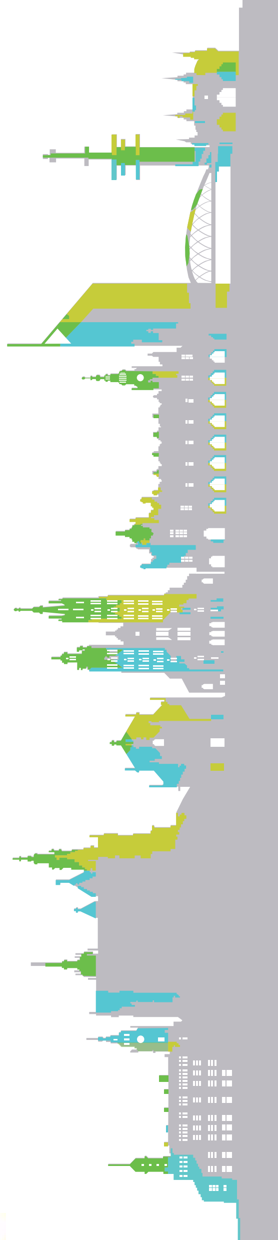
2022

IBIC

International Beam Instrumentation Conference



11 - 15 SEPTEMBER 2022
KRAKOW, POLAND

SOLARIS
NATIONAL SYNCHROTRON RADIATION CENTRE

GSI

Organizers:

Honorary patronage:
Jacek Majchrowski
Mayor of the City of Krakow

Media patronage:

Contents

About

Welcome

Dear Colleagues,

On behalf of the organizing committee, we are pleased to welcome you to Krakow, Poland, for the 2022 International Beam Instrumentation Conference (IBIC 2022).

IBIC is a fruitful and successful gathering of the world's beam instrumentation community and it reflects the maturity of international collaboration in the field of beam instrumentation for accelerators. IBIC is dedicated to exploring the physics and engineering challenges of beam diagnostic and measurement techniques for particle accelerators worldwide. The conference program includes tutorials on selected topics, invited and contributed talks, as well as poster sessions. An industrial exhibition and a tour to the SOLARIS National Synchrotron Radiation Centre is organized.

IBIC 2022 is hosted by the SOLARIS National Synchrotron Radiation Centre, Jagiellonian University in Krakow, Poland, in collaboration with the GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany. SOLARIS National Synchrotron Radiation Centre is 3rd generation light source, in operation since 2015. It is the largest scientific infrastructure in Poland providing more than 4000 hours of beamtime per year. Solaris NSRC is available for the academic and the industrial sector.

GSI Helmholtzzentrum für Schwerionenforschung operates a unique accelerator for heavy ions. Researchers from around the world use this facility for experiments that help them make fascinating discoveries in basic and applied research.

The venue is the Auditorium Maximum, a modern conference and teaching facility of Jagiellonian University opened in 2005. It is conveniently located within walking distance from hotels, restaurants and the city centre. Krakow, is the second-largest and one of the oldest cities in Poland situated at the foot of the Royal Wawel Castle in the Lesser Poland region. It is a former capital of Poland with the largest market square in Europe and further lovely touristic attractions. The Old Town was declared a UNESCO World Heritage Site.

We look forward to welcome you to Krakow!

Adriana Wawrzyniak
IBIC 2022 Conference Chair

Peter Forck
IBIC 2022 Scientific Chair

Scientific Program Committee

Peter Forck, GSI, Germany - Scientific Program Committee Chair

Tonia Batten, CLS, Canada
Willem Blockland, SNS, USA
Lorraine Bobb, DLS, UK
Alessandro Cianchi, University Rome, Italy
Alessandro Curcio, CLPU, Spain
Friederike Ewald, ESRF, France
David Gassner, BNL, USA
Nicolas Hubert, SOLEIL, France
Ubaldo Iriso ALBA, Spain
Kevin Jordan, JLAB, USA
Changbum Kim, PAL, Korea
Prapong Klysubun, SLRI, Thailand
Patrick Krejcik, SLAC, USA
Gero Kube, DESY, Germany
Thibaut Lefevre, CERN, Switzerland
Yongbin Leng, SSRF, China
Hirokazu Maesaka, Spring-8, Japan
Daniel Tavares, LNLS, Brasil
Junhui Yue, IHEP, China
Kenichirou Satou, J-PARC, Japan
Victor Scarpine, Fermilab, USA
Volker Schlott, PSI, Swiss
Adriana Wawrzyniak, SOLARIS, Poland
Kay Wittenburg, DESY, Germany

Local Organising Committee

Adriana Wawrzyniak, SOLARIS, Poland - Local Organising Committee Chair
Mirosław Burzyński, SOLARIS, Poland - Conference support
Bogumił Harnik, SOLARIS, Poland - Conference support
Ireneusz Zadworny, SOLARIS, Poland - Conference support
Tomasz Zbylut, SOLARIS, Poland - Conference support
Michał Żurek, SOLARIS, Poland - Conference support
Agnieszka Cudek, SOLARIS, Poland – Webmaster, Scientific Secretary
Joanna Kowalik, SOLARIS, Poland - Graphic Designer
Roman Panaś, SOLARIS, Poland – Poster Session Manager
Alicja Surowiec, GSI, Germany – Industrial Exhibit and Sponsorship
Beata Walasek-Hoehne, GSI, Germany – Industrial Exhibit and Sponsorship
Piotr Andryszczak, SOLARIS, Poland – Industrial Exhibit and Sponsorship

JACoW Editorial Team

Volker RW Schaa, GSI, Germany - Technical Editor
Michael Bree, CLS, Canada
Wojciech Grabowski, NCBJ, Poland
Grzegorz Kowalski, SOLARIS, Poland – Editor in Chief
Jaeyu Lee, PAL, Korea
Christine Petit-Jean-Genaz, CERN, Switzerland
Ana Štajminger, ELI, Czech Republic

Useful information

Official language

The language of the conference is English.

Time

Poland time in September is the Central European Summer Time (UTC+2), the current time zone offset during daylight saving time.

Currency, credit cards and tipping

Polish zloty (PLN) is the currency used in Poland. It makes no difference whether you are paying with cash or using credit/debit card, the exact amount will be used. All major credit cards are accepted in shops, taxis, and cash machines. Exceptions are some small shops, minor taxi companies and some old-style buses. Tips in bars, restaurants, and taxis are not included in the bill. You must add a tip to your bill. Usually, this is around 10% of the bill. All prices in shops are including the value-added tax.

1 EUR = 4,73 PLN; 1 USD = 4,64PLN (Status: 2022 - August)

Electricity

Type C and type F plugs are used in Poland, these are the same type which is commonly used in Europe, South America & Asia. They have 2 round pins and are 220 V to 240 V at 50 Hz.

Emergency number

112

Current Corona regulations in Poland

Link to the official Polish website for the current Corona regulations (entry requirements): https://www.gov.pl/web/coronavirus/travel

Internet access

At the conference venue the local Wi-Fi will be available for the conference guests - Wi-Fi password is: IBIC2022@uj. Moreover the academic eduroam is also available within all Jagiellonian University buildings.

At some public places in Kraków free internet is provided without any restrictions. The list of the hot spots is available here:
https://www.krakow.pl/instcbi/196800,,741,0,wyszukiwarka.html

About Krakow

Krakow is Poland's second largest city, located in the southern part of Poland. It is also one of the oldest cities of the country, as it dates back to seventh century, and a popular tourist destination. It used to be the capital of Poland and the residence of Polish kings. The city is divided into 18 districts, of which the most famous are the Old Town, Nowa Huta and Kazimierz. Architectural and urban complex of old Krakow is among the most important group of heritage sites in Poland and the world. The historical city centre has been placed on the UNESCO World Heritage List. The most significant architectural structures are the defence walls of the Wawel Castle, the Barbakan, Florian Gate, the Wawel Castle complex, with the Sigismund's Chapel and its cathedral, St. Mary's Basilica, with the altar by Veit Stoss and the renaissance Cloth Hall (Sukiennice). Of course, these are only the most famous tourist attractions of Krakow. There is a lot more to see if one comes here.

Credit: NSRC SOLARIS

What is significant, Krakow is considered by many to be the cultural capital of Poland. It was even named the European Capital of Culture by European Union for the year 2000. The city has several of the best museums in the country and a few famous theatres. When it comes to famous characters, two Polish Nobel laureates in literature lived in this city: Wisława Szymborska and Czesław Miłosz. Also, Krakow is a major centre of education. More than ten universities or academy-level institutions are there in the city. The most famous and the best university in the country is the Jagiellonian University with its Collegium Medicum. It is also the oldest one, dating back to the year 1364. There are numerous other academy-level institutions. This city is deservedly called the most beautiful city of Poland.

Credit: NSRC SOLARIS

Conference venue

The venue is the Auditorium Maximum, which is part of the 2nd Campus of the Jagiellonian University. Auditorium Maximum is a modern conference and teaching facility of Jagiellonian University opened in 2005. It is conveniently located within walking distance from hotels, restaurants and the city centre.

The conference will be held in a number of rooms of varying sizes and functionalities:

Large hall - a room with theatre-style seating and capacity of 1200 people. Conference lectures will be held in one half of this lecture hall. It can be access from ground floor as well as from 1st floor. The balcony that can be accessed from the 2nd floor will be excluded from the usage. Large lecture hall A has 480 sits available.

Photo by Anna Wojnar

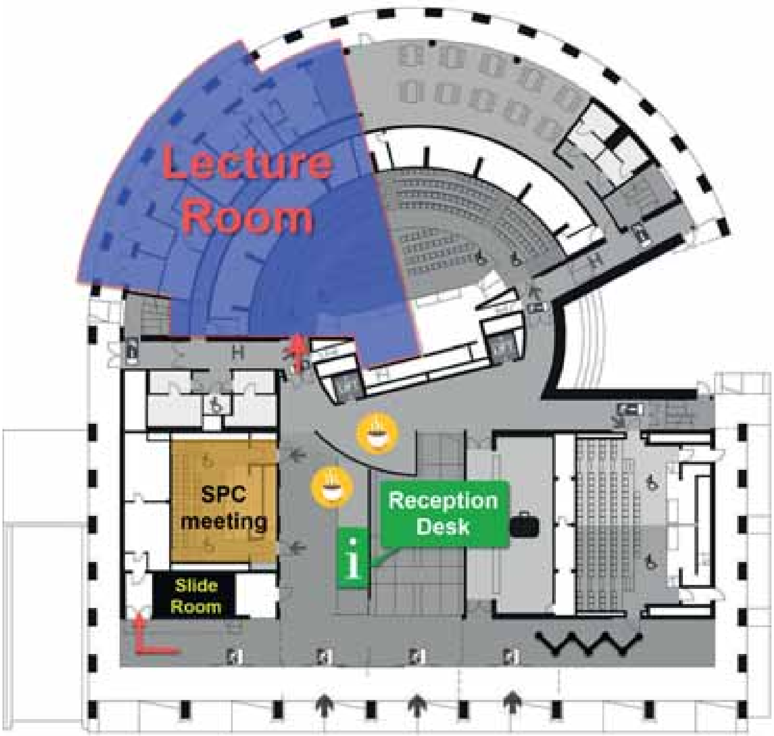
Slide room is position on the ground floor, this room will be used as a presentation service point, and for the technical support of the conference.

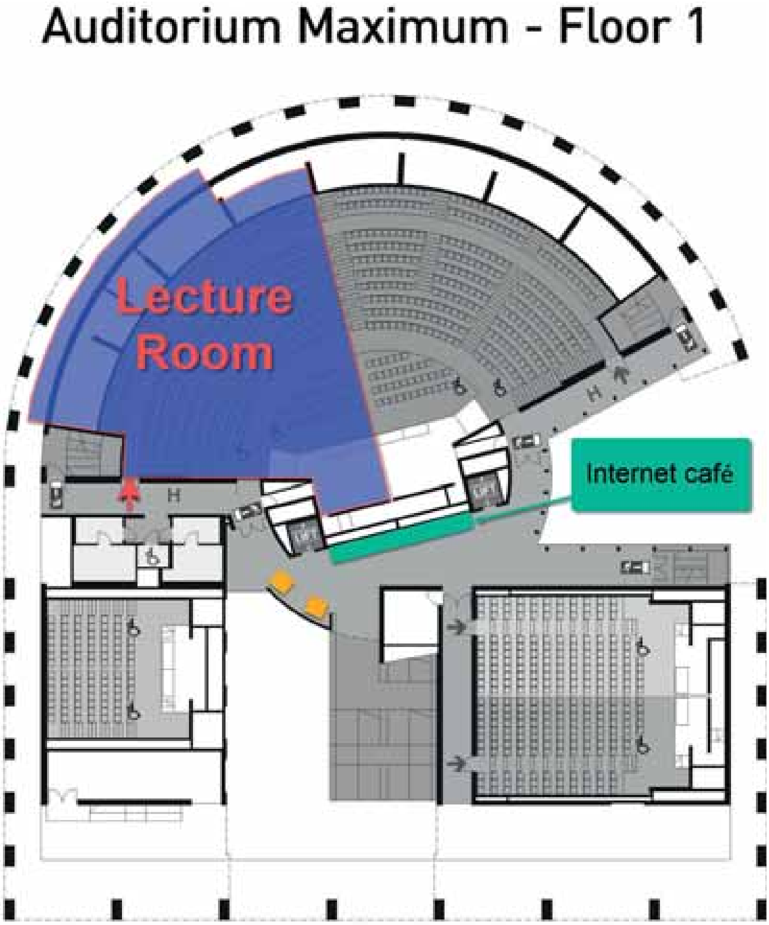
Reception desk will be on the ground floor in the main hall.

Photo by Anna Wojnar

Photo by Filip Radwański

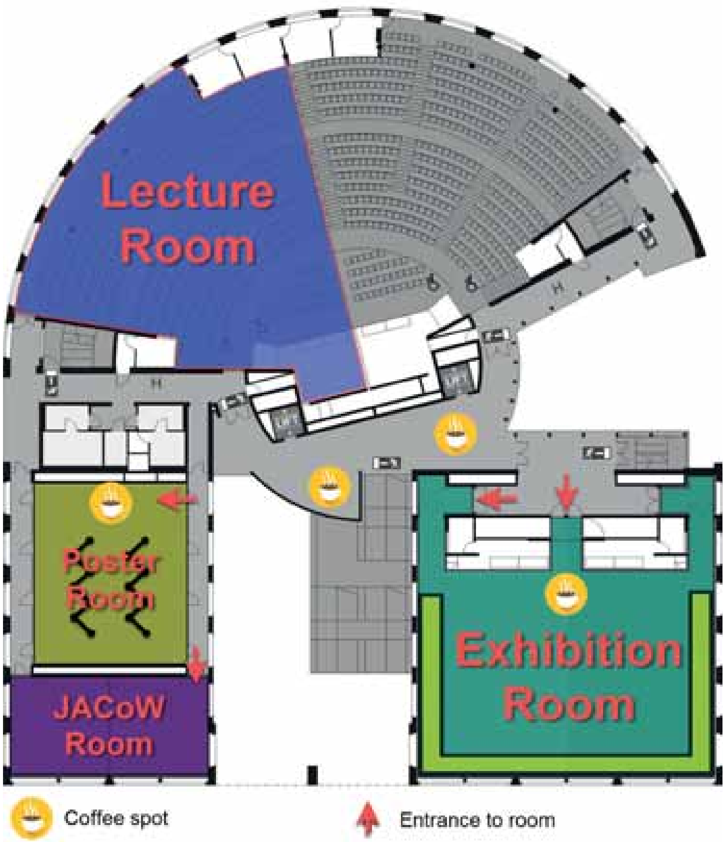
Auditorium Maximum - Ground Floor



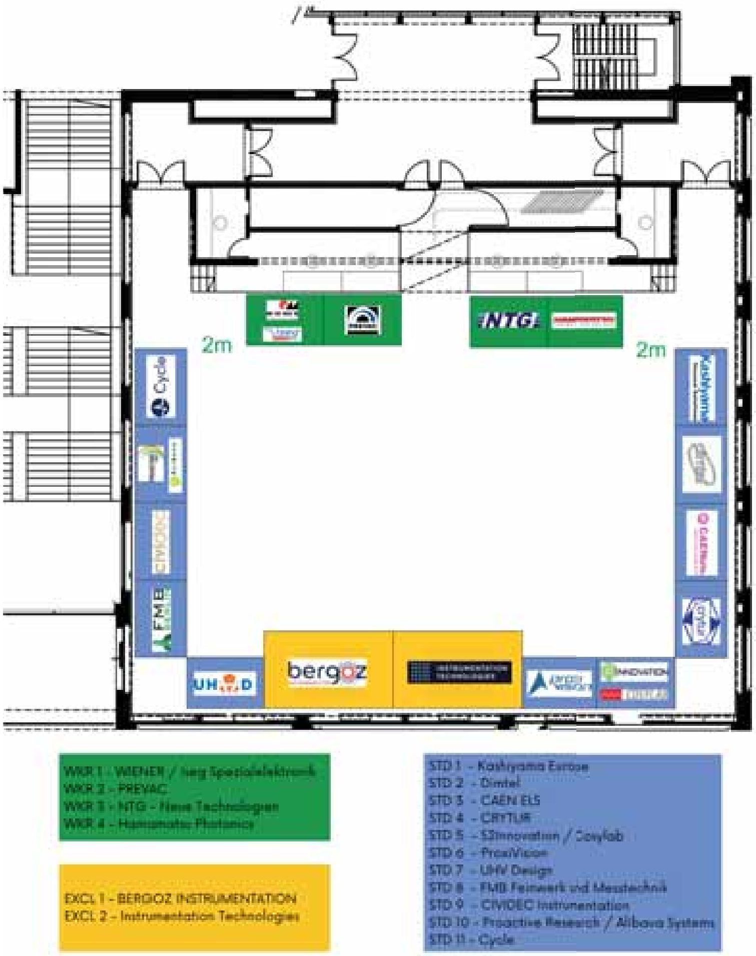


On the first floor the Authors reception and computers devoted for participants with internet access will be available on the corridor between lifts.

