technical solutions chosen require the combination of various industrial products such as PXI systems for applications requiring fast acquisition, analysis and reaction times, while PLCs are commonly used for their reliability and their ability to withstand industrial environments. The needs to exchange information between these different technologies can today be solved by using industrial fieldbusses such as PROFIBUS-DP or PROFINET-IO. This paper describes the technical aspects of the two options, focussing on their advantages and constraints and presents the experience gained with integrating a PXI and PLC system, as part of the 2016 consolidation project of the control of the kicker systems of the Antiptroton Decelerator (AD) at CERN.

THPHA146 LCLS-II Cryomodule and Cryogenic Distribution Control System

K.J. Mattison, *D. Fairley (SLAC)*

LCLS-II is a superconducting upgrade to the existing Linear Coherent Light Source at SLAC. Construction is underway with a planned continuous wave beam rate of up to 1 MHz. Two cryogenic plants provide helium to a distribution system, and 37 cryomodules with superconducting cavities will operate with Liquid helium at 2.2K. The cryomodules and distribution system is controlled with networked PLC's and EPICS as an integrated system that work in concert for controlling valves, pressure, flow, and temperature. Interlocks and critical process information is communicated with the Low Level Radio Frequency, vacuum, and magnet systems. Engaging the controls community proved vital in advancing the controls architecture from a conventional design to a centralized, reliable, and cost-effective distributed platform.

THPHA147 Conceptual Design of Vacuum Control System for ILSF

A. Khalilzadeh, *M. Jafarzadeh, J. Rahighi (ILSF)*

The Iranian Light Source Facility (ILSF) is a new 3 GeV third generation synchrotron light source facility with circumference of 528 m, which is in the design stage. In this paper conceptual design of vacuum control system is presented. The control system architecture, Software toolkit and controller in device layer are discussed in this paper.

THPHA148 Conceptual Design of Power Supply Control System for ILSF

A. Khalilzadeh, *M. Jafarzadeh, J. Rahighi, E.H. Yousefi (ILSF)*

The Iranian Light Source Facility which is currently under design is a new 3 GeV third generation synchrotron light source. The storage ring circumference is 538 m.

The conceptual design of power supply control system is presented in this paper which contain control system architecture, software toolkit and controller in device layer of the power supply.

THPHA149 Software and Gateware Development for Sirius BPM Electronics Using a Service-Oriented Architecture

***L.M. Russo** (LNLS)*

The Brazilian Synchrotron Light Laboratory (LNLS) is in the final stages of developing an open-source BPM system for Sirius, a 4th-generation synchrotron light source under construction in Brazil. The system is based on the MicroTCA.4 standard comprising of AMC FPGA boards carrying FMC digitizers and an AMC CPU module. The software is built with the HALCS framework [1] and employs a service-oriented architecture (SOA) to export a flexible interface between the gateware modules and its clients, providing a set of loosely-coupled components favoring reusability, extensibility and maintainability. In this paper, the BPM system will be discussed in detail focusing on how specific functionalities of the system are integrated and developed in the framework to provide SOA services. In particular, two domains will be covered: (i) gateware modules, such as the ADC interface, acquisition engine and digital signal processing; (ii) software services counterparts, showing how these modules can interact with each other in a uniform way, easing integration with control systems.

THPHA150 Introducing Fast Interlocks in the UNICOS-CPC Framework

***J.O. Ortola Vidal**, E. Blanco Viñuela, M. Vazquez Muñiz (CERN)*

The CERN UNified Industrial COntrol System framework (UNICOS) with its Continuous Control Package (UNICOS-CPC) is the CERN standard solution for the design and implementation of continuous industrial process control applications. The need of adapting the framework capabilities to the different processes at CERN has brought new challenges. Reacting as fast as possible to an interlock situation to protect equipment is a new requirement which has been introduced in UNICOS-CPC. This paper present the challenges, design and test results of the seamless integration of fast interlocks capabilities in the current UNICOS-CPC package based on conventional PLCs (Programmable Logic Controllers), with a heightened level of flexibility and maturity. The first implementation is employing SIEMENS PLCs but the underlying technique is extensible to the other UNICOS-CPC compliant platforms.