Auditorium Maximum - Floor 2

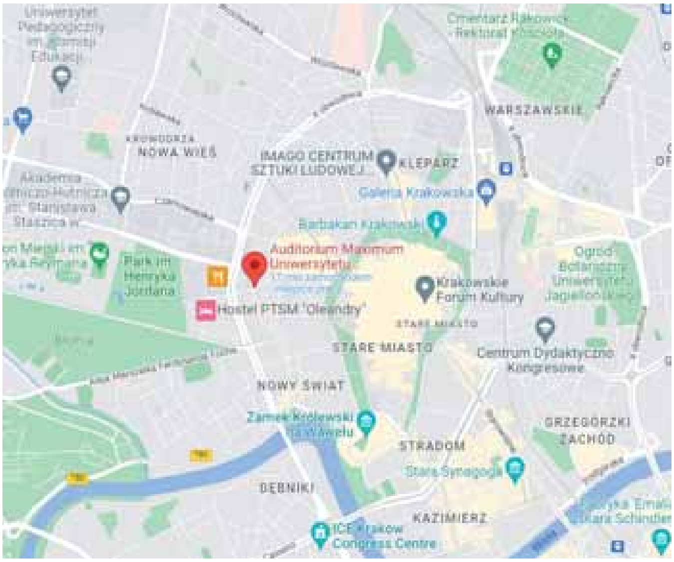


On the second floor of Auditorium Maximum exhibition room is located with available space of 468m2, where the industry exhibition and coffee breaks will be held. The layout of the exhibition booths is presented below:



Moreover there is also Poster room with 180 m2 space which accommodates part of the poster presentations and JACoW Editors room.

Venue coordinates:
Address: Krupnicza St. 33, 31-351 Krakow
Phone: +48 12 663 40 09
GPS coordinates: N 50.062925464215496, E 19.925586097978734
Google Map pin: https://goo.gl/maps/PAdfNKM4q4GK6kaCA



Public transport in Krakow

Information on bus and tram timetables can be found on the MPK Department of Transport in Krakow website (www.mpk.krakow.pl). We also recommend using the www.jakdojade.pl website, which allows you to easily find connections and plan your trip. To change language version of the website you must click on the settings button at the top-right corner of the homepage.

Tickets can be bought from vending machines for cash. Some vending machines accept credit card contactless payments. Do not forget to validate your ticket after boarding the vehicle! A single journey ticket costs 6,00 PLN per person.

How to get to the venue

... from railway and coach stations
From the Krakow Główny central railway station and a coach station you can get to the Auditorium Maximum by bus using line 189 (in the direction of Cracovia Stadion) or 192 (in the direction of Chełm). You have to get on the bus at the Dworzec Główny Wschód bus stop, which is located approx. 3-minute walk from the central railway station. When you get off the bus at the AGH/UR stop you should go a few steps straight to the pedestrian crossing on your left and cross over to the other side, then go straight along Krupnicza

Street until you see the black building of the Auditorium Maximum on your left hand side. The journey time is approx. 15-20 minutes.

... from the Krakow Airport by taxi

The Krakow Airport is located about 11 kilometres from the city centre. 24-hour taxi service is provided by Krakow Airport Taxi. Taxis can be ordered by phone at +48 12 258 0 258 or on-line (website in English). The cost of the journey is about 90 PLN. Each Krakow Airport Taxi car is equipped with a payment terminal. Dispatchers and drivers have at least communicative knowledge of English. You can get to the Auditorium Maximum from the Krakow Airport using other taxi company's services, as well (iCar, Barbakan, Mega Taxi, Eco Taxi, Dwójki, Krak Taxi). However, if you want to pay for the course with a credit card, you must make sure when ordering a taxi that a driver will have a payment terminal. Not all dispatchers and drivers speak English. The minimum journey time is 20 minutes, but there is a high risk of major delays due to traffic jams.

... from the Krakow Airport by bus

From the Krakow Airport, you can get to the Auditorium Maximum by bus using two lines: 300 (in the direction of Os. Podwawelskie) and later 503 (in the direction of Górka Narodowa Wschód).The bus no. 300 runs from the Krakow Airport every half hour from 5:00 a.m. to 11:00 p.m. and the fare is 8,00 PLN (a 90-minute agglomeration ticket). You have to get on the bus at the Krakow Lotnisko / Airport bus stop. You must get off the bus at the Rondo Grunwadzkie bus stop. Then you must cross the street and turn left. There you will find a bus stop named Rondo Grunwadzkie. Take bus number 503 in the direction of Górka Narodowa Wschód) and get off at the AGH/UR bus stop. Turn around and walk in the direction the bus came from, along the Aleja Mickiewicza street. Then turn right into Krupnicza Street. Auditorium Maximum will be on the left. Go straight along Krupnicza Street until you see the black building of the Auditorium Maximum on your left-hand side. The whole journey time is approx. 50 minutes, but there is a high risk of major delays due to traffic jams.

Registration

Registration will be at the conference venue, ground floor, on Sunday, September 11 from 16:30 – 18:00 and will also be possible on Monday, September 12 from 9:00.

Social events

Welcome reception

Sunday, September 11: Welcome reception will be held in the evening at the Auditorium Maximum, ground floor in Large Hall, from 18:00 – 20:00.

Conference dinner

Wednesday, September 14: Conference dinner will be hosted from 19:00 at the Stara Zajezdnia (www. starazajezdniakrakow.pl). The venue is in an international restaurant located in a restored UNESCO-listed building - Old Tram Depot. The hall is an example of wooden frame architecture with brick filling, rare in Krakow, popularly known as a half-timbered wall. The front of the hall is decorated with a picturesque gable with a clock framed in an Art Nouveau finial. The Main Hall belongs to the architectural and construction complex, under legal protection, entered in the register of monuments in 1985 and on the UNESCO World Cultural and Natural Heritage List and is recognized as a historical monument.

Conference dinner venue coordinates:
Address: Świętego Wawrzyńca St. 12, 31-060 Krakow
Phone: +48 664 323 988
Website: www.starazajezdniakrakow.pl
GPS coordinates: N 50.05020164940077, E 19.947158913465003
Google Map pin: https://goo.gl/maps/cBRNgTBwNGKSpEZU9

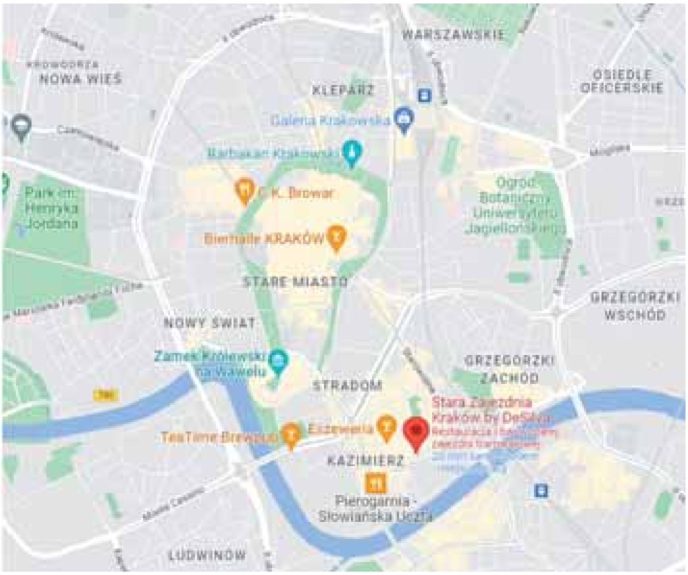


Photo by Bartek Dziedzic

Tour to SOLARIS NSRC

Thursday, September 15, from 14:00 – 18:00. After the conference closure the Tour to NCPS SOLARIS will be organised. The detailed schedule to be announced at later date.

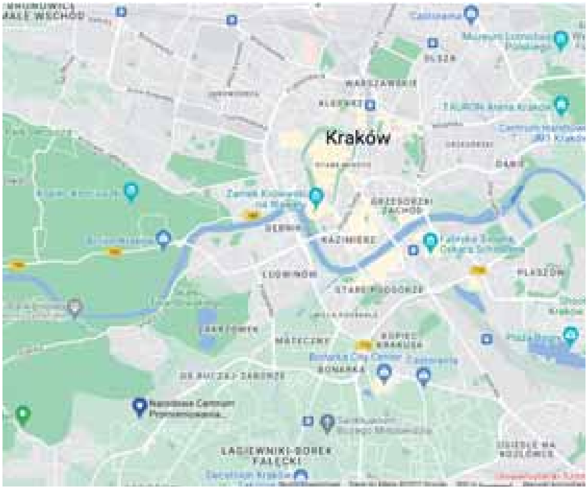
The National Synchrotron Radiation Centre functions under the auspices of the Jagiellonian University. It is located on the Campus of the 600th Anniversary of the Jagiellonian University Revival, in the southern part of Krakow. It neighbours the Krakow Technology Park special economic zone. The project Centre was established between 2010 and 2015. The Centre has been opened for Users since 2018 and at the end of 2021, SOLARIS facilitates five beamlines, operating in the range of radiation from UV to soft X-ray, providing various experimental techniques. At the PIRX beamline, the users can exploit X-ray absorption spectroscopy (XANES region, X-ray absorption near edge structure) and magnetic dichroism. The main technique at the URANOS beamline is angle-resolved photoelectron spectroscopy (ARPES). The PHELIX beamline based on two methods, ARPES and X-ray absorption spectroscopy (XANES). DEMETER beamline offers two end-stations: Scanning transmission X-ray microscopy (STXM) and photoemission electron microscopy (PEEM). Recently opened ASTRA beamline is X-ray absorption spectroscopy (XAFS, X-ray absorption fine structure) dedicated to many scientific field, for example the historical artifacts, the elemental composition of paints as well as monoatomic catalyst investigations.

Photo by Aleksander Koczur

Three new beamlines are under construction and they will be open in the next years. Ultimately, however, the experimental hall of the Krakow accelerator will house dozens of them. In total, the beamlines will be fitted with about twenty end-stations. SOLARIS Centre is more than the synchrotron alone. In our building, there are also two cryo-electron microscopes of the latest generation: Titan Krios G3i and Glacios. Both pieces of research equipment are parts of the National Electron Cryo-Microscopy Centre.

Photo by Joanna Kowalik

SOLARIS NSRC coordinates:
Address: Czerwone Maki St. 98, 30-392 Krakow
Phone: +48 12 664 40 00
Website: www.synchrotron.uj.edu.pl/en
GPS coordinates: N 50.02305132389522, E 19.89530672880748
Google Map pin: https://g.page/Synchrotron-SOLARIS?share



Disclaimer

The organisers are not liable for damages and/or losses of any kind which may be incurred by the conference delegates or by any other individuals accompanying them, both during the official activities as well as going to/from the conference. Delegates are responsible for their own safety and belonging.

IBIC 2022 anti-harassment policy

IBIC 2022 is dedicated to providing a harassment-free experience for everyone. We do nottolerate harassment in any form. Participants violating this rule may be sanctioned or expelled from the workshop without a refund at the discretion of the conference organisers. Harassment includes:

- offensive verbal comments related, but not limited to: gender, gender identity and expression, sexual orientation, disability, physical appearance, body size, race and religion;
- sexual images in public spaces;
- deliberate intimidation, stalking, following, harassing photography or recording;
- sustained disruption of talks or other events;
- inappropriate physical contact, and unwelcome sexual attention.

Participants asked to stop any harassing behaviour are expected to comply immediately. Exhibitors in the Industrial Exhibition are also subject to the anti-harassment policy. In particular, exhibitors should not use sexualised images, activities, or other material. Booth staff (including volunteers) should not use sexualized clothing/uniforms/costumes, or otherwise create a sexualized environment. If a participant engages in harassing behaviour, the workshop organizers may take any action they deem appropriate, including warning the offender or expulsion from the conference with no refund. If you are being harassed, notice that someone else is being harassed, or have any other concerns, please contact a member of organising staff immediately. Organising staff will be happy to help participants contact hotel/venue security or local law enforcement to feel safe for the duration of the conference. We value your attendance. We expect participants to follow these rules at all workshop venues and related social events.

Author information

Poster instructions

The poster sessions will take place from Monday to Wednesday in the afternoons. Posters must be mounted between 8:30 and 13:00 on the day of the presentation and must be removed at the end of the last oral session of the day, or posters will be trashed. The necessary material for poster display (pins, etc.) will be provided by the conference organizers.

Poster rules

Since no contributions are accepted for publication only, any paper not presented at the conference will be excluded from the proceedings. Furthermore, the organizers reserve the right to reject the publication of papers that were not properly presented in the poster session. Manuscripts of contributions to the proceedings (or large printouts of them) are not considered as posters and papers presented in this way will not be accepted for publication. There will be a designated „poster police" to verify that posters have been displayed during the relevant poster session and posters should be manned from 14:30 to 16:00. Papers for posters that are not displayed for the full poster session will not be published in the proceedings.

Paper submission

Authors will be kept updated on the status of their uploaded papers either by checking the status screen at the Workshop or by logging in to their IBIC 2022 SPMS account. Colour codes will be used to indicate the current editor status of papers. Note that, before the paper is completely ready to be published in the proceedings, the author must have a green indication by an editor. If the paper is being presented as a poster, it must also be additionally approved by the Poster Session Manager.

Paper acceptance:

• Green: The paper has adhered to the template and format guidance, and is ready to be published in the proceedings.

• Yellow: Changes have been made to the paper. The author must contact the proceedings office at the conference so that the modified version can be proof-read.

• Red: There is a major problem with the paper, such as one of the source files being corrupt. The author must contact the proceedings office to arrange to an editor to correct this.

kraków.pl Media patronage	**Magiczny Kraków** Email: bi@um.krakow.pl Phone: +48 12 616 18 00
GAPR Górnośląski Akcelerator Przedsiębiorczości Rynkowej sp. z o.o. Conference's Partner	**Górnośląski Akcelerator Przedsiębiorczości Rynkowej** Email: gapr@gapr.pl Phone: +48 32 33 93 110
ALIBAVA SYSTEMS	**Alibava System** Email: info@alibavasystems.com Standard booth No. 10
bergoz INSTRUMENTATION	**Bergoz Instrumentation** Email: info@bergoz.com Exclusive booth No. 1
CAENels Gear For Science	**CAEN ELS S.R.L.** Email: info@caenels.com Standard booth No. 3
cividec Instrumentation	**CIVIDEC Instrumentation GmbH** Email: office@cividec.at Standard booth No. 9
COSYLAB	**Cosylab** Email: info@cosylab.com Standard booth No. 5
crytur	**CRYTUR, spol. s r.o.** Email: sales@crytur.cz Standard booth No. 4
Cycle	**Cycle GmbH** Email: contact@cyclelasers.com Standard booth No. 11

	Dimtel, Inc. Email: info@dimtel.com Standard booth No. 2
	FMB Feinwerk- und Messtechnik GmbH Email: info@fmb-berlin.de Standard booth No. 8
	Hamamatsu Photonics Email: fbrandl@hamamatsu.de Working station No. 4
	Instrumentation Technologies, d.o.o. Email: info@i-tech.si Exclusive booth No. 2
	iseg Spezialelektronik GmbH Email: sales@iseg-hv.de Working station No. 1
	Kashiyama Europe GmbH Email: keg@kashiyama.com Standard booth No. 1
	NTG Neue Technologien GmbH & Co. KG Email: info@ntg.de Working station No. 3
	PREVAC sp. z o.o. Email: prevac@prevac.pl Working station No. 2
	ProxiVision GmbH Email: info@proxivision.de Standard booth No. 6

	Proactive Research & Development S.L. Email: info@proactiverd.com Standard booth No. 10
	S2Innovation Sp. z o.o. Email: contact@s2innovation.com Standard booth No. 5
	UHV Design Ltd Email: sales@uhvdesign.com Standard booth No. 7
	W-IE-NE-R Power Electronics GMBH Email: sales@wiener-d.com Working station No. 1

Student Sponsors

This year a total of 12 students from various countries were able to attend IBIC2022 thanks to funding from the International Beam Instrumentation Conference's budget.

Student Grant Committee

Willem Blockland, SNS, USA
Peter Forck, GSI, Germany
Ubaldo Iriso, Alba, Spain
Yongbin Leng, SSRF, China
Adriana Wawrzyniak, SOLARIS, Poland

Program and Abstracts

Contents

12-Sep-22 08:45 – 09:10	Pleanry

MOO — Conference Opening
Chair: A.I. Wawrzyniak (NSRC SOLARIS)

OPEN1 08:45 **Opening the meeting**
A.I. Wawrzyniak *(NSRC SOLARIS)*
Welcome by the Chairman of IBIC'22, Dr. Adriana Wawrzyniak, Accelerators Deputy Director (SOLARIS NSRC)

OPEN2 08:50 **Speech**
Speech by a representative of the Jagiellonian University

OPEN3 08:55 **Jörg Blaurock (GSI/FAIR)**
Speech by the Technical Managing Director of GSI and FAIR

OPEN4 09:00 **Prof. Marek Stankiewicz (SOLARIS NSRS)**
Speech by the Director of the SOLARIS NSRS

OPEN5 09:05 **Speech**
Speech by the representative of the Krakow's City Hall

OPEN6 09:10 **A.I. Wawrzyniak (NSRC SOLARIS)**
Speech by Prof. Agnieszka Zalewska, Head of the Department of Neutrino and Dark Matter Studies, H. Niewodniczański, Institute of Nuclear Physics of the Polish Academy of Sciences

12-Sep-22 09:10 – 10:30	Pleanry

MO1 — Monday Session 1

Chair: A.I. Wawrzyniak (NSRC SOLARIS)

MO1I1 09:10 30 **Photon Science Directions in Poland at the Large Scale Accelerator's Based Infrastructures**

***J. Szlachetko**, A.I. Wawrzyniak (NSRC SOLARIS) R. Nietubyc (NCBJ)*

Polish scientific society, for many decades, has been actively participating in research exploring synchrotrons and free-electron lasers facilities worldwide. Recently, the construction of the SOLARIS National Synchrotron Radiation Centre in Kraków was completed. SOLARIS belongs to the family of low energy synchrotrons with a 1.5 GeV storage ring and presently offers several beamlines for user operation. In parallel, the PolFEL free-electron laser facility at National Centre for Nuclear Research in Warsaw is under construction, and the facility will deliver the first photon beams in 2023. We will present areas of accelerator-based photon research where the Polish scientific community is active and discuss trends and research routes of interest to be implemented at SOLARIS and PolFEL facilities.

MO1I2 09:40 30 **Overview of Beam Diagnostics for POLFEL**

***R. Nietubyc**, P. Krawczyk (NCBJ)*

PolFEL - Polish Free Electron Laser will be driven by a continuous wave superconducting accelerator consisting of low emittance superconducting RF electron gun, four accelerating cryomodules, bunch compressors, beam optics components and diagnostic elements. The accelerator will split in three branches leading to undulators producing VUV, IR and THz radiation, respectively. Two accelerating cryomodules will be installed before a dogleg directing electron bunches towards IR and THz branches. Additional two cryomodules will be placed in the VUV branch accelerating electron bunches up to 185 MeV at 50 kHz repetition rate. Moreover, the electron beam after passing the VUV undulator will be directed to the Inverse Compton Scattering process for high energy photons experiments in a dedicated station. In order to measure and optimise the electron beam parameters along the entire accelerator the main diagnostics components like BPMs, charge monitors, YAG screens, coherent diffraction radiation (CDR) monitors and beam loss monitors are foreseen. Within this presentation the concept of the electron beam diagnostics will be discussed.