THPHA151 MARS: Easing Maintenance and Interventions for Cern Controls

***F. Varela**, U. Epting, M. Gonzalez Corral, E. Mandilara, S. Podgorski (CERN)*

Industrial control systems for the CERN technical infrastructure and accelerator complex consist of a myriad of devices and components geographically distributed around the CERN facilities. In the event of an intervention in such systems, the on-call engineer or the system expert needs detailed information about the nature of the problem, e.g. what device, what problem, intervention procedures, and contextual data like the location of the device, current access conditions to this place, the list of access rights required and whether he/she is granted with these rights. This is of special relevance when the person responsible for the intervention has only limited knowledge of the control system as it is the case for some on-call services. At CERN, this information is scattered over a number of data sources. This paper presents MARS, a web-based tool designed to federate data from heterogeneous sources with the aim of providing support for interventions and maintenance activities. The information can be displayed in a single web page or be accessed through a REST API.

THPHA152 Reactive Streams for Data Acquisition and Analysis of Accelerator Devices

***M.A. Galilée**, S. Boychenko, A. Calia, J.Q.C. Do, K. Fuchsberger, J.C. Garnier, M. Hostettler, K.H. Krol, M. Osinski, M.P. Pocwierz, T.M. Ribeiro, A. Stanisz, M. Zerlauth (CERN)*

Inspired by the recent developments of reactive programming and the ubiquity of the concept of streams in modern software industry, we assess the relevance of a reactive streams solution in the context of accelerator controls. The promise of reactive streams, to govern the exchange of data across asynchronous boundaries at a rate sustainable for both the sender and the receiver, is alluring to most data-centric processes of CERN's accelerators. Our primary use case is the online analysis of accelerator devices, which requires the acquisition of data from different source systems, its transformation and composition into higher level, domain related data, and its utilization by expert defined analysis modules. This paper will detail the two orthogonal components built to this end. First, the reactive streams framework itself, which allows for the creation, composition, reuse and publication of data streams. Secondly, the online analysis service, which relies on accelerator device data transformed by the reactive framework to continuously publish consolidated reports. Lastly, we will show how these components could be extended to cover more accelerator controls domains and use cases.

THPHA153 Real Time Java and Reactive Streams to support Device Property Model

***J.C. Garnier**, C. Cardin, M.A. Galilée, K.H. Krol, M. Zerlauth (CERN)*

Today's front-end controllers, which are widely used in CERN's controls environment, feature CPUs with high clock frequencies and extensive memory storage. Their specifications are comparable to low-end servers, or even smartphones. The Java Virtual Machine (JVM) has been running on similar configurations for years now and it seems natural to evaluate their behavior on this environment to characterize if Firm or Soft Real Time constraints can be addressed efficiently. Using Java at this low-level, offers the opportunity to refactor CERN's current implementation of the device/property model and to move away from a monolithic architecture to a promising and scalable separation of the area of concerns, where the front-end may publish raw data that other layers would decode and publish. This paper presents first the evaluation of Machine Protection control system requirements in terms of Real Time constraints and a comparison of the performance of different JVMs regarding these constraints. In a second part, it will detail the efforts towards a first prototype of a minimal supervision RT Java layer and reactive streams implementation to realise the decoding logic of the hardware layer.