MO1C3 10:10 20

Development of a 6d Electron Beam Diagnostics Suite for Novel Acceleration Experiments at CLARA-FEBE

T.H. Pacey, *A.R. Bainbridge, J. Henderson, J.K. Jones, N.Y. Joshi, S.L. Mathisen, A.E. Pollard, Y.M. Saveliev, E.W. Snedden, C. Tollervey, D.A. Walsh (STFC/DL/ASTeC) A.R. Bainbridge, J.K. Jones, T.J. Overton, Y.M. Saveliev, C. Swain, J. Wolfenden (Cockcroft Institute) J. Henderson (Cockcroft Institute, Lancaster University) N.Y. Joshi (UMAN) T.J. Overton (The University of Manchester) C. Swain, J. Wolfenden (The University of Liverpool)*

The CLARA-FEBE facility will combine a 250 MeV FEL quality electron beam with a 100 TW class laser. One area of research FEBE will support is novel acceleration schemes; both structure and plasma based. There are stringent diagnostic requirements for measuring the input electron beam and challenges in characterisation of the accelerated beams produced by these novel schemes. Several of these challenges include measurement of: micrometer scale transverse profiles, 10 fs scale bunch lengths, single shot emittance, broadband energy spectra at high resolution, and laser-electron time of arrival jitter. Furthermore, novel shot-by-shot non-invasive diagnostics are required for machine learning driven optimisation and feedback systems. This paper presents an overview of R&D activities in support of developing a 6D diagnostics suite to meet these challenges.

12 Sep – Mon

12-Sep-22 11:00 – 12:50	Pleanry

MO2 — Monday Session 2

Chair: P. Forck (GSI)

MO2I1 11:00 30 **Beam Diagnostics for FRIB Commissioning**

S.M. Lidia *(FRIB)*

The Facility for Rare Isotope Beams has commenced operation for production of rare isotope beams. A large suite of beam diagnostics and instrumentation have been developed and commissioned for the FRIB linac, target, and fragment separator systems. This talk will present the status of diagnostic systems to support current beam commissioning activities and experimental support for rare isotope production. We will review the performance of specific diagnostic systems used for position, intensity, beam distribution, and beam loss measurements. The initial performance of target and fragment separator diagnostics will be discussed. Aspects of the machine protection system and global timing system to support flexible, high power operation are presented. Finally, development of novel or enhanced techniques in signal processing will be introduced as means to improve overall system performance for various classes of diagnostics.

MO2C2 11:30 20 **Beam Tuning Studies in the ESS MEBT**

N. Milas*, M. Eshraqi, Y. Levinsen, R. Miyamoto, D. Noll (ESS)*

The European Spallation Source (ESS), currently under construction and initial commissioning in Lund, Sweden, will be the brightest spallation neutron source in the world, when its driving proton linac achieves the design power of 5 MW at 2 GeV. Such a high power requires production, efficient acceleration, and almost no-loss transport of a high current beam, thus making design and beam commissioning of this machine challenging. During the the commissioning time in 2022 a campaign for a full characterisation of the ESS Medium Beta Transport session (MEBT) was carried out. Both transverse optics and longitudinal parameters were measured and compared to simulation, amongst them: buncher cavity tunning, trasnverse emittance and initial twiss parameters. In this paper we present the results and future plans.

MO2C3 11:50 20

Novel Approaches for Forecasting of Beam Interruptions in Particle Accelerator

S. Li, *A. Adelmann, J. Snuverink (PSI)*

The beam interruptions (i.e. interlocks) of particle accelerators, despite being necessary safety measures, lead to abrupt operational changes and a substantial loss of beam time. Novel data-driven time series classification approaches are applied in the High-Intensity Proton Accelerator complex of Paul Scherrer Institut, in order to forecast interlock events thus decrease beam time loss. The forecasting is performed through binary classification of single timestamps as well as windows of multivariate time series, with methods ranging from linear Lasso models based on statistical Two Sample Test, to deep learning model that generates Recurrence Plots followed by Convolutional Neural Network. The "beam time savedïn any given time interval, a continuous evaluation metric, is established with preliminary experiments showing that interlocks could be circumvented by reducing the beam current. The models have been integrated with EPICS, and the best-performing interlock-to-stable classifier on real-time data potentially increases 5 min beam time per day for the users.

MO2I4 12:10 40

Statistical Properties of Undulator Radiation

I. Lobach *(ANL) S. Nagaitsev, A.L. Romanov, G. Stancari (Fermilab)*

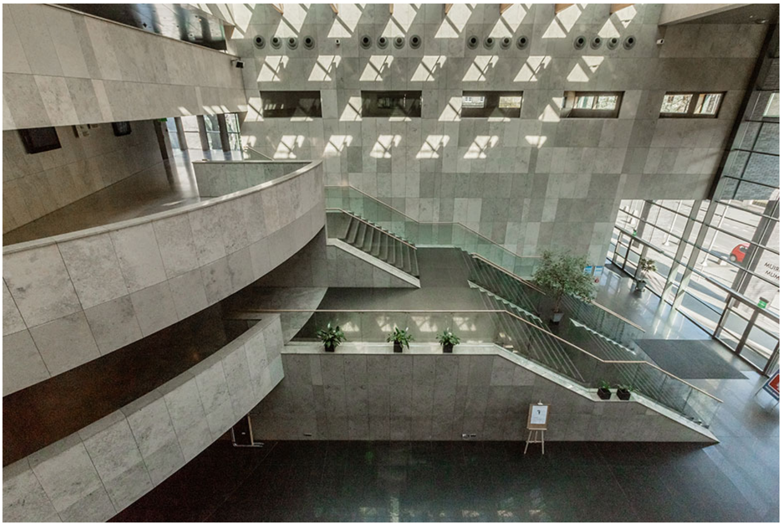
Two experiments were carried out to study the statistical properties of undulator radiation in the Integrable Optics Test Accelerator (IOTA) storage ring at Fermilab. The first experiment studied the turn-to-turn fluctuations in the power of the radiation generated by an electron bunch. The magnitude of these fluctuations depends on the 6D phase-space distribution of the electron bunch. In IOTA, we demonstrated that this effect can be used to measure some electron bunch parameters, small transverse emittances in particular. In the second experiment, a single electron was stored in the ring, emitting a photon only once per several hundred turns. In this regime, any classical interference-related collective effects were eliminated, and the quantum fluctuations could be studied in detail to search for possible deviations from the expected Poissonian photon statistics. In addition, the photocount arrival times were used to track the longitudinal motion of a single electron and to compare it with simulations. This allowed us to determine several dynamical parameters of the storage ring such as the rf cavity phase jitter and the dependence of the synchrotron motion period on amplitude.

12-Sep-22 12:50 – 13:00	Pleanry

MOB — Group Photo

PHOTO **Group Photo**
12:50 10 ***All Participants***

The Organizing Committee provides for taking two photos - on the stairs, in the main hall of Auditoruim Maximum (see picture below) and outside, on the main stairs in front of the entrance to the building (in case of favorable weather conditions).



MOP — Monday Poster Session

MOP01 **SLS 2.0 – Status of the Diagnostics**

***C. Ozkan Loch**, R. Ischebeck, N. Samadi, A.M.M. Stampfli, J. Vila Comamala (PSI)*

This poster will give an overview of the diagnostics development for SLS 2.0. Details on the beam size monitors in the storage ring, the screen monitors for the booster to ring transfer line, and beam loss monitors for the linac and storage ring will be presented. Test results carried out at the SLS will also be presented.

MOP02 **An Optical Diagnostic Beamline for the Bessy II Booster**

***T. Atkinson**, J.-G. Hwang, G. Rehm, M. Ries, G. Schiwietz (HZB)*

As part of the global refurbishment of the injector at BESSY II, a new optical beamline has been installed in the booster. This paper covers the conceptual design: incorporating the beamline into an operational facility without downtime, the simulation and expectations of the optical transport line, mechanical installation and commissioning with beam. These first results with the present beam delivery system have already achieved source point imaging and bunch length measurements using a fast diode. With the additional PETRA cavity installed for this booster upgrade and connection to acquire RF power in the 2022 summer shutdown planned, the bunch length diagnostics are critical. The beamline will also undergo a final mechanical upgrade and then see the installation of a streak camera.

MOP03 **Status Overview of the HESR Beam Instrumentation**

***C. Böhme**, A.J. Halama, V. Kamerdzhiev, G.R. Rupsch (FZJ)*

The High Energy Storage Ring (HESR), within the FAIR project, will according to current planning provide anti-proton beams for PANDA and heavy ion beams for a.o. SPARC. With the beam instrumentation devices envisaged in larger quantities, e.g. BPM and BLM, testing is well underway. Other beam instrumentation instruments like Viewer, Scraper are in late production stage and for the Ionization Beam Profile Monitor the mechanical design phase is finished. An overview of the status of the work package beam instrumentation will be presented as well as test bench results of already produced instruments.

MOP05 **Fiber Bragg Grating Sensors as Beam-Induced Heating Monitor for the Central Beam Pipe of CMS**

***F. Fienga**, G. Breglio, A. Irace, V.R. Marrazzo, L. Sito (University of Napoli Federico II) N. Beni, F. Giordano, B. Salvant, W. Zeuner (CERN) S. Buontempo (INFN-Napoli) Z. Szillasi (Atomki)*

The passage of a high-intensity particle beam inside accelerator components generates heating, leading to degradation of the accelerator performance or damage to the component itself. It is therefore essential to monitor such beam-induced heating in most accelerators. This proceeding showcases the capabilities of iPipe, which is a set of Fiber

Bragg Grating sensors stuck on the inner beam pipe of the Compact Muon Solenoid (CMS) experiment installed in the CERN Large Hadron Collider (LHC). This iPipe system has proved to be an effective solution ’ in terms of multiplexing capability, installation ease, and robustness to harsh environments ’ to monitor the temperature variations continuously at multiple locations along the CMS beam pipe. In this study, the wavelength shift, linked directly to the temperature shift, is measured for various LHC fills and is compared with the computed dissipated power for a set of LHC fills. Electromagnetic and thermal simulations were also coupled to predict the beam-induced temperature increase along the beam pipe. These results further validate the sensing system and the methods used to design accelerator components to mitigate beam-induced heating.

MOP06 **Upgrades of Beam Diagnostics for Linac of Siam Photon Source**

T. Chanwattana, *S. Boonsuya, S. Bootiew, Ch. Dhammatong, S. Jummunt, S. Klinkhieo, W. Phacheerak, T. Pulampong, P. Sudmuang, N. Suradet (SLRI) S. Naeosuphap (Synchrotron Light Research Institute (SLRI))*

Siam Photon Source (SPS) is an existing synchrotron light source in Thailand, which has been operated and provided synchrotron radiation for user beam service for more than 10 years. The SPS accelerator system consists of a 40-MeV linac, a 1.2 GeV booster synchrotron and a storage ring with double bend achromat (DBA) lattice. The linac is one of the most critical parts of the SPS machine in which its performance affects beam injection and hence to the beam service. Beam diagnostics of the SPS linac has been upgraded in order to allow better beam monitoring and become a crucial part for linac optimization to achieve higher machine performance. In this paper, upgrades of beam diagnostics of the SPS linac will be discussed.

MOP07 **Beam Instrumentation Performance During Commissioning of the ESS RFQ, MEBT and DTL**

T.J. Shea, *R.A. Baron, C.S. Derrez, E.M. Donegani, V. Grishin, H. Hassanzadegan, I. Kittelmann, N. Milas, H.A. Silva, R. Tarkeshian, C.A. Thomas (ESS) I. Bustinduy (ESS Bilbao) M. Ferianis (Elettra-Sincrotrone Trieste S.C.p.A.) T. Papaevangelou, L. Seguí (CEA-IRFU)*

In late 2021 through mid-2022, the first protons were accelerated and transported through the European Spallation Source’s RFQ and MEBT at 3.6 MeV, and finally through the first DTL tank at 21 MeV. To enable these achievements, the following beam instrumentation systems were deployed: Ion Source power supply monitors, a beam chopping system, Faraday Cups, Beam Current Monitors and Beam Position Monitors that also measured phase. Additional systems were deployed for dedicated studies, including Wire Scanners, a slit and grid emittance measurement unit, neutron Beam Loss Monitors, and fast Beam Current and Position Monitor systems. The instrumentation deployment is the culmination of efforts by a partnership of the ESS beam diagnostics section, multiple ESS groups and institutes across the globe. This paper summarizes the beam tests that characterized the performance of the instrumentation systems and verified the achievement of commissioning goals.

MOP08 **Development of a Waveguide BPM System**

***A. Lyapin**, W. Shields (JAI)*

A mode-selective waveguide beam position monitor is under development. It is aimed primarily at electron linacs, although with its low impedance and wide bandwidth it could find alternative applications. In this paper we go over the design of the waveguide BPM system including the sensor and analog electronics, consider requirements to the digital processing and present some simulated results.

MOP09 **Towards Higher Stability in Large Scale Cavity BPM Systems**

***A. Lyapin**, M.S. McCallum (JAI) A. Aryshev (KEK)*

In this contribution we consider a possible solution to long-term stability issues common in cavity BPM systems. The method will see a wider use active in-situ calibration systems injecting a tone into the measurement channel. We plan to compensate the bulk of the beam generated signal and so potentially extend the dynamic range of the electronics, reduce the amount of wakefield seen by the beam. The signal matching the real beam can then be used for mimicking the beam and calibrating out any drifts of the whole sensing and processing chain. We present the concept, give some simulated results and consider possible hardware solutions.

MOP10 **Removing Noise in BPM Measurements with Variational Autoencoders**

***J.P. Edelen**, J.A. Einstein-Curtis, C.C. Hall (RadiaSoft LLC) A.L. Romanov (Fermilab)*

Noise in beam measurements is an ever-present challenge in accelerator operations. In addition to the routine challenges presented by hardware and signal processing, new operational regimes, such as ultrashort bunches, create additional difficulties in routine beam measurements. Techniques in machine learning have been successfully applied in other domains to overcome challenges inherent in noisy data. Variational autoencoders (VAEs) are shown to be capable of removing significant levels of Gaussian noise. A VAE can be used as a pre-processing tool for noise removal before the de-noised data is analyzed via other methods, or the VAE can be directly used to make beam dynamics measurements. Here we present the use of VAEs as a tool for addressing noise in BPM measurements.

MOP12 **Production of Cavity Beam Position Monitors for the ARES Accelerator at DESY**

***D. Lipka**, M. Holz, S. Vilcins (DESY)*

The SINBAD facility (Short and INnovative Bunches and Accelerators at DESY) hosts various experiments in the field of production of ultra-short electron bunches and novel high gradient acceleration techniques. The SINBAD facility, also called ARES (Accelerator Research Experiment at SINBAD), is a conventional S-band linear RF accelerator allowing the production of low charge ultra-short electron bunches within a range between 0.5 pC and 1000 pC. The positions of the low charge bunches will be detected by cavity beam position monitors. The principal design is based on the experience from the EU-XFEL cavity beam position monitors. It consists of a 316 LN stainless steel body with a design loaded quality factor of 70, a resonance frequency of 3.3 GHz and a relative wide gap of 15 mm to reach a high peak position sensitivity of 4.25 V/nC mm). This poster covered, the manufacture of the individual mechanical parts, as well as presents the special features in the manufacture of customer designed UHV feedthroughs.

`MOP13` **Test and Measurements Results of the Pilot Tone Front End Industrialization for Elettra 2.0**

***G. Brajnik**, R. De Monte (Elettra-Sincrotrone Trieste S.C.p.A.) M. Cargnelutti, U. Dragonja, P. Leban, P. Paglovec, B. Repič, A. Vigali (I-Tech)*

Elettra 2.0 will be the low-emittance upgrade of the present machine, a third-generation lightsource based in Trieste, Italy. The new machine, foreseen to be completed in 2025-2026, will be equipped with 168 beam position readout systems divided into 12 cells. The BPM electronics will be based on the prototypes developed by the laboratory, relying on the pilot-tone compensation technique for assuring the required resolution and long-term stability. The industrialization and production of the BPM electronics system are being carried out in partnership with Instrumentation Technologies, a company that has experience with BPM readout systems within the accelerator field. This paper will present the results of the industrialization of one of BPM system's key component: the Pilot Tone Front End, focusing on its improvements introduced on electronic and mechanical sides, giving not only a significant performance gain with respect to the previous prototype but also improving robustness and reliability. An overview of the testing procedures that will assure the performance repeatability of the series will also be provided.

`MOP14` **Design and Implementation of an FPGA-Based Digital Processor for BPM Applications**

***M. Colja**, S. Carrato (University of Trieste) G. Brajnik, R. De Monte (Elettra-Sincrotrone Trieste S.C.p.A.)*

Digital processing systems have been proven to often outperform analog elaboration. Indeed, thanks to high-density DSPs and FPGAs, operations in digital domain give results that are impossible to achieve in other ways. On the other side, dealing with this great performance and flexibility is not always straightforward: the processing chain needs to be accurately planned to reach the desired goals, avoiding erratic behaviours in the digital domain. In this paper, we focus on the design and implementation of an FPGA-based digital processor that will be used in the electron beam position monitors of Elettra 2.0. After digitizing the 500 MHz beam signals from the pickups, the system executes a digital down conversion, followed by several filtering and demodulating stages, in order to have a selectable data rate that is suitable for both diagnostics and feedback. The position calculation is also performed in FPGA as well, with the well-known difference-over-sum algorithm. According to results provided by a fixed-point simulation, the overall system has been implemented in an Intel Arria 10 FPGA, demonstrating the correct design functionality that meets the specified requirements.

MOP15 **Development of Non-Invasive Calibration Software for Front End X-Ray Beam Position Monitors at Diamond Light Source**

***C.E. Houghton**, C. Bloomer, L. Bobb (DLS)*

Tungsten blade based photoemission X-ray Beam Position Monitors (XBPMs) are widely used as white beam diagnostics at synchrotrons. Traditionally, the scale factors are determined by stepper motor movements of the XBPM, or by controlled electron beam displacements, and measuring the response. These measurements must be repeated for each ID gap to produce a complete set of scale factors for all operational conditions. This calibration procedure takes time and cannot be done during user operation. In addition, the scale factors can vary over time due to changes to the storage ring. It is possible for these scale factors to become inaccurate, reducing the accuracy of the beam position measured. By using the intrinsic kHz electron beam movements and correlating the signals from electron beam position monitors and XBPMs it is possible to have real-time calculation of the scale factors without the need to disturb user operation. Presented in this paper is the method for producing software to non-invasively calculate, and to implement the varying scale factors. A comparison of the precision of this method versus the traditional stepper motor method is presented.