THPHA154 Experiment Control With Epics7 and Symmetric Multiprocessing on Rtems

***H. Junkes**, M. Heyde, P. Marschalik (FHI)*

At the Fritz Haber Institute of the Max Planck Society a new very high speed scanning tunneling microscope (VHS-STM) is being set up to resolve glass dynamics (Cryvisil). We have been successfully using EPICS (v3) for many of our most important and larger experiments. However, for the new project, the data throughput to be achieved with EPICS (v3) is not sufficient. For this reason, we have completely aligned the experiment control for the STM to the new EPICS7 by using the new protocol pvAccess. The development versions of EPICS 3.16 and bundleCPP of the EPICSv4-suite are in use. Both of them will be the base components of the new EPICS7 Framework. The expected data rate is 300 MByte/s for up to 5 hrs to address the transition from a vitreous state to a crystal-line in real space over a wide range of temperatures ranging from cryogenic temperatures to 1500 K (*). In the poster we will show the control system setup (VMEbus, RTEMS-SMP, MVME6100, MVME2500, V375, SIS3316) and the used environment like ArchiverAppliance and pva2pva gateway.

THPHA155 PLC Integration in EPICS Environment: Comparison Between Opc Server and Direct Driver Solutions

***L. Antoniazzi**, M.G. Giacchini, M. Montis (INFN/LNL)*

In the IFMIF EVEDA project*, INFN-LNL Laboratory has been involved in the design and construction of a normal conducting Radio Frequency Quadrupole (RFQ) used to bunch and accelerate a 130 mA steady beam to 5 MeV. The EPICS based control system** has been entirely developed in house using different hardware solutions: PLC for tasks where security is the most critical feature, VME system where the acquisition speed rate is crucial, common hardware when only integration is required without any particular feature in terms of security. Integration of PLCs into EPICS environment was originally accomplished through OPC DA server*** hosted by a Windows embedded industrial PC. Due to the issues analyzed in injector LCS, LNL proposed to migrate to the usage of EPICS Direct Driver solution based on s7plc****. The driver itself is suitable for direct communication between EPICS and PLCs, but it doesn't take care of data update and synchronization in case of communication failure. As consequence LNL team designed a dedicated method based on state machine to manage and verify data integrity between the two environments, also in case of connection lost or failure.

THPHA156 Cyclotron Control System Integration in EPICS for SPES Project: Proof of Concept Based on OPC UA

***M.G. Giacchini**, L. Antoniazzi, M. Montis (INFN/LNL) M.A. Bellato (INFN-Sez. di Padova)*

SPES accelerator*, under construction at the Legnaro National Laboratories (LNL), is an ISOL facility (Isotope Separation On-Line) dedicated to the production of radioactive ion beams with high energy and high degree of purity. The radioactive ion beam will be produced on the secondary line by proton induced fission on an UCx direct target and driven in the transport beam line, the primary line comes from a commercial Cyclotron with high output current (~0.7 mA) and high energy (up to 70 MeV). For having the complete supervision on the entire facility, many information related to cyclotron control must be integrated in the SPES main control system based on EPICS**: to provide this task, a proof of concept based on OPC UA*** has been designed and prepared for preliminary tests.

THPHA157 IFMIF EVEDA RFQ Local Control System Integration into Main Control System

***M. Montis**, L. Antoniazzi, A. Baldo, M.G. Giacchini (INFN/LNL)*

The RFQ apparatus Local Control System built for IFMIF EVEDA Project* has been designed and realized for being both a standalone architecture and part of a more complex control system composed by different sub-systems. This approach let RFQ's engineers and scientists have a degree of freedom during power tests in Legnaro and during the RFQ integration in IFMIF EVEDA facility in Rokkasho. In this paper we will describe the different aspects observed when the LCS was converted from the standalone configuration to the final integrated one.

THPHA158 First Step to Manage Migration to Siemens S7-15XX PLCs using TANGO Framework

***P. Rommeluère**, Y.-M. Abiven, P. Monteiro (SOLEIL) J. Gounot, S.M. Minolli (NEXEYA SYSTEMS)*

Over the past years, SOLEIL* uses SIEMENS PLCs** as a standard for signal monitoring and security. SOLEIL is today thinking about a major upgrade of the facilities, and has to adapt its organization to face efficient operation and R&D. In this context, automation experts are now merged in a single group. In a middle term, migration from the existing 3XX series PLCs to the new 15XX series will be necessary. As the new 15XX series PLCs do not support Fetch/Write protocol anymore, a first step is the upgrade of TANGO*** PLCServer. This software device ensures data exchange with supervisory applications using TANGO infrastructure. It opens multiple TCP/IP connections to the PLC hardware, manages asynchronous communication to read/write PLC Datablocks and acts as a server for other clients. The upgrade of PLCServer is based on Snap7**** open source Ethernet communication suite for interfacing with Siemens PLCs using the S7 native protocol. This paper details the evolutions, performances and limitations of this new version of the PLCServer.

THPHA159 What Is Special About PLC Software Model Checking?

D. Darvas*, I. Majzik (BUTE) , E. Blanco Vinuela (CERN)*

Model checking is a formal verification technique to check given properties of models, designs or programs with mathematical precision. Due to its high knowledge and resource demand, the use of model checking is restricted mainly to highly critical systems. However, we and many other authors have argued that automated model checking of PLC programs is feasible and beneficial in practice. In this paper we aim to explain why model checking is applicable to PLC programs if its use for software in general is too difficult. We present an overview of the particularities of PLC programs which influence the feasibility and complexity of their model checking. Furthermore, we list the main challenges in the domain and the responses given in previous works.

THPHA160 Experience With Static PLC Code Analysis at CERN

B. Fernández Adiego*, E. Blanco Viñuela, C. Tsiplaki Spiliopoulou (CERN)*

The large number of industrial control systems based on PLCs (Programmable Logic Controllers) available at CERN implies a huge number of programs and lines of code. The software quality assurance becomes a key point to ensure the reliability of the control systems. Static code analysis is a relatively easy-to-use, simple way to find potential faults or error-prone parts in the source code. While static code analysis is widely used for general purpose programming languages (e.g. Java, C), this is not the case for PLC programs. We have analyzed the possibilities and the gains to be expected from applying static analysis to the PLC code used at CERN, based on the UNICOS framework. This paper reports on our experience with the method and the available tools and sketches an outline for future work to make this analysis method practically applicable.

THPHA161 Applying Model Checking to Critical PLC Applications: An ITER Case Study

B. Fernández Adiego*, E. Blanco Viñuela, D. Darvas (CERN) B. Avinashkrishna, Y.C. Gaikwad, S. Sreekuttan (Tata Consultancy Services) G.S. Lee (Mobiis Co., Ltd.) R. Pedica (Vitrociset s.p.a) I. Prieto Diaz (IBERINCO) Gy. Sallai (BUTE)*

The development of critical systems requires the application of verification techniques in order to guarantee that the requirements are met in the system. Standards like IEC~61508 provide guidelines and recommend the use of formal methods for that purpose. The ITER Interlock Control System has been designed to protect the tokamak and its auxiliary systems from failures of the components or incorrect machine operation. ITER has developed a method to assure that some critical operator commands have been correctly received and executed in the PLC (Programmable Logic Controller). The implementation of the method in a PLC program is a critical part of the interlock system. A methodology designed at CERN has been applied to verify this PLC program. The methodology is the result of 5 years of research in the applicability of model checking to PLC programs. A proof-of-concept tool called PLCverif implements this methodology. This paper presents the challenges and results of the ongoing collaboration between CERN and ITER on formal verification of critical PLC programs.