MOP16 **Time Resolved Dynamics of Transverse Resonance Island Buckets at SPEAR3**

***K. Tian**, W.J. Corbett, J. Kim (SLAC)*

The Transverse Resonance Island Buckets have been studied at SPEAR3 as an option for timing experiment mode operation of this third generation synchrotron radiation facility. In this mode, with proper optics setting, the electron beam is populated to island orbits with the excitation from a kicker. In this paper, we will report the experimental observation of the beam dynamics with turn by turn beam position monitors and a fast gated camera. The results are also compared with tracking simulations.

MOP17 **Development of a Scintillation Fibre Transverse Profile Monitor for Low-Intensity Ion Beams**

***R.L. Hermann**, Th. Haberer, A. Peters (HIT)*

Low intensity ion beams (below 10 million ions/sec.) are not used in patient treatment at the Heidelberg Ion Beam Therapy Center (HIT), but available for several diverse experiments. A transverse ion beam profile monitor for low intensity regions is of high interest, as till now the ion beam is manually degraded to low intensities due to non-existing built-in detectors for these beam properties in the HIT accelerator control system. One application for low intensities is the ion beam radiography, investigated in the same DFG project of which the presented beam monitor is a part. The measurement method is based on green 3HF scintillating fibres due to their enhanced radiation hardness. If an ion passes through the fibres they emit photons which are then converted and amplified via silicon-photomultipliers to electric pulses. These pulses are recorded and processed by a new sophisticated readout electronics, the FERS A5200 by CAEN. A prototype set-up consisting of all above mentioned parts was tested in beam and has proven to record the transverse beam profile successfully below the intensity of 100 ions/second with down to 200 µs time frames.

MOP18 **Studies of the X-Ray Pinhole Camera Spatial Resolution Using High Aspect Ratio LIGA Pinhole Apertures**

***N. Vitoratou**, L. Bobb (DLS) A. Last (KIT) G. Rehm (HZB)*

X-ray pinhole cameras are employed to provide the transverse profile of the electron beam from which the emittance, coupling and energy spread are calculated in the storage ring of the Diamond Light Source. Tungsten blades separated by shims are commonly used to form the pinhole aperture. However, this approach introduces uncertainties regarding the aperture size. X-ray lithography, electroplating and moulding, known as LIGA, has been used to provide thin screens with well-defined and high aspect ratio pinhole apertures. Thus, the optimal aperture size given the beam spectrum can be used to improve the spatial resolution of the pinhole camera. Experimental results using a LIGA screen of different aperture sizes have been compared to SRW-Python simulations over the 15-35 keV photon energy range. Good agreement has been demonstrated between the experimental and the simulation data. Challenges and considerations for this method are also presented.

MOP19 **Commissioning of the Renewed Long Radial Probe in PSI Ring Cyclotron**

***M. Sapinski**, R. Dölling, M. Rohrer (PSI)*

PSI's Ring cyclotron is a high intensity proton cyclotron producing 2 mA beam. The beam is accelerated over about 180 turns from 72 MeV to 590 MeV. The Long Radial Probe, called RRL, scans the beam along the range of beam radii from 2048 mm to 4480 mm. A replacement for the RRL has been developed in the last years. The recently installed new probe drives three carbon fibers with 30 µm diameter through the turns and measures secondary electron currents, providing information on horizontal and vertical beam shape. Additional drives are available for a later extension of measurement capabilities. The main challenges are a coupling of the device elements to RF fields leaking from the accelerating cavities, plasma interfering with the measured signal and performance of the carbon fibers in harsh environment with high intensity beam. We report on commissioning of the probe with RF and beam and discuss measurement results.

MOP20 **Synchrotron-Radiation-Monitor of the SwissFEL Bunch-Compressor (BC-SRM): From the Bunch Energy and Length Characterization to the Machine-Learning**

G.L. Orlandi*, S. Bettoni, H. Brands, Z. Geng, N. Hiller, R. Ischebeck, E. Prat, S. Reiche, T. Schietinger, V. Schlott, V.G. Thominet, R. Xue (PSI)*

The Synchrotron-Radiation-Monitor (SRM) of the SwissFEL Bunch-Compressor (BC) is now equipped with a fast gated camera able to monitor at 100 Hz the single electron bunch of the 28 ns long 2-bunch macro-structure. The monitor ensures a fully non-invasive reconstruction of the beam energy distribution as well as an estimate of the electron bunch length. The characterization of the electron bunch length at every shot is possible thanks to the beam-synchronous correlation of the SRM images with the RF parameters (phase and amplitude) via a suitable algorithm. Next upgrade of the BC-SRM consists in implementing a machine-learning algorithm based on the analysis of the SRM images that should allow us to optimize the injector settings as well as to determine the electron bunch length.

MOP21 **First Results of PEPITES, a New Transparent Profiler Based on Secondary Electrons Emission for Charged Particle Beams**

C. Thiebaux*, L. Bernardi, F. Gastaldi, Y. Geerebaert, R. Guillaumat, F. Magniette, P. Manigot, M. Verderi (LLR) G. Blain, F. Haddad, N. Michel, N. Servagent, T. Sounalet (SUBATECH) É. Delagnes, F.T. Gebreyohannes, O. Gevin (CEA-IRFU) F. Haddad, C. Koumeir, F. Poirier (Cyclotron ARRONAX)*

The PEPITES project consists of a brand new operational prototype of an ultra-thin, radiation-resistant profiler capable of continuous operation on mid-energy (O(100 MeV)) charged particle accelerators. Secondary electron emission (SEE) is used for the signal because it only requires a small amount of material (10 nm); very linear, it also offers good dynamics. The lateral beam profile is sampled using segmented electrodes, constructed by thin film methods. Gold strips, as thin as the electrical conductivity allows (~ 50 nm), are deposited on an insulating substrate as thin as possible. While crossing the gold, the beam ejects the electrons by SEE, the current thus formed in each strip allows the sampling. SEE was characterized at ARRONAX with 68 MeV proton beams and at medical energies at CPO. Electrodes were subjected to doses of up to 10^9 Gy without showing significant degradation. A de-

monstrator with dedicated electronics (CEA) is installed at ARRONAX and will be used routinely with proton beams of 17-68 MeV for intensities of 100fA to 100nA. An overview of the design and first measurements will be presented, and system performances will be assessed.

MOP22 **Development of a New Beam Position Detectors for NA61/SHINE Experiment**

M.U. Urbaniak *(University of Silesia in Katowice)*

NA61/SHINE is a fixed-target experiment located at CERN Super Proton Synchrotron. The development of new beam position detectors is part of the ongoing upgrade of the detector system. Two types of detectors have been manufactured and tested. The first one is a scintillating fibers detector with photomultiplier as a readout. The scintillating fibers detector consists of two ribbons, which are arranged perpendicularly to each other. Each ribbon is made of two layers of 250 μm diameter fibers. The grouping method was used, which allows using of a single multichannel photomultiplier for one detector. The second type of detector is based on the single-sided silicon strip detector (SSD). In this project, Si strips produced by Hamamatsu (S13804) were used, where the pitch has a width equal to 190 um. The developed detectors must meet several requirements: should work efficiently with proton and lead beams with beam intensity on the level of 100 kHz, the detector's material on the beamline should be minimized, the detectors should be able to determine the position of X and Y hit of each beam particle with maximum possible accuracy. During my speech I will present the results of our work.

MOP23 **Recent LHC SR Interferometer Simulations and Experimental Results**

D. Butti*, E. Bravin, G. Trad (CERN) S.M. Gibson (Royal Holloway, University of London)*

At the CERN Large Hadron Collider (LHC), among the different systems exploiting Synchrotron Radiation (SR) for beam diagnostics, interferometry is under study as a non-invasive technique for measuring absolute beam transverse sizes. Extensive numerical simulations, recently completed for characterising the spatial coherence of the LHC SR source, allowed optimising the LHC interferometer design and the existing prototype system tested in the past has been refurbished to include the new simulation findings. This contribution describes the simulation specificity and then focuses on first measurements performed at the beginning of the LHC run 3. Such experiments allowed obtaining a first validation of the expected system performance at the injection energy of 450 GeV. A complete benchmark of the simulations will be carried out throughout the run, as soon as the LHC will reach its top energy of 6.8 TeV.

MOP24 Test of a Prototype for Modular Profile and Position Monitors in the Shielding of the 590 MeV Beam Line at HIPA

R. Dölling, *M. Sapinski (PSI)*

A new generation of monitor plugs is under development as spares for the ageing wire profile monitors and beam position monitors inserted into massive shielding in the target regions of the 590 MeV proton beam line at HIPA. A prototype was installed recently in the beam line to the ultra-cold neutron source UCN, to test the performance of wire monitor, BPM and modular mechani¬cal design in a low-radiation environment. We report on first measurements with a few uA splitted beam and with the full 2 mA proton beam directed to the UCN for several seconds.

MOP26 Bunch Length Measurement Systems at S-DALINAC

A. Brauch, *M. Arnold, J. Enders, L.E. Jürgensen, N. Pietralla, S. Weih (TU Darmstadt)*

A high-quality beam is necessary for electron scattering experiments at the superconducting Darmstadt electron linear accelerator S-DALINAC. An optimization of the bunch length to typical values of < 2 ps is performed to reach a high energy resolution of 10^{-4}. Currently, this is accomplished by inducing a linear momentum spread on the bunch in one of the accelerating cavities. The bunch length can then be measured with a target downstream. This method is time consuming and provides only an upper limit of the bunch length. Two new setups for bunch length measurements will improve the optimization process significantly. On the one hand, a new diagnostic beam line is set up in the low energy beam area. It includes a deflecting copper cavity used for measuring the bunch length by shearing the bunch and projecting its length on a target. On the other hand, a streak camera placed at different positions downstream the injector and the main linac will be used to measure the bunch length. Optical transition radiation from an aluminium coated kapton target is used to perform this measurement. The present layout of both systems and their current status will be presented in this contribution.

MOP27 Design Considerations of the Corrugated Structures in a Vacuum Chamber for Impedance Studies at KARA

S. Maier, *M. Brosi, H.J. Cha, A. Mochihashi, A.-S. Müller, M.J. Nasse, P. Schreiber, M. Schwarz (KIT)*

Two parallel corrugated plates will be installed at the KIT storage ring KARA (KArlsruhe Research Accelerator). This impedance manipulation structure can be used to study and eventually control the electron beam dynamics and the emitted coherent synchrotron radiation (CSR) at KARA. In this contribution, we present the new impedance chamber's design with the corrugated structure, simulation results showing the influence of different corrugation parameters on its impedance, and the impact of this additional impedance source on the emitted CSR.

MOP28 **Improvements in Longitudinal Phase Space Tomography at PITZ**

N. Aftab, *Z. Aboulbanine, G.D. Adhikari, P. Boonpornprasert, M.E. Castro Carballo, G.Z. Georgiev, J. Good, M. Groß, A. Hoffmann, C. Koschitzki, M. Krasilnikov, X.-K. Li, O. Lishilin, A. Lueangaramwong, D. Melkumyan, R. Niemczyk, A. Oppelt, H.J. Qian, F. Stephan, G. Vashchenko, T. Weilbach (DESY Zeuthen) W. Hillert (University of Hamburg, Institut für Experimentalphysik)*

The Photo Injector Test facility at DESY in Zeuthen (PITZ) was established as a test stand of electron sources for the European XFEL and FLASH. It allows methodological studies of electron-beam phase-space characterization techniques in parallel to simulations and analytical modelling. In order to improve the existing longitudinal phase space (LPS) tomographic reconstruction technique, some core concerns have been addressed e.g. booster phase scan range, momentum resolution and space-charge effects. An analytical model was developed to quantify momentum, rms energy spread, bunch length and phase advance. Phase advance analysis determined the booster phase range and step size to be used for obtaining the momentum projections. The signal resolution of these projections was improved by a careful beta function control at the reference screen of the momentum measurements. To cater the noisy artifacts that are inherent in tomography, an initial scientific presumption of LPS from low energy section momentum measurements was established. This paper will highlight the improvements made in LPS tomography and compare the simulated and experimental results.

MOP29 **Low Gain Avalanche Detector Application for Beam Monitoring**

V. Kedych, *T. Galatyuk, W. Krueger, A. Rost (TU Darmstadt) T. Galatyuk, S. Linev, J. Pietraszko, C.J. Schmidt, M. Träger, M. Traxler, F. Ulrich-Pur (GSI) J. Michel (Goethe Universität Frankfurt) A. Rost (FAIR) V. Svintozelskyi (Taras Shevchenko National University of Kyiv)*

The S-DALINAC is a superconductive linear electron accelerator operating at 3 GHz and allows operation in energy recovery mode (ERL). For the operation in the ERL mode accelerated and decelerated beams travel inside the same beamline but not necessarily share the same orbit. That leads to a bunch rate of 6 GHz. Non-destructive monitoring tools that allow optimization of acceleration and deceleration processes and achieve high recovery efficiency are important for operation in the ERL mode. The Low Gain Avalanche Detector (LGAD) is a silicon detector with internal gain layer optimized for 4-D tracking with timing resolution below 50 ps which makes it a promising candidate for beam time structure monitoring. In this contribution we present the status of the first proof of principle beam time structure measurement with LGAD sensors at S-DALINAC in normal operation mode together with future activities overview.

MOP31 **Automatic Adjustment and Measurement of the Electron Beam Current at the Metrology Light Source (MLS)**

Y. Petenev, *J. Feikes, J. Li (HZB) A.B. Barboutis, R. Klein, M. Müller (PTB)*

The electron storage ring MLS (Metrology Light Source) is used by the Physikalisch-Technische Bundesanstalt (PTB), the German metrology institute, as a primary source standard of calculable synchrotron radiation in the ultraviolet and vacuum ultraviolet spectral range. For this, all storage ring parameters have to be appropriately set and measured with high uncertainty. E.g., the electron beam current can be varied by more than 11 orders. This adjustment of the electron beam current, and thus the spectral radiant intensity of the synchrotron radiation, for the specific calibration task is conveniently performed fully automatic by a computer program.

MOP32 **Analog Front End for Measuring 1 to 250 pC Bunch Charge at CLARA**

S.L. Mathisen, *T.H. Pacey, R.J. Smith (STFC/DL/ASTeC)*

As part of the development of the CLARA electron accelerator at Daresbury Laboratory, a new analog front end for bunch charge measurement has been developed to provide accurate measurements across a wide range of operating charges with a repetition rate of up to 400 Hz. The qualification tests of the front end are presented. These include tests of the online calibration system, compared to a bench Faraday cup test setup; online beam test data with a Faraday cup from 1 to 200 pC; online beam test data with a wall current monitor from 1 to 200 pC, and tests using signal processing such as singular value decomposition. This is demonstrated to enable the measurement of bunch charges as low as 100 fC using both Faraday Cups and Wall Current Monitors.

MOP33 **Beam Current Measurements at the Nano-Ampere Level Using a Current Transformer**

M. Xiao *(UMCG) S. Brandenburg, M.J. Goethem (PARTREC) T. Delaviere, L. Dupuy, F. Stulle (BERGOZ Instrumentation)*

In conventional proton therapy (PT) typical beam currents are of the order of 1 nA. At these currents dose monitoring is reliably achieved with an ionization chamber. However, at the very high dose rates used in FLASH irradiations (employing beam currents >100 nA) ionization chambers will exhibit large intensity dependent recombination effects and cannot be used. A possible solution is a current transformer. Here we report on the performance of the LC-CWCT (Bergoz Instrumentation, France) which has been developed to push noise floor of such non-destructive current measurement systems into the nano-ampere range. We present first beam current measurements at the PARTREC cyclotron (Netherlands). Beam currents measured by the LC-CWCT and a Faraday Cup were shown to linearly correlate up to the maximum intensity of 400 nA used in the measurements. For pulsed beams, charge measured by the LC-CWCT linearly correlated with pulse length over the measurement range from 50 to 1000 µs. Measurement noise as low as 2.8 nA was achieved. The results confirm that the LC-CWCT has the potential to be applied in FLASH PT for accurate determination of beam current and macro pulse charge.

MOP34 **New X-Rays Diagnostics at ESRF: The X-BPMs, the Halo-Monitor and the Energy-Monitor**

E. Buratin, *K.B. Scheidt (ESRF)*

Several new X-ray diagnostics have been installed in the Front-Ends of the Storage Ring of the ESRF's Extremely Brilliant Source (EBS) recently. Two independent optical X-BPMs at 23m distance from their bending magnet source-point are giving extremely useful additional information on the vertical beam stability in comparison to the e-BPMs data. A vertical beam Halo-monitor allows to measure permanently and quantitatively the level the electron density at large distance (1-3 mm) from the beam core, in a non-destructive manner. Additionally, an Energy-monitor is planned for installation in August to use the very hard part of the X-ray spectrum, to measure small variations of the 6GeV electron beam, and thus to measure with a simple method the momentum compaction factor of our Ring.

MOP35 **New Measurements Using Libera-Spark Electronics at ESRF: The High Quality Phase-Monitor and the Single-Electron**

E. Buratin, *K.B. Scheidt (ESRF)*

Several new diagnostics have been installed and exploited at the ESRF's new Extremely Brilliant Source (EBS) in 2022. A Libera-Spark BPM device has been implemented to measure the phase of Booster and EBS rings, with high resolution and up to turn-by-turn rate. In the Storage Ring we achieved irrefutably the control, injection and measurement of single electron(s) with the use of transfer-line screens, the visible-light extraction system and a low-cost photo-multiplier tube, combined with the commercial Spark Beam Loss Monitor. Further planned developments, like the TCPC technique, on this are on-going and will be essential to verify that our Booster cleaning process reaches a level of zero-electron bunch pollution in EBS.

MOP36 **Novel Beam Excitation System Based on Software-Defined Radio**

P.J. Niedermayer, *R. Singh (GSI)*

A signal generator for transverse excitation of stored particle beams is developed and commissioned at GSI SIS-18. Thereby a novel approach using a software-defined radio system and the open-source GNU Radio ecosystem is taken. This allows for a low cost yet highly flexible setup for creating customizable and tuneable excitation spectra, which - due to its open-source nature - has the potential for long term maintainability and integrability into the accelerator environment. Furthermore, this opens up the possibility to easily share waveform generation algorithms across accelerator facilities. As a first application, the device is used to control the coherence and amplitude of transverse oscillations by excitation in the vicinity of betatron sidebands. It enables measurement of beam parameters like tune and chromaticity. On a longer term, it will be used for more complex tasks such as beam shaping, extraction and automated parameter scans towards these complex processes.

MOP37 **Beam Polarization Measurements with the revised Compton Polarimeter at ELSA**

***M.T. Switka**, K. Desch, R. Koop (ELSA)*

The Compton Polarimeter at the ELSA storage ring has been designed to measure the polarization degree of the stored electron beam by analyzing the profile of the back-scattered gamma-beam with a silicon microstrip detector. Due to a scattering asymmetry from interaction with circularly polarized laser light, the electron beam polarization is determined from the vertical shift of the gamma-beam's center of gravity in respect to the handedness of the laser light. The installation of a new laser source and silicon strip detector has improved the polarimeter's performance significantly. Additionally, the profile analysis could be enhanced by using a Pearson type VII peak function fit. The analyzing power was determined through the observation of the Sokolov-Ternov effect and a statistical measurement accuracy of 2 % could be obtained within 5 minutes of measurement time. The polarimeter resolves the expected spin dynamical effects occurring in the storage ring and has shown to be a robust and reliable measurement system for operation with the GaAs source for polarized electrons.

MOP38 **Beam Profile Monitoring and Distributed Analysis Using the Rabbit MQ Message Broker**

***D. Proft**, K. Desch, D. Elsner, S. Kronenberg, A. Spreitzer, M.T. Switka (ELSA)*

The ELSA facility utilizes several digital cameras for beam profile measurements on chromox, transition radiation screens and synchrotron radiation monitors. Currently, a multitude of digital cameras with analogue signal output are being replaced in favour of PoE-capable ethernet cameras. The increased network traffic for streaming, analyzing and distribution of processed data to the control system and machine operators is managed through an additional camera network in which distributed computing is performed on top of the Rabbit MQ message broker. This allows performant and platform-independent image acquisition for multiple cameras, real time profile analysis and supports programming interfaces for C++ and Python. The setup, performance and scalability of the implementation are presented.

MOP39 **Development of Compact Radio Frequency Sources**

***M.S. McCallum**, A. Lyapin (JAI)*

Our group is developing a family of compact radio frequency sources aiming to cover 50 MHz to 20 GHz with several models. The primary goal is to provide an alternative to using expensive laboratory generators in permanent installations. In addition, we work towards providing a higher specification than similar telecommunications devices as this is a typical requirement in accelerator instrumentation. We take a minimalistic approach with only a network interface planned, assuming that such a device operates remotely in a large facility. An EPICS interface is in the works for monitoring and control. In this paper, we present the results of rapid prototyping with XMicrowave components. The first measurements show encouraging phase noise performance and spectral purity.

MOP40 **Synchronous Data System at the European Spallation Source**

R. Titmarsh *(STFC/RAL/ISIS) J.F. Esteban Müller, J.P.S. Martins (ESS)*

The Synchronous Data Service (SDS) is a tool to monitor and capture events in the European Spallation Source, building on top of the EPICS control system. Large amounts of data from different input output controllers are acquired and synchronised at the level of beam pulses. The acquisition can be triggered by beam events though the timing system or manually by a user. Captured data is stored in standardised NeXus files and indexed in a database for easy searching and retrieval.

MOP42 **KINGFISHER: A Framework for Fast Machine Learning Inference for Autonomous Accelerator Systems**

L. Scomparin*, E. Blomley, E. Bründermann, M. Caselle, T. Dritschler, A. Kopmann, A.-S. Müller, A. Santamaria Garcia, P. Schreiber, J.L. Steinmann, M. Weber (KIT) T. Boltz (SLAC)*

Modern particle accelerator facilities allow new and exciting beam properties and operation modes. Traditional real-time control systems, albeit powerful, have bandwidth and latency constraints that limit the range of operating conditions currently made available to users. The capability of Reinforcement Learning to realize self-learning control policies by interacting with the accelerator is intriguing. The extreme dynamic conditions require fast real-time components throughout the whole control loop from the diagnostic, with novel and intelligent detector systems, all the way to the interaction with the machine. In this talk, the novel KINGFISHER framework based on the modern Xilinx Versal devices will be presented. Versal combines several computational engines, specifically combining powerful FPGA logic with programmable AI Engines in a single device. Another key characteristic of this system is the native integration with the fastest beam diagnostic tools already available, i.e. KAPTURE and KALYPSO. In this contribution, the recent beam test and preliminary results aiming to control the microbunching instability at KARA at KIT will be presented.

MOP43 **Web-Based Calculator for Cable Simulation Models**

M.C. Paniccia, *S.L. Clark, D.M. Gassner, R.L. Hulsart, R.J. Michnoff, P. Thieberger (BNL)*

Attenuation in a lossy coaxial cable increases over distance and varies over frequency. Having a model of these variations can help predict the expected loss and distortion of a signal. This paper discusses a free web-based application developed to provide accurate SPICE models for various coaxial cable types. The user can specify a length and select between different cable types, or upload their own cable attenuation curve, and receive a SPICE model for that cable. These simulation models have been used to assist the design and development of new instrumentation systems for the future Electron Ion Collider (EIC).

MOP44 **Novel Photoemission Type XBPM for the 'white' Undulator Radiation**

P. Ilinski *(MAX IV Laboratory, Lund University)*

A concept of novel Photoemission type XBPM for "white" undulator radiation will be described. The modeling was performed for the MAX IV CoSAXS undulator. This concept do not have deficiencies of the Photoemission Blade type of XBPM, currently widely used at the Synchrotron Radiation Facilities. This type of XBPM will be installed and tested at the MAX IV.

12-Sep-22 16:30 – 18:00	Pleanry

MO3 — Monday Session 3

Chair: U. Iriso (ALBA-CELLS Synchrotron)

MO3I1 **Review of BPM Drift Effects and Compensation Schemes**

16:30 30 ***G. Rehm*** *(HZB)*

Apart from short term BPM resolution (repeatability), which aims at a few nm / sqrt(Hz) in modern systems, medium to long-term drift over durations of seconds to weeks (reproducibility) represents one of the challenges for BPM electronic developments. A number of approaches and compensation schemes have been developed and tested during the past years (e.g. cross-bar switching, pilot tone compensation, active temperature stabilization etc.) and experience has been gathered with environmental effects on electronics, cables and connectors. This talk will provide a review of drift effects and mitigation schemes for the next generation BPM systems.

MO3C2 **Diamond-II Electron Beam Position Monitor Development**

17:00 20 ***L.T. Stant****, M.G. Abbott, L. Bobb, G. Cook, L. Hudson, E.P.J. Perez Juarez, A.J. Rose, A. Tipper (DLS)*

The UK national synchrotron facility, Diamond Light Source, is preparing for a major upgrade to the accelerator complex. Improved beam stability requirements necessitate the fast orbit feedback system be driven from beam position monitors with lower noise and drift performance than the existing solution. Short-term beam motion must be less than 2 nm/sqrt(Hz) over a period of one second with a data rate of 100 kHz, and long-term peak-to-peak beam motion must be less than 1 µm. A new beam position monitor is under development which utilises the pilot-tone correction method to reduce front-end and cabling perturbations to the button signal; and a MicroTCA platform for digital signal processing to provide the required data streams. This paper discusses the challenges faced during the design of the new system, presents experimental results from testing on the existing machine, and offers some ideas to improve the effectiveness of similar implementations.

MO3C3 17:20 20 **Pulse-by-Pulse Photon Beam Position Measurements at the SPring-8 Undulator Beamline**

H. Aoyagi, *T. Fujita, K. Kobayashi, H. Osawa, S. Takahashi (JASRI/SPring-8)*

This study analyzes a pulse-mode x-ray beam position monitor that enables pulse-by-pulse position measurement in a synchrotron radiation beamline of the synchrotron radiation facility, SPring-8. The monitor is equipped with blade-shaped detection elements utilizing diamond heatsinks to reduce stray capacitance and a microstripline transmission line to improve high-frequency characteristics. The detection elements operate as photocathodes and generate single unipolar pulses with a full width at half-maximum of less than 1 ns, allowing pulse-by-pulse measurement of the synchrotron radiation beam. We confirmed the basic operation of the monitor at the SPring-8 bending magnet beamline. The detection element's heat resistance consequently improved. An evaluation test was carried out at the SPring-8 undulator beamline with significantly high synchrotron radiation intensity. We aim to report the evaluation results of the sensitivity and resolution of the monitor measured by exciting a betatron oscillation in the horizontal/vertical direction using beam shakers of the SPring-8 storage ring and the observation results of the pulse-by-pulse photon beam dynamics induced by beam injection.

MO3C4 17:40 20 **Beam Position Monitoring of Multi-bunch Electron Beams at the FLASH Free Electron Laser**

N. Baboi, *B. Lorbeer (DESY)*

The superconducting FLASH user facility (Free electron LASer in Hamburg) accelerates 10 electron pulses per second, which are used to produce high brilliance XUV and soft X-ray pulses or for laser-plasma acceleration studies. Each pulse usually contains up to 600 electron bunches with a typical charge between 100 pC and 1 nC and a minimum bunch spacing of 1 us. Various types of beam position monitors (BPM) are built in the three electron beam lines, most of them being able to measure each bunch with a resolution of 10-100 um rms. This paper presents multi-bunch position measurements for various types of BPMs and built in at various locations.

13-Sep-22 09:00 – 10:30	Pleanry

TU1 — Tuesday Session 1

Chair: N. Hubert (SOLEIL)

TU1I1 09:00 30 **Electro-Optical BPM Development for High Luminosity LHC**

***S.M. Gibson**, A. Arteche (Royal Holloway, University of London)*

An Electro-Optical Beam Position Monitor (EO-BPM) is under development as a high-frequency (6 GHz-10 GHz) diagnostic for crabbing and Heat-Tail intra-bunch detection at the HiLumi Large Hadron Collider (HiLumi LHC). Following up on an initial prototyping phase at the SPS, an upgraded version of the EO-BPM has been installed at the HiRadMat facility for validation and characterisation studies. The new design showed significantly enhanced optical modulation signals of single-shot SPS bunches acquired at 3 GHz bandwidth. Also, a transverse resolution test was successfully performed within a ±20 mm range, which constitutes the first fully optically interferometric position measurement ever obtained. The outcome of this campaign delivered promising results toward the installation of the first operative system in the SPS in late 2022.

TU1I2 09:30 30 **Diagnostics with Quadrupole Pick-Ups**

***A. Oeftiger** (GSI)*

The beam quadrupole moment of stored beams can be measured with a four plate quadrupole pick-up. The frequency spectrum of the quadrupole moment contains not only the usual first-order dipole modes (the betatron tunes) but also the second-order coherent modes, comprising of (1.) (even) normal envelope modes, (2.) odd (skew) envelope modes and (3.) dispersion modes. As a novel diagnostic tool, the measured frequencies and amplitudes provide direct access to transverse space charge strength (through the tune shift) as well as linear coupling (and mismatch thereof), at the benefit of a non-invasive beam-based measurement. Technically, quadrupole moment measurements require a pick-up with non-linear positions sensitivity function. We discuss recent developments and depict measurements at the GSI SIS18 heavy-ion synchrotron.

TU1C3 10:00 20 **Beam-Based Calibration of Sextupole Magnet Displacement with Betatron Tune Shift**

S. Takano, *T. Fujita, K. Fukami, H. Maesaka, M. Masaki, K. Soutome, M. Takao, T. Watanabe (JASRI) K. Fukami, T. Hiraiwa, H. Maesaka, K. Soutome,* ***S. Takano***, *H. Tanaka, T. Watanabe (RIKEN SPring-8 Center) K. Ueshima (QST)*

The alignment of sextupole magnets is one of the critical issues for the upcoming 4th generation light sources and future colliders. The alignment error of magnets and the beam offsets in sextupoles should be within a few 10 μm rms to ensure enough dynamic aperture for stable operation and minimize deterioration of beam quality. Considering that the quadrupole field in a sextupole is proportional to the displacement (normal Q for horizontal and skew Q for vertical), we propose a beam-based calibration (BBC) method to measure the sextupole centers by observing the betatron tune shift. The magnetic center is the point where the tune does not change regardless of the sextupole field strength. The key is increasing the XY coupling to obtain a tune shift large enough for the vertical calibration. We studied experimentally the feasibility of the sextupole BBC at SPring-8 and successfully demonstrated the principle for both horizontal and vertical calibration. The tune shift was monitored by bunch-by-bunch feedback electronics with approximately 10^{-5} resolution. The measurement resolution of the sextupole center was approximately 10 μm std., which was sufficient for our requirement.

13 Sep – Tue

13-Sep-22 11:00 – 13:00	Pleanry

TU2 — Tuesday Session 2

Chair: K. Wittenburg (DESY)

13 Sep – Tue

TU2T1 11:00 50 **Collimation and Machine Protection for Low Emittance Rings**

***J.C. Dooling**, M. Borland, Y. Lee, N. Sereno (ANL)*

The reduced emittance and concomitant increase in electron beam intensity in Fourth Generation Storage Ring (4GSR) light sources lead to the challenging machine protection problem of how to safely dispose of the circulating charge during unplanned whole-beam loss events. Two recent experiments conducted to study the effects of 4GSR whole-beam dumps showed that damage to candidate collimator materials can be severe. This is a paradigm shift for SR light source machine protection. Typically the biggest threat to the machine is from CW synchrotron radiation. The choice of collimator material is important. High-Z, high-density materials such as tungsten may appear effective for stopping the beam in static simulations; however, in reality, short radiation lengths will cause severe destructive hydrodynamic effects. In our experiments, significant damage was observed even in low-Z aluminum. Thus unplanned, whole-beam dumps cannot be stopped in a single collimator structure. In this tutorial, alternatives such as multiple collimators and fan-out abort kicker systems will be discussed. Collimator design strategy and foreseen diagnostics for their operation will also be presented.

TU2C2 11:50 20 **The Diamond Beam Loss Monitoring System at CERN LHC and SPS**

***E. Calvo Giraldo**, E. Effinger, M. Gonzalez Berges, J. Martínez Samblas, S. Morales Vigo, B. Salvachúa, C. Zamantzas (CERN) J. Kral (DESY)*

The LHC and SPS accelerators have been equipped with 16 pCVD Diamond based Beam Loss Monitors (dBLM) detectors at strategical locations where their nanosecond resolution could provide insights on the loss mechanisms and complement the information of the standard ionization chamber type detectors. They are used on the injection and extraction lines of LHC and SPS, to analyse the injection or extraction efficiency, and to verify the timing alignment of other elements like kicker magnets. They are used in the betatron collimation regions and are being also explored as detectors to analyse slow extractions. The acquisition chain was fully renovated during the LHC second long shutdown period to provide higher resolution measurements, real-time data processing and data reduction at the source as well as integrate seamlessly to the controls infrastructure. This paper presents the new hardware platform, the different acquisition modes implemented, the system capabilities and initial results obtained during the commissioning and operation at the beginning of the LHC's Run 3.

TU2C3 12:10 20 **Commissioning Beam-Loss Monitors for the Superconducting Upgrade to LCLS**

***A.S. Fisher**, G.W. Brown, E.P. Chin, C.I. Clarke, B.T. Jacobson, R.A. Kadyrov, J.A. Mock, J. Park, E. Rodriguez, M. Rowen, M. Santana-Leitner, L. Sapozhnikov, J.J. Welch (SLAC)*

Commissioning of the 4-GeV, 120-kW superconducting linac, an upgrade to the LCLS x-ray FEL at SLAC, began in March 2022 with the injector and with RF processing of cryomodules. In stages, the beam will accelerate along the full linac, pass through the bypass transport line above the normal-conducting LCLS linac, to the new high-power dump at the muon shield wall. The first beam through the undulators is expected by the end of 2022, initially well below the full 1-MHz beam rate. A new system of beam-loss detectors provides radiation protection, machine protection, and diagnostics. Radiation-hard optical fibers span the full 4 km from the electron gun to the undulators and beam dump. Diamond detectors cover anticipated loss points. These replace the ionization chambers previously used with the copper linac, due to concern about ion pile-up at high loss rates. Signals from the new detectors, integrated with a 500-ms time constant, are compared to the allowed loss threshold. If crossed, the beam is halted within 0.2 ms. We will report on commissioning of this system and on the detection of losses of both photocurrent and of dark current from the gun and cryogenic cavities.

TU2I4 12:30 30 **Acceleration, Transport and Diagnostic of Protons from Laser-Matter Interaction**

***G. Petringa**, G.A.P. Cirrone (INFN/LNS)*

Laser-generated radiation represent one of the frontiers of the acceleration techniques. When a TW level, fs duration laser is focused in small spot size, the radiation pressure triggers physics processes able to accelerate ions with intensities of the order of E9-E11 particles/steradians. Laser driven ion acceleration has several applications. The development of laser-accelerated proton irradiation systems was proposed by many research group. The Czech pillar of ELI site, includes the 'ELIMED' beamline, devoted to exploring medical applications of laser-driven proton beams. Radioisotope production is another potential medical application, but many other are of interest such as high-resolution proton radiography, nuclear reactions and the development of laser-driven high-brightness injectors. All these applications require the detectors and diagnostic systems able to detect these high intense beams. In this talk an overview on the last approaches of laser-driven ion acceleration and diagnostic will be presented. Advanced solutions on detectors development will be presented with a critical discussion on the current limitations and potential future achievable progresses.

TUP — Tuesday Poster Session

TUP01 **Commissioning of the Libera Beam Loss Monitoring System at SPEAR3**

***K. Tian**, S. Condamoor, W.J. Corbett, J.J. Sebek, F. Toufexis (SLAC)*

SPEAR3 is a third generation synchrotron radiation light source, which operates approximately 9 months each year with a very high reliability. The beam loss monitoring system in the storage ring has recently been upgrade to the modern Libera system from the original legacy hardware. During the initial stage of the new beam loss monitoring system deployment, it was proved to be useful for a new lattice commissioning at SPEAR3. In this paper, we will report the progress in the Libera system commissioning at SPEAR3 and present some first results.

TUP02 **Design of High Dynamic Range Preamplifiers for a Diamond-Based Radiation Monitor System**

***M. Marich**, S. Carrato (University of Trieste) L. Bosisio, A. Gabrielli, Y. Jin, L. Lanceri (INFN-Trieste) G. Cautero, D. Giuressi (Elettra-Sincrotrone Trieste S.C.p.A.) L. Vitale (Università degli Studi di Trieste)*

Regardless of the different accelerator types (light sources like FELs or synchrotrons, high energy colliders), diagnostics is an essential element for both personnel and machine protection. With each update, accelerators become more complex and require an appropriate diagnostic system capable of satisfying multiple specifications, that become more stringent as complexity increases. This paper presents prototyping work towards a possible update of the readout electronics of a system based on single-crystal chemical vapor deposition (scCVD) diamond sensors, monitoring the radiation dose-rates in the interaction region of SuperKEKB, an asymmetric-energy electron-positron collider. The present readout units digitize the output signals from the radiation monitors, process them using an FPGA, and alert the accelerator control system if the radiation reaches excessive levels. The proposed updated version introduces a new design for the analog front end that overcomes its predecessor's limits in dynamic range thanks to high-speed switches to introduce a variable gain in transimpedance preamplifiers, controlled by an ad-hoc developed FPGA firmware.