THPHA162 Monitoring of CERN's Data Interchange Protocol (DIP) System

***B. Copy**, M. Bräger, E. Mandilara, I. Prieto Barreiro, F. Varela (CERN)*

CERN's Data Interchange Protocol (DIP)* is a publish-subscribe middleware infrastructure developed at CERN to allow lightweight communications between distinct industrial control systems (such as detector control systems or gas control systems). Among many usages, DIP is employed for essential, non-critical communication such as the Large Hadron Collider (LHC) Handshake sequence to initiate data acquisition sequences. DIP does not enforce any access control, does not impose any durability in what is currently published, and furthermore does not provide out of the box any history of its participants' activity. Such a permissive approach to data exchanges requires however a good understanding of the current state of the entire system. This paper presents a mechanism which has been implemented to keep track of every single publisher or subscriber node active in the DIP infrastructure, along with the DIP name servers supporting it. Since DIP supports more than 55 000 publications, regrouping hundreds of industrial control processes, keeping track of the system activity requires advanced web visualization mechanisms (e.g. connectivity maps, live historical charts)**.

THPHA163 A Model-driven Generator to Automate the Creation of HMIs for the CERN Gas Control Systems

***T. Bato**, G. Thomas, F. Varela (CERN)*

A total of 33 gas control applications are currently in production in the LHC Experiments and the CERN accelerator complex. Each application contains around fifty synoptic views and hundreds of plots. In this paper, the entirely model-driven approach followed to generate all these HMIs is presented. The procedure implemented simplifies the creation of these graphical interfaces; allowing the propagation of changes to all visualizations at once in a coherent manner, and reducing the long-term maintenance effort. The generation tool enables the creation of files of similar content based on templates, specific logic (rules) and variables written in simple user-defined XML files. This paper also presents the software design and the major evolution challenges currently faced and it describes how the functions performed by the tool, as well as the technologies used in its implementation have evolved while ensuring compatibility with the existing models.

THPHA164 Automated Software Testing for Controlling And Monitoring the MeerKAT Telescope

***B. Xaia**, T. Gatsi, O.J. Mokone (SKA South Africa, National Research Foundation of South Africa)*

The 64-dish MeerKAT radio telescope, under construction in South Africa, will become the largest and most sensitive radio telescope in the Southern Hemisphere until integrated with the Square Kilometre Array (SKA). Software testing is an integral part of software development that is aimed at evaluating software quality; verifying and validating that the given requirements are met. This poster will present the approach, techniques and tools used to automate the testing of the software that controls and monitors the telescope. Jenkins continuous integration system is the server used to run the automated tests together with Git and Docker as the supporting tools to the process. In addition to the aforementioned tools we also use an Automated Qualification Framework (AQF) which is an in-house developed software that automates as much as possible of the functional testing of the Control and Monitoring (CAM) software. The AQF is invoked from Jenkins by launching a fully simulated CAM system and executing the Integrated CAM Tests against this simulated system as CAM Regression Testing. The advantages and limitations of the automated testing will be elaborated in the paper in detail.

THPHA165 JavaFX and CS-Studio: Benefits and Disadvantages in Developing the Next Generation of Control System Software

C. Rosati *(ESS) K.-U. Kasemir (ORNL) K. Shroff (BNL)*

The new developments inside the CS-Studio community were made using the JavaFX platform to overcome the limitations and difficulties of using Eclipse SWT. This article will explain the benefits and disadvantages of using the JavaFX technology inside Eclipse RCP, and try to foresee the path of the new generations of CS-Studio application.

THPHA166 Control System Integration of a μTCA.4 Based Digital LLRF Using the ChimeraTK OPC UA Adapter

R. Steinbrück*, M. Kuntzsch, P. Michel (HZDR) M. Hierholzer, M. Killenberg, H. Schlarb (DESY) C.P. Iatrou, J. Rahm, L. Urbas (TU Dresden)*

The superconducting linear electron accelerator ELBE at Helmholtz-Zentrum Dresden-Rossendorf is a versatile light source. It operates in continuous wave (CW) mode to provide a high average beam current. To fulfil the requirements for future high resolution experiments the analogue low level radio frequency control (LLRF) is currently replaced by a digital μTCA.4 based LLRF developed at DESY, Hamburg. Operation and parametrization is realized by a server application implemented by DESY using the ChimeraTK software framework. To interface the WinCC 7.3 based ELBE control system an OPC UA Adapter for ChimeraTK has been developed in cooperation with DESY and Technische Universität Dresden (TUD). The poster gives an overview of the collaborating parties, the variable mapping scheme used to represent LLRF data in the OPC UA server address space and integration experiences with different industrial OPC UA Clients like WinCC 7.3 and LabVIEW.