TUP03 **The Beam Loss Monitoring System after the LHC Long Shutdown 2 at CERN**

***M. Saccani**, E. Effinger, W. Viganò, C. Zamantzas (CERN)*

Most of the LHC systems at CERN were updated during the Long Shutdown 2 from 2018 to 2022 to prepare the accelerator for High-Luminosity the Beam Loss Monitoring (BLM) system is a key part of the LHC's instrumentation for machine protection and beam optimisation by producing continuous and reliable measurements of beam loss along the accelerator while ensuring safe operation. The updated BLM system in the LHC aims to offer remote reset capabilities for the tunnel

electronics, to provide better gateware portability to future evolution and to significantly improve the data rate in the backend processing and the software efficiency. We will first review the main changes on all parts of the BLM system during LS2 before focusing on the commissioning phase of the LHC's Run 3.

TUP04 **Beam Loss Monitor for Polish Free Electron Laser (PolFEL): Design and Tests**

R. Kwiatkowski, *R. Nietubyc, J. Szewiński, D.R. Zaloga (NCBJ) A.I. Wawrzyniak (NSRC SOLARIS)*

The Beam Loss Monitor (BLM) system is primarily used for machine protection and is especially important in the case of high energy density of accelerated beam, when such a beam could cause serious damages due to uncontrolled loss. PolFEL linear accelerator is designed with the beam parameters, which made BLM an essential system for machine protection. The design of BLM system for PolFEL is composed of several scintillation probes placed along and around the accelerator. The paper reports on design and first tests of prototype detector, which is planned to be used for PolFEL project. The prototype was tested in NCBJ and SOLARIS, using radioactive calibration samples and linear electron accelerator as a sources. We also present results of numerical investigation of radiation generated due to interaction of fast electrons with accelerator components.

TUP05 **Experience with MPS at PIP2IT**

A. Warner, *M.R. Austin, L.R. Carmichael, J.-P. Carneiro, B.M. Hanna, E.R. Harms, M.A. Ibrahim, R. Neswold, L.R. Prost, R.A. Rivera, A.V. Shemyakin, J.Y. Wu (Fermilab)*

The PIP2IT accelerator was assembled in multiple stages in 2014 ' 2021 to test concepts and components of the future PIP-II linac that is being constructed at Fermilab. In its final configuration, PIP2IT accelerated a 0.55 ms x 20 Hz x 2 mA H^- beam to 16 MeV. To protect elements of the beam line, a Machine Protection System (MPS) was implemented and commissioned. The beam was interrupted faster than 10 µs when excessive beam loss was detected. The paper describes the MPS architecture, methods of the loss detection, procedure of the beam interruption, and operational experience at PIP2IT.

TUP06 **Design and Simulation of Button Bpm for the Low Energy Storage Rings for Fourth Generration Light Sources**

Z.Q. Luo, *Z. Liu (HUST)*

Compared to 3rd-generation light sources, 4th-generation SR light sources improve the brightness by reducing the emittance of the electron beam. To ensure the extremely low emittance of electron beams, it is necessary to provide more accurate beam position measurement. Based on the BPM of the 3rd generation light source (SSRF), the design of button BPM for a diffraction-limited storage ring in the low-energy region of the 4th-generation light source is presented in this paper. Here we have focused on optimizing the BPM in terms of the basic

structure sizes, the wakefield caused by electron beam transport and the voltage signals picked up by the electrodes, etc. The optimization improves the measurement resolution of BPM together with matching the requirements of beam position measurement proposed by the low energy storage ring.

TUP08 **Progress on the Development of the EIC Hadron Storage Ring BPM Button Pickup**

D.M. Gassner, *R.L. Hulsart, C. Liu, R.J. Michnoff, M.C. Paniccia, V. Ptitsyn, P. Thieberger (BNL) J.R. Bellon, A. Blednykh, C. Hetzel (Brookhaven National Laboratory (BNL), Electron-Ion Collider)*

A new high-luminosity Electron Ion Collider (EIC) is being designed at Brookhaven National Laboratory (BNL). The Hadron Storage Ring (HSR) is planned to operate up to 275 GeV and with a variety of ion species including polarized protons, with an average current of up to 1 Amp, 1160 bunches, with 6 cm RMS bunch lengths. It is necessary to operate the HSR with relatively large radial offsets (up to ± 20 mm in a 32 mm radius aperture) during store in order to match the revolution frequency of the electrons in the Electron Storage Ring (up to 18 GeV) over a range of hadron beam energies. These beam parameters and operating modes present a challenge with regards to the cryogenic BPM pick-up design to ensure the impedance, wakefields, beam induced heating, fabrication feasibility and measurement capability can meet the performance requirements. The preliminary design progress and simulation results will be presented.

TUP09 **Beam Position Monitor for SOLEIL Upgrade**

M. El Ajjouri, *F. Alves, A. Gamelin, N. Hubert (SOLEIL)*

The Beam Position Monitors for the SOLEIL low emittance upgrade project are in the design phase. Efforts are put on the minimization of the heat load on the button by optimizing the longitudinal impedance and the BPM materials. To validate the mechanical design and tolerances a first prototype has been manufactured and controlled. This paper presents the mechanical design of the BPM, the metrology of the prototype and the lessons learned from this prototyping phase.

TUP10 **Development of a New Measurement System for Beam Position Pickups in the LINAC and Beam Energy Measurement (Time of Flight) in the MEBT for Medaustron**

M. Repovž, *M. Cerv, C. Kurfürst, G. Muyan, S. Myalski, A. Pozenel, C. Schmitzer, M. Wolf (EBG MedAustron) A. Bardorfer, B. Baričevič, P. Paglovec, M. Škabar (I-Tech)*

The MedAustron Ion Therapy Centre is a synchrotron-based particle therapy facility which delivers proton and carbon beams for clinical treatment. Currently, the facility treats roughly 40 patients per day and is improving its systems and workflows to further increase this number. MedAustron was commissioned and is operational without fully integrated systems for measurements of 'time of flight' (beam energy) in the

MEBT and beam position in the LINAC. This paper presents the newly developed system for these use cases, which will improve the overall commissioning and QA accuracy. It will unify the hardware used for the cavity regulation in the injector LLRF and the synchrotron LLRF. It will also be used for SYNC pickups, Schottky monitors and RF knock-out exciter. The new system is based on the CotS MicroTCA platform, which is controlled by the MedAustron Control System based on NI-PXIe. Currently it supports fiber-optic links (SFP+), but other links (e.g. EPICS, DOOCS) can be established. The modular implementation allows for connections to other components, such as motors, amplifiers, or interlock systems and will increase the robustness and maintainability of the accelerator.

TUP11 **A Cryogenic RF Cavity BPM for the Superconducting Undulator at LCLS**

***C.D. Nantista**, A.A. Haase, P. Krejcik (SLAC)*

The new superconducting undulator beamline at LCLS requires the BPMs to be operated at cryogenic temperatures alongside the undulator magnets. They are used for beam-based alignment of the undulator magnets and quadrupole and require submicron resolution to achieve good FEL performance. This is to be achieved with X-band RF cavity BPMs, as is done now on the permanent undulator beamline. However, operating the cavities at cryogenic temperatures introduces significant challenges. We review the changes in RF properties of the cavities that result from cooling and how the design is changed to compensate for this. This includes a novel approach for employing a rectangular cavity with split modes to separately measure the X and Y position without coupling.

TUP12 **First Application of a MPSoC BPM Electronics Platform at SwissFEL**

***B. Keil**, R. Ditter, M. Gloor, G. Marinkovic (PSI)*

PSI has developed a new BPM electronics platform based on a Multi-Processing System-on-Chip (MPSoC). This contribution introduces the first application of the platform, which is the cavity BPM system for the SwissFEL Athos soft X-ray undulator beamline, where a larger number of systems are now operational. Measurement results and differences to the predecessor system will also be presented.

TUP13 **Standard Button BPMs for PETRA IV**

***S. Strokov**, M. Holz, G. Kube, D. Lipka, S. Vilcins (DESY)*

A new diffraction limited light source PETRA IV (DESY, Germany) with ultra-low emittance is currently designed as an upgrade of the 3rd generation light source Petra III. For transverse beam position measurements, beam position monitors (BPMs) will be used as an essential part of the beam diagnostic system. There will be a total of about 800 BPMs distributed around the 2.3 km long storage ring. The inner diameter of the standard beam pipe, and therefore of most of the BPM chambers, will be 20 mm. In addition, elliptical beam pipe before The primary purpose of the systems is to provide high-resolution measurements of the transverse position of the electron beam. By specification, the impact of the mechanical tolerances on the position readings should be below 150 microns which is essential for the commissioning of the machine. To achieve this goal, the dependence of the accuracy of the beam position measurement on the tolerances of each manufactured part of the BPM was studied. This paper summarizes development and optimization of each part of the BPM by using EM simulations performed with CST Microwave Studio.

TUP14 **Transverse Emittance Measurement in Injector of RAON**

E.H. Lim *(Korea University Sejong Campus) Y.S. Chung, G.D. Kim, J.W. Kwon (IBS) E.-S. Kim (KUS)*

It is important to measure the transverse emittance, a beam characteristic for beam dynamics calculation. There are several methods for measuring transverse emittance. The emittance is calculated from the phase space distribution of the beam measured by Allison scanner. Quadrupole scan with wire scanner or multi wire scanner for RAON injector were also performed to compare with these data. RAON injector consists of ECR-IS, LEBT, RFQ, MEBT. Various diagnostic devices such as 8 Wire Scanners and 1 Allison Scanner were installed in beam transport line. Each diagnostic device was driven by PLC and the current was measured with microTCA-based DAQ system. EPICS was used to control the diagnostic system, and each device was driven and measured according to the sequencer module. In this paper, the measurement result of each diagnostic device and result of the emittance measurement on Ar-40 beam are presented.

TUP15 **New gas target design for the HL-LHC Beam Gas Vertex profile monitor**

H. Guerin*, R. De Maria, R. Kersevan, B. Kolbinger, T. Lefèvre, M.T. Ramos Garcia, B. Salvant, G. Schneider, J.W. Storey, R. Veness (CERN) S.M. Gibson,* ***H. Guerin*** *(Royal Holloway, University of London)*

The Beam Gas Vertex (BGV) instrument is a novel non-invasive transverse beam profile monitor under development for the High Luminosity Upgrade of the Large Hadron Collider (HL-LHC). Its principle is based on the reconstruction of the tracks and vertices issued from beam-gas inelastic hadronic interactions. The instrument is currently in the design phase, and will consist of a gas target, forward tracking detectors installed outside the beam vacuum chamber and computing resources dedicated to event reconstruction. The beam profile image will then be inferred from the spatial distribution of the reconstructed vertices. With this method, the BGV should be able to provide bunch-by-bunch measurement of the beam size, together with a beam profile image throughout the whole LHC energy cycle, and independently of the beam intensity. This contribution describes the design of the gas target system and of the gas tank of the future instrument.

TUP16 **FOCUS: Fast Monte-CarlO Approach to Coherence of Undulator Sources**

M. Siano *(Università degli Studi di Milano) D. Butti, T. Lefèvre, S. Mazzoni, G. Trad (CERN) G. Geloni (EuXFEL) U. Iriso, A.A. Nosych, L. Torino (ALBA-CELLS Synchrotron) B. Paroli, M.A.C. Potenza (Universita' degli Studi di Milano & INFN)*

"Fast Monte-CarlO approach to Coherence of Undulator Sources" (FOCUS) is a new GPU-based code to compute the transverse coherence of X-ray radiation from undulator sources. The code relies on scaled dimensionless quantities and analytic expressions of the electric field emitted by electrons in an undulator, obtained in the frequency domain under paraxial approximation (justified by the assumption of ultra-relativistic electrons) and free space propagation, with the addition of the resonance approximation. We describe the core structure of the code, which exploits GPUs for massively parallel computations. We validate our approach by direct comparison with SRW (Synchrotron Radiation Workshop) simulations. The benchmarks prove that FOCUS yields similar results with respect to SRW, while at the same time reducing the computation times by five orders of magnitude. Finally, we show examples of applications to beam size diagnostics. The aim of the code is to fast evaluating the transverse coherence properties of undulator X-ray radiation as a function of the electron beam parameters, and to support and help preparing more rigorous numerical simulations with traditional codes like SRW.

TUP17 **HL-LHC Beam Gas Fluorescence Studies for Transverse Profile Measurement**

O. Sedláček*, M. Ady, S. Mazzoni, G. Schneider, K. Sidorowski, R. Veness (CERN) P. Forck, S. Udrea (GSI)* ***O. Sedláček****, O. Stringer, C.P. Welsch, H.D. Zhang (The University of Liverpool)* ***O. Sedláček****, O. Stringer, C.P. Welsch, H.D. Zhang (Cockcroft Institute)*

For the gas jet monitor, a supersonic gas curtain traversing a beam is injected to image the proton beam transverse profile. The monitor exploits fluorescence induced by beam-gas interaction as an observable, allowing it to be a minimally invasive profile measurement. This monitor will be installed as part of the High Luminosity LHC upgrade at CERN inside the Hollow Electron Lens. Before the installation of the gas jet monitor, measurements of proton-neon and nitrogen photon yield horizontal profile of LHC beam at 450GeV and 6.8 TeV (LHC injection and flat top) energies will be performed. In these measurements, neon, or alternatively nitrogen gas will be injected into the LHC vacuum pipe by a regulated gas valve to create an extended pressure bump and fluorescence photons will be measured. This work presents the camera module instalment at the LHC prepared for the measurements of the photon yield and LHC horizontal beam profile. Measurements of camera module visibility function are presented as well as preliminary measurements of possible background at the LHC.

TUP18 **Spot-Size Retrieval of Low-Intensity Beams in Plasma-Wakefield Accelerators Using High-Resolution Interferometry**

***J.-G. Hwang**, B. Alberdi-Esuain (HZB)*

Plasma-based accelerators are on the brink of a development stage, where applications of the beam for medical sciences, imaging, or as an injector for a future large-scale accelerator-driven light source become feasible. The requirements on electron beams for injection into a storage-ring light source are very stringent with regard to beam quality and reliability. To meet these needs, we are preparing a device suitable for online, non-destructive monitoring of the transverse spot size of the injected beam. In order to measure lateral beam sizes with a few-um resolution the technique uses the interferometric regime of coherent synchrotron radiation that is enabled by a sub-femtosecond short bunch-length. Using simulations, we demonstrate the precise spot-size retrieval under different beam and experimental conditions. The results of a proof of concept experiment conducted at the IR-beamline of the Metrology Light Source show the potential of the technique at extremely low photon intensities similar to those expected in plasma-acceleration injectors.

TUP19 **Visible Range Polarized Imaging for High Resolution Transverse Beam Size Measurement at SOLEIL**

***M. Labat**, A. Bence, A. Berlioux, B. Capitanio, G. Cauchon, J. Da Silva, N. Hubert, D. Pédeau, M. Thomasset (SOLEIL)*

SOLEIL storage ring is presently equipped with three diagnostics beamlines: two in the X-ray range (pinhole cameras) and one in the visible range. The visible range beamline relies on a slotted copper mirror extracting the synchrotron radiation from one of the ring dipoles. The extracted radiation is then transported down to a dedicated hutch in the experimental hall. Up to now, this radiation was splitted into three branches for rough monitoring of the beam transverse stability, bunch length measurements and filling pattern measurements. In the framework of SOLEIL's upgrade, we now aim at developing a new branch for high resolution beam size measurement using polarized imaging. This work presents the various modifications recently achieved on the beamline to reach this target, including a replacement of the extraction mirror, and the first results of transverse beam size measurement.

TUP20 **Correction for Systematic Errors in Transverse Phase Space Measurements at PITZ**

***C.J. Richard**, Z. Aboulbanine, G.D. Adhikari, N. Aftab, P. Boonpornprasert, G.Z. Georgiev, M. Groß, A. Hoffmann, M. Krasilnikov, X.-K. Li, A. Lueangaramwong, R. Niemczyk, H.J. Qian, F. Stephan, G. Vashchenko, T. Weilbach (DESY Zeuthen)*

The Photo Injector Test Facility at DESY in Zeuthen (PITZ) characterizes and optimizes electron sources for use at FLASH and European XFEL. AT PITZ, the transverse phase space is measured using a single slit scan and scintillator screen method. With the trend in photoinjectors towards lower current and emittance, these measurements become increasingly influenced by systematic errors including camera resolution and scintillator response due to smaller spot sizes. This study investigates the effects and corrections of the systematic errors for phase space measurements at PITZ.

TUP21 **Scintillator Nonproportionality Studies at PITZ**

***A.I. Novokshonov**, G. Kube, S. Strokov (DESY) Z. Aboulbanine, G.D. Adhikari, N. Aftab, P. Boonpornprasert, G.Z. Georgiev, J. Good, M. Groß, C. Koschitzki, M. Krasilnikov, X. Li, O. Lishilin, A. Lueangaramwong, D. Melkumyan, F. Mueller, A. Oppelt, H.J. Qian, F. Stephan, G. Vashchenko, T. Weilbach (DESY Zeuthen)*

A standard technique to measure beam profiles in linear accelerators are screen monitors using scintillating screens. This technique is used e.g. at the European XFEL in order to overcome coherence effects in case of OTR usage. During the XFEL commissioning it was found out that screens based on LYSO:Ce as scintillating material revealed a non-proportional light output. Reason for it is the high particle beam density. As consequence it was decided to exchange LYSO:Ce by GAGG:Ce scintillators because the excitation carriers can rapidly transfer their energy to excited states of gadolinium, and a rapid migration of this energy among the Gd sub-lattice is expected. Driven by the observations at XFEL a series of measurements was started to investigate the properties of various scintillator materials (LYSO:Ce, YAP:Ce, YAG:Ce, LuAG:Ce and GAGG:Ce). The last measurement campaign was carried out at PITZ which allows to operate at higher beam charge and lower electron energy compared to the XFEL. The present work summarizes the results of these measurements.

TUP22 **Linear Approach to Space Charge Calculations Proton Testbeam at KAHVELab (PTAK)**

***G. Unel** (UCI) A. Adiguzel, S. Esen (Istanbul University) H. Cetinkaya (Dumlupinar University, Faculty of Science and Arts) S. Ogur, S. Ogur (CERN) E.V. Ozcan (Bogazici University)*

In Kandilli Detector, Accelerator, and Instrumentation Laboratory, a proton accelerator system is produced using local resources consists of 2 types of ion sources, a low energy beam transfer line (LEBT)and a 1-meter-long RFQ that will operate at 800 MHz. A bespoke Python program calculated the space charge effect created by internal interactions of the beam along the line before entering the RFQ. The results were validated with CERN's TRAVEL program. The growth of the beam with a 1.4 mA current value in the transverse axis due to the effect of space charge has been calculated with a maximum margin of error of 4% for different current and frequency values. Studies using different emittance calculation methods on emittance growth due to space charge dominance continues to be developed. In addition, studies on comparing new methods' findings with outputs of A Space Charge Tracking

Algorithm (ASTRA) and RF-Track Programs are ongoing and aim to finalize by the end of 2023.

TUP23 **Commissioning of the Timing System at ESS**

***N. Milas**, A.A. Gorzawski, J.J. Jamróz (ESS)*

The European Spallation Source (ESS), currently under construction and initial commissioning in Lund, Sweden, will be the brightest spallation neutron source in the world, when its driving proton linac achieves the design power of 5 MW at 2 GeV. Such a high power requires production, efficient acceleration, and almost no-loss transport of a high current beam, thus making design and beam commissioning of this machine challenging. The commissioning runs of 2021 and early 2022 were the first where the master timing system for the linac was fully available. As a consequence of that, the beam actuators and beam monitoring equipment relied fully on timing events sent accross the machine, not only to be triggered to act but also to get the configuration. In this paper, we describe the timing system as available today, present how we define and create the beam pulses using the available parameters. We also present planned future upgrades and other outlook for the system.

TUP25 **Simulation and Measurements of the Fast Faraday Cups at GSI UNILAC**

***R. Singh**, P. Forck, T. Reichert (GSI) S. Klaproth (THM)*

The longitudinal charge profiles of the high intensity heavy ion beam differs significantly in consecutive macro-pulses at the GSI UNILAC. A variation in bunch shape and mean energy also seen within a single macro-pulse. In order to have an accurate determination of these effects, a study of fast Faraday Cup designs is underway at GSI. Simulations comparing the radially coupled co-axial Fast Faraday Cup (FFC) - developed at Fermilab to the conventional axially coupled FFC design is discussed in this contribution. The simulations are performed with CST Particle Studio using protons as impinging particles. The simulation results are compared to the measurements performed with these FFCs at the X2@GSI. The effect on biasing the FFC central electrode on the measured profiles is specially discussed.

TUP26 **Study on Beam Length Measurement Technique Using Highspeed Oscilloscope**

***HS. Wang** (SSRF)*

In order to study the nonlinear beam dynamics in the storage ring, the SSRF BI group developed the software package HOTPCAP, which is used to extract the bunch-by-bunch 3D beam position information from the BPM electrode signal. In order to enhance the function of this software, we studied the beam length extraction method from digitized BPM electrodes signal. By analyzing the signal spectrum distribution for each bunch and each turn and gaussian fitting in frequency domain, bunch length information be extracted. Compared with the traditional longitudinal diagnostic tool streak camera, this method can obtain and store measurement data as long as ten ms while maintaining the time resolution of ps level, which is a powerful diagnostics tool for study of injection transient stage and longitudinal instability. In this paper, the hardware and software architecture of the system and the beam experimental results obtained during the third harmonic cavity commissioning are introduced.

TUP27 **The DEOS Reconstruction Algorithm for Chirped Pulse Electro-Optic Detection: Theoretical Background and Practical Implementation**

***S. Bielawski**, C. Evain, E. Roussel, C. Szwaj (PhLAM/CERLA) C. Gerth, B. Steffen (DESY) B. Jalali (UCLA)*

Recording electric fields evolution with ps or sub-ps resolution is possible using electro-optic (EO) detection based chirped laser pulses. In such setups, the electric field under interest modulates a chirped laser pulse, which is then analyzed using a optical spectrum analyzer. However the provided EO measurements represent the input signals with good fidelity only for relatively low bandwidth signals and/or short analysis windows. Recently, a numerical reconstruction strategy called DEOS (Diversity Electro-Optic Sampling) proved to be much more efficient in retrieving ultrafast input signals. In this presentation, we focus on the theoretical background, hardware design rules, as well as practical aspects of the algorithm used to reconstruct the input signal. Ultimate limits of DEOS (versus classical spectral encoding) will be also discussed.

TUP28 **Coherent Difraction Radiation for Longitudinal Electron Beam Characteristics**

***R. Panaś** (NSRC SOLARIS) A. Curcio (CLPU) K.~Łasocha (Jagiellonian University)*

For the needs of diagnostics of the longitudinal electron beam characteristics at the first Polish free electron laser (PolFEL) project, a Coherent Diffraction Radiation (CDR) system is being developed and tested. It will allow for nondestructive bunch length measurement based on the power balance of CDR radiation collected by Schottky diodes in different ranges of sub-THz radiation. The first tests and measurements will be performed at the end of the Solaris synchrotron injector linac, where the beam profile is already known from previous studies. In addition the camera system with automatic focus was developed and tested. In this contribution the theoretical background of the measurement, calculations and first experimental steps will be presented.

13 Sep – Tue

TUP29 **Investigation of ZnO(In) Radiation Hard Fast Scintillator for Heavy Ion Detector Application**

M. Saifulin, *P. Simon, C. Trautmann (TU Darmstadt) P. Boutachkov,* ***M. Saifulin***, *P. Simon, C. Trautmann, B. Walasek-Höhne (GSI) E.I. Gorokhova (GOI) P. Rodnyi, I.D. Venevtsev (SPbPU)*

Indium-doped Zinc Oxide ceramic, ZnO(In), is a novel scintillating material that exhibits fast (<1 ns) light emission in the UV-blue spectral range (~390 nm) and has a high radiation tolerance compared to plastic scintillators. Therefore, this material is of high interest in several beam diagnostics applications such as scintillation counters, and scintillating screens. In this contribution, we performed ZnO(In) material characterization to understand in more detail its performance under heavy ion beam exposure at high doses. Iono-luminescence (IL) and light transmission spectra of ZnO(In) ceramic have been measured as a function of fluence under 4.8 MeV/u 48Ca and 197Au ion irradiation. The IL intensity loss due to irradiation observed in this work was described within the Birks-Black model, and results were compared to previous measurements with 300 MeV/u heavy ions.

TUP30 **Beam Intensity Measurement in ELENA Using Orbit Pick-Ups**

O. Marqversen, *D. Alves (CERN)*

A bunched beam intensity measurement system for the CERN Extra Low ENergy Antiproton Ring (ELENA), using a cylinder shoe-box electrostatic pick-up from the existing orbit system, is presented. The system has been developed to measure the very challenging beam currents, as low as 200nA corresponding to intensities of the order of 10^7 antiprotons circulating with a relativistic beta of the order of 10^{-2}. In this work we derive and show that the turn-by-turn beam intensity is proportional to the baseline of the sum signal and that, despite the AC-coupling of the system, the installed front-end electronics, based on a charge amplifier, not only guarantees the preservation of the bunch shape (up to a few tens of MHz), but also allow for an absolute calibration of the system. In addition, the linearity of the intensity measurements and their independence with respect to average beam position is evaluated using a standard finite element electromagnetic simulation tool. Finally, experimental measurements throughout typical antiproton deceleration cycles are presented and their accuracy and precision are discussed.

TUP31 **The Cryogenic Current Comparator at CRYRING@ESR**

L. Crescimbeni, *D.M. Haider, A. Reiter, M. Schwickert, T. Sieber, T. Stöhlker (GSI) H. De Gersem, N. Marsic, W.F.O. Müller (TEMF, TU Darmstadt) M. Schmelz, R. Stolz, V. Zakosarenko (IPHT) F. Schmidl (FSU Jena) T. Stöhlker (IOQ) T. Stöhlker, V. Tympel (HIJ) V. Zakosarenko (Supracon AG)*

The Cryogenic Current Comparator (CCC) at the heavy-ion storage ring CRYRING@ESR at GSI provides a calibrated non-destructive measurement of beam current with a resolution of 10 nA or better. With traditional diagnostics in storage rings or transfer lines a non-interceptive absolute intensity measurement of weak ion beams (<1 μA) is already challenging for bunched beams and virtually impossible for coasting beams. Therefore, at these currents the CCC is the only diagnostics instrumentation that gives reliable values for the beam intensity independently of the measured ion species and without the need for tedious calibration procedures. Herein, after a brief review of the diagnostic setup, an overview of the operation of the CCC with different stored ion beams at CRYRING is presented. The current reading of the CCC is compared to the intensity signal of various standard instrumentations including a Parametric Current Transformer (PCT), an Ionization Profile Monitor (IPM) and the Beam Position Monitors (BPMs). It was shown that the CCC is a reliable instrument to monitor changes of the beam current in the range of nA.

TUP32 **Differential Current Transformer for Beam Charge Monitoring in Noisy Environments**

***H. Maesaka**, T. Inagaki (RIKEN SPring-8 Center) H. Dewa, T. Inagaki, **H. Maesaka**, K. Yanagida (JASRI) K. Ueshima (QST)*

We developed a differential current transformer (CT) for electron beam charge measurement in noisy environments, such as near high-power pulse sources. This CT has four pickup wires coiled at equal intervals (90 deg.) on a toroidal core and each coil is wound for two turns. The midpoint of the coil is connected to the body ground so that a balanced differential signal is generated at both ends. A beam pipe with a ceramics insulation gap is inserted into the toroidal core to obtain a signal from a charged-particle beam. The four pairs of signals are transmitted through a CAT6 differential cable and fed into differential amplifiers. The common-mode noise from the noisy ground at the CT is canceled out by the amplifier. The four signals are then summed and digitized by an AD converter. We produced differential CTs and installed them into the new injector linac of NewSUBARU. Before the installation, the frequency response was measured in a laboratory and a flat response of up to 100 MHz was obtained as expected. Common-mode noise cancellation was also confirmed at NewSUBARU and the CTs have been utilized for beam charge monitoring stably.

TUP34 **LHC Schottky Spectrum from Macro-particle Simulations**

***C. Lannoy**, D. Alves, K.~Łasocha, N. Mounet (CERN) **C. Lannoy** (EPFL) K.~Łasocha (Jagiellonian University)*

We introduce a method for building Schottky spectra from macro-particle simulations performed with the code PyHEADTAIL, applied to LHC beam conditions. In this case, the use of a standard Fast Fourier Transform algorithm to recover the spectral content of the beam becomes computationally intractable memory-wise, because the relatively short bunch length compared to the large revolution period implies handling an extremely large amount of data for the FFT. To circumvent this difficulty, a semi-analytical method was developed to compute efficiently the Fourier transform. The spectral content of the beam is calculated on the fly along with the macro-particle simulation and stored in a compact manner, independently from the number of particles, thus allowing the processing of one million macro-particles in the LHC over 100'000 revolutions on a regular computer, in a few hours. The simulated Schottky spectrum is then compared against theoretical formulas and measurements of Schottky signals obtained with lead ion beams in the LHC.

TUP35 **First RF Phase Scans in the European Spallation Source**

Y. Levinsen *(ESS)*

The installation and commissioning of the European Spallation Source is currently underway at full speed, with the goal to be ready for first neutron production by end of 2024. This year we transported beam through the first DTL tank. This included the RFQ, 3 buncher cavities in the medium energy beam transport as well as the DTL tank itself as RF elements. At the end of the DTL tank we had a Faraday cup acting as the effective beam stop. This marks the first commissioning when RF matching is required for beam transport. In this paper we discuss the phase scan measurements and analysis of the buncher cavities and the first DTL tank.

TUP36 **Beam Characterization of Slow Extraction Measurement at GSI-SIS18 for Transverse Emittance Exchange Experiments**

J. Yang*, P. Forck, T. Milosic, R. Singh, S. Sorge (GSI)*

The quality of slowly, typically several seconds, extracted beams from the GSI synchrotron SIS18 is characterized with respect to the temporal beam stability, the so-called spill micro-structure on the 100 µs scale. Previous investigations suggested that a decreased horizontal emittance reduces the temporal fluctuations. A pilot experiment was performed at SIS18 to introduce transverse emittance exchange between horizontal and vertical planes, resulting in smaller horizontal beam size and improved spill micro-structure. Important beam instrumentation comprises an Ionization Profile Monitors (IPM) for beam profiles measurement inside the synchrotron and a plastic scintillators (BC400) inside the transfer line for ion counting with up to several 10^6 particles per second and 20 µs time slices. The performant data acquisition and analysis tools allows to determine quantities such as maximum-average ratio, standard deviation and duty factor. The experimental setup, measurement and related simulation results are discussed.

TUP38 **Deep Neural Network for Beam Profile Classification in Synchrotron**

M. Piekarski *(NSRC SOLARIS)*

The main goal of NSRC SOÂLARIS is to proÂvide sciÂenÂtific comÂmuÂnity with high qualÂity synÂchroÂtron light. To achieve this, it is necessary to constantly monitor many subsystems responsible for beam stability and to analyze data about the beam itself from various diagnostic beamlines. In this work a deep neural netÂwork for transverse beam profile classification is proÂposed. Main task of the system is to automatically assess and classify transverse beam profiles based solely on the evaluation of the beam image from the Pinhole diagnostic beamline at SOLARIS. At the present stage, a binary assignment of each profile is performed: stable beam operation or unstable beam operation / no beam. Base model architecture consists of a pre-trained conÂvoÂluÂtional neural netÂwork followed by a densely-connected classifier and the system reaches accuracy at the level of 90%. The model and the results obtained so far are discussed, along with plans for future development.

TUP39 **Neural Network Inverse Models for Implicit Optics Tuning in the AGS to RHIC Transfer Line**

J.P. Edelen, *N.M. Cook, J.A. Einstein-Curtis (RadiaSoft LLC) K.A. Brown, V. Schoefer (BNL)*

One of the fundamental challenges of using machine-learning-based inverse models for optics tuning in accelerators, particularly transfer lines, is the degenerate nature of the magnet settings and beam envelope functions. Moreover, it is challenging ' if not impossible ' to train a neural network to compute correct quadrupole settings from a given set of measurements due to the limited number of diagnostics available in operational beamlines. However, models that relate BPM readings to corrector settings are more forgiving, and have seen significant success as a benchmark for machine learning inverse models. We recently demonstrated that when comparing predicted corrector settings to actual corrector settings from a BPM inverse model, the model error can be related to errors in quadrupole settings. In this paper, we expand on that effort by incorporating inverse model errors as an optimization tool to correct for optics errors in a beamline. We present a toy model using a FODO lattice and then demonstrate the use of this technique for optics corrections in the AGS to RHIC transfer line at BNL.

TUP40 **Photon Polarization Switch at ALBA**

L. Torino, *G. Benedetti, F.F.B. Fernández, U. Iriso, Z. Martí, J. Moldes, D. Yépez (ALBA-CELLS Synchrotron)*

The polarization of the synchrotron radiation produced by a bending magnet can be selected by properly choosing the vertical emission angle. At beamlines this can be done by moving a slit to cut out unwanted polarization: this method is time consuming and not very reproducible. Another option is to fix the slit position and generate a local bump with the electron beam, and vary the emission angle at the source point such that the slit is illuminated with the desired polarization. At ALBA, we have implemented this option within the Fast Orbit Feedback, which allows to perform the angle switch in less than one minute without affecting the other beamlines. This report describes the implementation of this technique for the dipole beamline MISTRAL at the ALBA Synchrotron.

13 Sep – Tue

TUP41 **Multi-Dimensional Feedforward Controller at MAX IV**

C. Takahashi, *Á. Freitas, V. Hardion, M. Holz, M. Lindberg, M. Sjöström, H. Tarawneh (MAX IV Laboratory, Lund University)*

Feedforward control loops are used in numerous applications to correct process variables. While feedforward control loops correct process variables according to expected behaviour of a system at any given set point, feedback loops require measurements of the output to correct deviations from the set point. At MAX IV, a generic multi-dimensional input and output feedforward controller was implemented using Tango Control System. This paper describes the development and use cases of this controller for beam orbit and optics corrections at MAX IV.

TUP42 **Fast Orbit Feedback Upgrade at SOLEIL**

R. Broucquart *(SOLEIL)*

In the framework of the SOLEIL-Upgrade project, the diagnostics group must anticipate ahead of the dark period the upgrade of important system like the BPM electronics, the timing system end the Fast Orbit Feedback (FOFB). The (FOFB) is a complex system that is currently embedded in the BPM electronics modules. A new flexible standalone platform is under conception to follow the future upgrades of surrounding equipment, and to allow the integration of future correction schemes. In this paper we will present the current status of technical decisions, tests and developments.

TUP43 **Requirements and Design for the PETRA IV Fast Orbit Feedback System**

S. Pfeiffer, *H.T. Duhme, B. Dursun, A. Eichler, S. Jabłoński, J. Klute, F. Ludwig, S.H. Mirza, H. Schlarb, B. Szczepanski (DESY)*

PETRA IV is the upcoming low-emittance, 6 GeV, fourth generation light source at DESY Hamburg. It is based upon a six-bend achromat lattice with additional beamlines as compared to PETRA III. A stringent stability of the electron beam orbit in the ring will be required to achieve a diffraction-limited photon beam quality at 1 Angstrom. In this regard, the requirements and the proposed topology of the orbit feedback system are discussed both in slow and fast regimes of perturbations. An initial analysis based upon system requirements, design and modeling of the subsystems of the orbit feedback system is also presented.

TU3 — Tuesday Session 3

Chair: A. Cianchi (INFN-Roma II)

TU3I1 16:30 30 **Investigating the Transverse Dynamics of Electron Bunches in Laser-Plasma Accelerators**

A. Koehler *(DLR)*

The demonstrations of GeV electron beams and FEL radiation driven by a centimeter-scale device illustrate the tremendous progress of laser-plasma accelerators. In such applications, beam divergence and size, along with beam energy and charge, are critical parameters of electron beams. An insight on the transverse parameters and their dynamics such as beam decoherence can be obtained by diagnostics complemented by betatron radiation detectors. This talk will also provide a brief overview of recent techniques for accessing the transverse phase space.

TU3C2 17:00 20 **Angular-Resolved Thomson Parabola Spectrometer for Laser-Driven Ion Accelerators**

C. Salgado*, G. Gatti, J.L. Henares, J. Imanol Apinaz, J.A.P. Perez-Hernandez, L. Volpe, D.d.L. de Luis (CLPU)*

Laser-plasma driven accelerators have become reliable sources of low-emittance, broadband and multi-species ion sources, with cut-off energies above the MeV-level. We report on the development, construction, and experimental test of an angle resolved Thomson parabola spectrometer for laser-accelerated multi-MeV ion beams able to distinguish between ionic species with different q/m ratio. The angular resolving power, which is achieved due to an array of entrance pinholes, can be simply adjusted by modifying the geometry of the experiment and/or the pinhole array itself. The analysis procedure allows for different ion traces to cross on the detector plane, which greatly enhances the flexibility and capabilities of the detector. A full characterization of the TP magnetic field has been implemented into a relativistic code developed for the trajectory calculation of each beamlet. High repetition rate compatibility is guaranteed by the use of a MCP as active particle detector. We describe the first test of the spectrometer at the 1 PW VEGA 3 laser facility at CLPU, Salamanca (Spain), where up to 15 MeV protons and carbon ions from a 3-micron laser-irradiated metallic foil are detected.