THPHA167 EPICS Data Streaming and HDF File Writing for ESS Benchmarked Using the Virtual AMOR Instrument

D. Werder*, M. Brambilla, M. Koennecke (PSI)*

As a contribution to the European Spallation Source as part of BrightnESS, the Paul Scherrer Institut is involved in the streaming of EPICS data and the writing of NeXus compliant HDF5 files. We combine this development with the transition of the AMOR instrument at the Paul Scherrer Institut to EPICS and a streaming based data architecture. To guide our development before ESS has operational equipment, we use a detailed simulation of the instrument AMOR at SINQ to test and integrate our data streaming components. EPICS data sources are efficiently converted to Google Flatbuffers as our message format and distributed using Apache Kafka. On the file writing side, we combine the messages from EPICS data sources as well as from neutron events to write HDF5 files. We present the performance of our development prototype under a number of typical scenarios. This platform will also be used for testing the experiment control software on top of EPICS.

THPHA168 Dockers With TANGO - Control System Approach for SKA

R. Warange *(National Centre for Radio Astrophysics, Tata Institute of Fundamental Research) , R.E. Braddock (University of Manchester) G.R. Mant (STFC/DL)*

The Square Kilometre Array (SKA) project aims to build a large radio telescope in Australia and South Africa. The Synchronization and Timing (SAT) System, consists of the Timescale Generation, Frequency Distribution and UTC Distribution sub-systems. The local monitoring and control system for SAT (SAT. LMC) monitors and controls the SAT system. SAT. LMC uses the TANGO Control System Framework for performing its monitoring and control functions. The application isolation between the Tango Device Servers for controlling the 3 SAT sub-systems is achieved through Docker Containers. Docker Containers share the operating system and are portable across environments, which reduces the overall cost and helps operations/maintenance. They are lightweight when compared to Virtual Machines. This paper gives an overview of the SAT. LMC control system solution, discusses the working of the TANGO Control System Framework with Docker Containers, and presents the configuration for the hierarchical SAT. LMC solution, which could potentially be extended to the SKA Control System.

THPHA169 Building S.C.A.D.A. Systems in Scientific Installations with Sardana and Taurus

D. Fernández-Carreiras *(ALBA-CELLS Synchrotron)*

Sardana and Taurus form a python software suite for Supervision, Control and Data Acquisition (SCADA) optimized for scientific installations. Sardana and Taurus are open source and deliver a substantial reduction in both time and cost associated to the design, development and support of control and data acquisition systems. The project was initially developed at ALBA and later evolved to an international collaboration driven by a community of users and developers from ALBA, DESY, MAXIV and Solaris as well as other institutes and private companies. The advantages of Sardana for its adoption by other institutes are: free and open source code, comprehensive workflow for enhancement proposals, a powerful environment for building and executing macros, optimized access to the hardware and a generic Graphical User Interface (Taurus) that can be customized for every application. Sardana and Taurus are currently based on the Tango Control System framework but also capable to inter-operate to some extend with other control systems like EPICS. The software suite scales from small laboratories to large scientific institutions, allowing users to use only some parts or employ it as a whole.

THPHA170 Usage and Development of Web Services at MAX IV

A. Milan-Otero*, F. Bolmsten, J. Brudvik, M. Eguiraun, J. Forsberg, V.H. Hardion, L. Kjellsson, D.P. Spruce, Ł. Å»ytniak (MAX IV Laboratory, Lund University)*

The web continues to grow as an application platform, with accessibility and platform independence as major benefits. It also makes it possible to tie services together in new ways through simple APIs. At MAX IV we are using web services for various purposes related to the control system, for example, monitoring servers and services, accessing alarm history, viewing control system status, managing system and users logs and running recurring jobs. Furthermore, all user management is also accessed via web applications, and even data analysis and experiment control can now be performed via web based interfaces. We make an effort to use existing tools whenever possible (e.g. Kibana, Prometheus), and otherwise develop systems in-house, based on current well established libraries and standards, such as JavaScript, Python, Apache, etc. This paper presents an overview of our activities in the field and describes different architectural decisions taken.

THPHA171 Control System Software Environment in ELI Beamlines

P. Bastl *(Institute of Physics of the ASCR) O. Janda, A. Kruchenko, P. Pivonka, B. Plötzeneder, S. Saldulkar, J. Trdlicka (ELI-BEAMS)*

The ELI Beamlines facility is a Petawatt laser facility in the final construction and commissioning phase in Prague, Czech Republic. The central control system operates and controls complex subsystems (lasers, beam transport, beamlines, experiments, facility systems, safety systems) with huge ammount of devices and computers. Therefore standards for software development were established: - Model based development - Standard approach to user interfaces - Standard approaches to device interfaces - Third party envirnment interfaces TANGO framework was choosen for communication in distributed control system environment.

THPHA173 Vacuum System Simulation with EtherCAT Simulator

T.A. Wallace *(SLAC)*

Vacuum systems are ubiquitous at LCLS, and new ones are constantly being designed and built for instrumentation. In an effort to buffer vacuum control system engineering and deployment we built a simple framework for constructing vacuum system simulators using Structured Text (PLC programming language). This library couples with Beckhoff's EtherCAT simulator and enables us to assemble and test PLC code against what the PLC perceives as real EtherCAT hardware coupled to a real vacuum system. All before any of the hardware (controls or mechanical) arrives. By the time we actually deploy code to the PLCs our GUI and PLC logic is nearly completely verified. This saves us time, and provides an excellent training platform for bringing operators as well as controls engineers up-to-speed on vacuum systems, a somewhat specialized field.

THPHA174 Preventing Run-Time Bugs at Compile-Time Using Advanced C++ Techniques

R. Neswold *(Fermilab)*

When writing software, we develop algorithms that tell the computer what to do at run-time. Our solutions are easier to understand and debug when they are properly modeled using class hierarchies, enumerations, and a well-factored API. Unfortunately, even with these design tools, we end up having to debug our programs at run-time. Worse still, debugging an embedded system changes its dynamics, making it tough to find and fix concurrency issues. This paper describes techniques using C++ to detect run-time bugs *at compile time*. A concurrency library, developed at Fermilab, is used for examples in illustrating these techniques.

THPHA175 Extending the Remote Control Capabilities of the CMS Detector Control System with Remote Procedure Call Services

R.J. Jiménez Estupinan *(ETH)*

There is an increasing need of remote supervision and operation of the CMS Detector. The CMSONLINE platform has become the flagship of the CMS Detector Control System (DCS) project due to its flexibility to monitor and perform basic control operations through the web. One of the points in question about this topic is the form in which the control operations should be modelled and exposed while ensuring the consistency and integrity of the systems. The CMS XML-RPC Service is an implementation of the standard Remote Procedure Call (RPC) protocol using XML to model, encode and expose a certain set of operations using HTTP as transport mechanism. This paper presents details of the XML-RPC implementation written in WinCCOA Control Language using an object oriented approach.

NOTES

Boldface papercodes indicate primary authors

NOTES

SIEMENS
Ingenio para la vida

TIA Portal - Your Gateway to automation in the Digital Enterprise

The engineering framework for all automation tasks integrates HMI, controller, distributed I/O systems and drives seamlessly into a single engineering environment.

Totally Integrated Automation Portal

siemens.es/simatic