TU3C3 **LINAC4 Laser Profile and Emittance Meter Commissioning**

17:20 20

A. Goldblatt *(CERN)*

The LINAC4 is now equipped with two laser profile and emittance meters, basically non destructive and not limited by beam power density. A pulsed laser is transported through fibres and focused into the 160 MeV H^- beam. Its interaction with the H^- ions detaches electrons that are collected by an electron-multiplier, while the resulting H^0 particles, after being separated from the main H^- beam by a dipole magnet, are recorded by a diamond strip detector, few meters away from the interaction point. The emittance and profile are reconstructed from the laser step by step scan of the beam. After several years of feasibility tests and prototyping, this paper will present all details about the final HW and SW implementation and the 2022 experimental results. This will include comparison with the wire grids and wire scanner measurements, remaining issues/limitations and the potential system upgrades.

TU3C4 **A High Performance Scintillator Ion Beam Monitoring System**

17:40 20

D.S. Levin*, C. Ferretti, N.A. Ristow (University of Michigan) P.S. Friedman (Integrated Sensors, LLC) T.N. Ginter (NSCL)*

A high performance Scintillator Ion Beam Monitor (SBM)provides diagnostics across a range of isotopes, energies, and intensities. It uses a machine-vision camera and a magazine of thin scintillators, movable into the beam without breaking vacuum. Two proprietary scintillators are used: a semicrystalline polymer material (PM) tested over a thickness range of ~1 to 190 µm. The PM yields stronger signals than other commercial plastic scintillators tested and is radiation damage resistant; a 100-400 µm opaque wafer consisting of inorganic crystals in a polymer hybrid matrix (HM). Both PM and HM are non-hygroscopic and produce minimal secondary reflections. HM produces significantly larger signals than CsI with excellent radiation damage resistance. The SBM was staged at the FRIB (East Lansing) ion beam, demonstrating real-time beam profile and rate analysis spanning more than five orders-of-magnitude including visualization of single ion signals with ~10-20 µm spatial resolution. It is superior to and may replace the reference detectors: Faraday cup, silicon strips and a CCD camera beam imager. A proton test beam extended the dynamic range by four orders-of-magnitude.

14-Sep-22 09:00 – 10:30	Pleanry

WE1 — Wednesday Session 1

Chair: L. Bobb (DLS)

WE1I1 09:00 30 **First Observation of Quasi-Monochromatic Optical Cherenkov Radiation in a Dispersive Medium (Quartz)**

A.I. Novokshonov *(DESY)*

Spectral properties of optical Cherenkov radiation (ChR) were studied both theoretically and experimentally. This type of radiation has a continuous spectral distribution which allows to use it in different fields of physics. By exploiting the frequency dependence of the target permittivity it is possible to observe quasi-monochromatic radiation. A theoretical model based on a surface current approach is presented. In order to test the predictions, an experiment was carried out using 855 MeV electrons and a 0.2 mm thick quartz target as radiator. Quasi-monochromatic ChR was observed with a spectrometer, and tilting the radiator crystal offered the possibility to tune the radiation wavelength. The monochromatization effect is attributed to the frequency dependence of the quartz permittivity, and taking into account the refraction law it is possible to deduce a dispersion relation which connects ChR wavelength and target tilt angle for fixed observation angle. Dispersion relation and model description are confirmed in the experiment. Exploiting the ChR monochromatization mechanism might offer versatile tools which can find applications in beam diagnostics.

WE1C2 09:30 20 **An X-Ray Beam Property Analyzer Based on Dispersive Crystal Diffraction**

N. Samadi*, M. Böge, J. Krempaský, C. Ozkan Loch, M.S. Stampanoni (PSI) L.D. Chapman (CLS) X. Shi (ANL)*

The advance of low-emittance x-ray sources urges the development of novel diagnostic techniques. Existing systems either have limited resolution or rely heavily on the quality of the optical system. In this work, we introduce an x-ray beam property analyzer based on a multi-crystal diffraction geometry. By measuring the transmitted beam profile of a dispersive Laue crystal, the system can provide a high-sensitivity characterization of spatial source properties, namely, size, divergence, position, and angle in the diffraction plane of the system at a single location in a beamline. This versatile system can be used at bending magnet, wiggler, or undulator beamlines for x-ray beam quality characterization. It can also help understand the effects of source and optics instability in the experiments, which will help enhance the performance of the beamlines. In addition, the system can be utilized as a diagnostic tool for monitoring the electron source. Detailed theoretical modeling and experimental validation are carried out to show the system's feasibility as a versatile characterization tool for monitoring the x-ray source and beam properties.

WE1I3 09:50 30

High Accuracy Measurement of the Absolute Energy by Synchrotron Radiation Interferometry with Relativistic Electrons

P. Klag, *P. Achenbach (KPH)*

The Mainz Microtron is an electron accelerator, which delivers electron energies up to 1.6 GeV, with a small spread of the energy <13 keV. Besides a small energy spread, the high quality of the beam allows producing high coherent synchrotron radiation. The light from two spatially separated and movable light sources (undulators) can be superimposed to render an interference pattern. The ideal applications are high accuracy absolute energy measurements of the relativistic electrons. Experiments have been carried out at 180 MeV and 195 MeV. The radiation lies in the optical range where also Fresnel Diffraction patterns occur, which features allow very precise alignment control.

WE2 — Wednesday Session 2

Chair: T. Batten (CLS)

WE2T1 11:00 50 **Beam Stability Requirements for Ultra-Low Emittance Circular Light Sources**

v

G.M. Wang (BNL)

For many light sources undergoing upgrades to 4th generation facilities, the breadth and importance of beam stability has grown substantially i.e. tighter stability requirements over greater bandwidths over various timescales. Diagnostics groups now require significant knowledge of beam stability requirements, sources of disturbances (ground motion, thermal expansion, water cooling, power supplies), their measurement (accelerometers, FEA, experimental modal analysis, transfer functions) and mitigation (passive damping, feedback or stabilisation techniques/reference monitoring like hydrostatic levelling or length encoders on reference columns etc). A more holistic approach of beam stability is becoming more common, considering electron BPMs, front-end XBPMs and beamline XBPMs together and enabling synchronised review of stability data from fast archivers.

WE2C2 11:50 20 **Beam Stability in the MAX IV 3 GeV Storage Ring**

J. Breunlin *(MAX IV Laboratory, Lund University)*

The MAX IV Laboratory, inaugurated in 2016, hosts a 3 GeV ring ultra-low emittance storage ring, a 1.5 GeV storage ring and a linear accelerator driven Short Pulse Facility to deliver synchrotron radiation to scientific users. A Stability Task Force has been assigned to ensure the delivery of stable beams since early on in the design phase of the laboratory and is continuing its work in an ongoing and multi-disciplinary effort. Measurements of the electron beam stability resulting from the passive stabilization approach taken for the two storage rings will be presented, as well as figures of beam stability with the Fast Orbit Feedback system in operation. Each ID beamline in the 3 GeV storage ring is equipped with a pair photon beam position monitors that are currently used to complement the electron beam position monitors. In the light of the city development around the MAX IV campus, maintaining the good mechanical stability of the laboratory has to be seen as an ongoing effort. A number of studies are being performed to identify possible risks and to decide where measures need to be taken.

WE2I3 12:10 30 **Adaptive Feedforward Control of Closed Orbit Distortion Caused by Fast Helicity-Switching Undulators**

__M. Masaki__, H. Dewa, T. Fujita, H. Maesaka, K. Soutome, T. Sugimoto, S. Takano, M.T. Takeuchi, T. Watanabe (JASRI) T. Fukui, H. Maesaka (RIKEN SPring-8 Center, Innovative Light Sources Division) K. Kubota (SES) K. Soutome, T. Sugimoto, S. Takano, H. Tanaka, T. Watanabe (RIKEN SPring-8 Center)

We developed a new correction algorithm for closed orbit distortion (COD) based on adaptive feedforward control (AFC). The AFC system effectively works for the suppression of the fast COD due to known error sources with repetitive patterns such as helicity-switching undulators. The scheme aims to counteract error sources by feedforward correctors at the position or in the vicinity of error sources so that a potential risk of unwanted local orbit bumps, which is known to exist for the global orbit feedback, can be eliminated in a reliable and accurate manner. This option is especially advantageous when an error source causes an angular distortion of photon beams such as a fast orbit distortion near undulators. Thus, the AFC provides a complementary capability to a so-called fast global orbit feedback (FOFB) for coming next-generation light sources where ultimate light source stability is essentially demanded. In this talk, introduction to the AFC, its theoretical aspect and advantages, the system overview, the experimental results for the effects of AFC will be presented.

WE2C4 12:40 20 **RF Systems-on-Chip for Multibunch and Filling Pattern Feedbacks**

__B. Keil__, P.H. Baeta Neves Diniz Santos, G. Marinkovic (PSI)

RF Systems-on-Chip (RFSoCs) are FPGAs with CPUs, multi-GSample/s ADCs and DACs and other components on the same chip. We have evaluated the use of RFSoCs for low-latency multibunch (bunch-by-bunch) feedback and filling pattern (single bunch charge) measurement systems for the Swiss Light Source (SLS) storage ring. First results obtained with an RFSoC evaluation board will be presented.

WEP02 **Design of Machine Protection System for Shenzhen Innovation Light-Source Facility (SILF)**

M.T. Kang *(IASF)*

The Shenzhen Innovation Light-source Facility (SILF) is the fourth generation of synchrotron radiation source based on diffraction limit storage ring, it is proposed by the Institute of Advanced Science Facilities, Shenzhen, the pre-research project is in process. The uncontrolled beam may permanently damage the components or lead to very high residual radiation dose along the beam line. The Machine Protection System (MPS) is to prevent the accelerator components along the beams from being damaged. So MPS must be deliberately designed and implemented. MPS is designed based on Gigabit POWERLINK, and the interlock controller use China-made Hollsys PLC and Zynq-based controller. Design of the MPS is introduced in this paper.

WEP04 **Dual channel FMC High-Voltage Supply**

W. Viganò, *J. Emery, M. Saccani (CERN)*

The Beam Loss Monitoring (BLM) detectors and electronics are installed along the CERN accelerators to provide measurements of the beam loss as well as protection from them when excessive. Majority of the BLM detector types require voltage biasing up to 2000VDC with the possibility to generate voltage modulation patterns to verify the connection chain of the detectors to the front-ends. Currently, the power supply solution consists of COTS large format power supplies with additional custom electronics and various interconnections to provide monitoring and remote control. For this reason, a market search has been done to identify a high reliability module suitable for dedicated BLM installations composed by a few detectors. The outcome of the market search has justified the need to design a low cost custom board, compatible with the CERN infrastructure and different detector types, as well as allow easy customization to cover various installation architectures and voltage range needs. Main characteristics could be summarized with the following points: completely remote controlled and autonomous system, common hardware for different applications, only need to change DC/DC converter.

WEP05 **Online Machine Learning Version of the SNS Differential Beam Current Monitor**

W. Blokland, *F. Liu, N.R. Miniskar, A.R. Young, A.P. Zhukov (ORNL)*
K. Rajput, M. Schram (JLab)

We have duplicated the Spallation Neutron Source (SNS) Differential beam Current Monitor (DCM) and included Machine Learning algorithms to observe the beam condition by looking for errant beam event precursors. The new system runs in parallel to the existing operational system and receives the same beam current signals but can be modified without affecting Operations. The archived data from the operational DCM was used to prove the existence of precursors and to generate the models. The new system has implemented Siamese Twin models on the real-time OS and a Random Forest model in the FPGA of the system. The system can also stream all acquired data at full rates to a data server for archival and online analysis. We discuss the setup and initial results.

WEP06 **An LHC Protection System Based on Fast Beam Intensity Drops**

***M. Gąsior**, T.E. Levens (CERN)*

The Large Hadron Collider (LHC) is protected against potentially dangerous beam losses by a distributed system based on some four thousand beam loss monitors. To provide an additional level of safety, the LHC has been equipped with a system to detect fast beam intensity drops and trigger a beam dump for potentially dangerous rates. This paper describes the architecture of the system and its signal processing, optimized to cope with dump thresholds in the order of 0.01 % of the circulating beam intensity. The performance of the installed system is presented based upon beam measurements.

WEP07 **Influence of the Beam Induced Irradiation on the Critical Current Phenomena in Superconducting Elements**

***J. Sosnowski** (NCBJ)*

Currently developed nuclear accelerators more and more widely use superconducting elements especially in windings of superconducting electromagnets and current leads to them. These elements are however sensitive to the irradiation caused by primary beam as well as by secondary particles, as it is the case for PolFEL. In the paper it is discussed how this irradiation damages the subtle structure of superconducting materials, leading to columnar defects formation in 2D HTc superconductors. It is analysed, in which way created nano-sized structural defects influence the critical current properties of the superconducting materials, in the process of capturing of the magnetic pancake vortices. Various initial positions of the captured vortices are analysed; their movement leads to potential barrier variations. Influence of the irradiation effects on the current-voltage characteristics of superconductors are investigated then and maximal current density detected as the function of irradiation dose, nano-defects size and physical parameters as magnetic field and temperature.

WEP08 **Upgrade of the BPM Long Term Drift Stabilization Scheme Based on External Crossbar Switching at PETRA III**

***G. Kube**, F. Schmidt-Föhre, K. Wittenburg (DESY) A. Bardorfer, L. Bogataj, M. Cargnelutti, P. Leban, M.O. Oblak, P. Paglovec, B. Repič (I-Tech)*

PETRA IV at DESY will be an upgrade of the present synchrotron radiation source PETRA III into an ultra low-emittance source with beam emittance of about 20 pm.rad which imposes stringent requirements on the machine stability. In order to measure beam positions and control orbit stability to the required level of accuracy, a high resolution BPM system will be installed which consists of about 800 monitors with the readout electronics based on MTCA.4. In order to fulfill the requested long-term drift requirement (< 1 micron over 7 days), also the BPM cable paths have to be stabilized because of the PETRA-specific machine geometry. To achieve this, the crossbar switching concept was extended such that the analogue switching part is separated from the read-out electronics and brought as close as possible to the BPM pickup. While first measurements were presented before, meanwhile the system has undergone a major revision, especially the external switching matrix changed from a prototype setup to a system close to the final design. This contribution summarizes the latest measurements from PETRA III, demonstrating the high performance of the external stabilization concept.

WEP09 **Preliminary Evaluation of the MTCA.4 BPM Electronics Prototype for the PETRA IV Project**

P. Leban, *A. Bardorfer, L. Bogataj, M. Cargnelutti, M.O. Oblak, P. Paglovec, B. Repič (I-Tech) G. Kube, F. Schmidt-Föhre, K. Wittenburg (DESY)*

Within the PETRA IV project at DESY, the synchrotron radiation source PETRA III will be upgraded into a low-emittance source. The small beam emittance and reduced beam size imply stringent requirements on the machine stability. To meet the requirements on position measurement and orbit stability, a high-resolution BPM system will be installed in the new machine, with about 800 BPMs and MTCA.4-based readout electronics. In the TDR phase of the project, I-Tech and DESY are cooperating on the realization of a BPM prototype that will demonstrate the feasibility of reaching the PETRA IV requirements. Several analog, digital and SW parts are taken from the Libera Brilliance^{+} instrument and are reused in the MTCA.4 BPM prototype, with some innovations. One of them is the separation of the RF switch matrix used for long-term stabilization: placing it near the BPM pickup enables also the long RF cables to be stabilized. An 8 channel RTM board, able to acquire signals from two BPM pickups was developed and is also tested. This paper presents an overview of the BPM prototype and the promising test results achieved in the Instrumentation Technologies' laboratory with the first boards produced.

WEP10 **Detection of a DC Electric Field Using Electro-Optical Crystals**

A. Cristiano, *M. Krupa (CERN)*

Standard beam position monitors (BPM) are intrinsically insensitive to beams with no temporal structure, so-called DC beams, which many CERN experiments rely on. We therefore propose a novel detection technique in which the usual BPM electrodes are replaced with electro-optic (EO) crystals. When exposed to an electric field, such crystals change their optical properties. This can be exploited to encode the electric field magnitude onto the polarisation state of a laser beam crossing the crystal. An additional EO crystal, placed outside the vacuum chamber, can be used to control the system's working point and to introduce a sinusoidal modulation, allowing DC measurements to be performed in the frequency domain. This contribution presents the working principle of this measurement technique, its known limitations, and possible solutions to further increase the system's performance. Analytical results and simulations for a double-crystal optical chain are benchmarked against the experimental data taken on a laboratory test bench.

WEP11 **Beam Based Calibration of Button Type Beam Position Monitor at MEBT of RAON**

J.W. Kwon, *G.D. Kim (IBS) E.H. Lim (Korea University Sejong Campus)*

The RAON(Rare-isotope Accelerator complex for ON-line experiments) is an accelerator for heavy ions, such as uranium, oxygen and argon. 60 button beam position monitors was fabricated for the SCL3 that accelerate and deliver the beam from 0.5 MeV/u to 18.5 MeV/u in a uranium case. The beam has bunch structure after the RFQ at 0.5 MeV/u, the lowest energy measurable by BPM. Developed electronics measure positions using IQ method for 1st, 2nd and 3rd harmonic frequencies of 81.25 MHz. Calibration factors of BPM for the three frequency harmonic components were obtained taking into account the frequency dependence of the electronics at wire test bench. To measure the correction factor based on the acceleration beam, a movable stage equipped with a micrometer was prepared on a one-dimensional plane. We present the beam-based calibration test results of button-type BPM for low-beta and heavy-ion beams at MEBT of RAON.

WEP12 **HL-LHC BPM System Development Status**

M. Krupa, *I. Degl'Innocenti, D. Gudkov, G. Schneider (CERN) D.R. Bett (JAI)*

The demanding instrumentation requirements of the future High Luminosity LHC (HL-LHC) require 44 newly designed Beam Position Monitors (BPM) to be installed around the ATLAS and CMS experiments in 2026-2028. Three BPM types are now in pre-series production, with two more variants under design. Close to the collision point, a suite of cryogenic directive stripline BPMs equipped with a brand new acquisition system based on nearly-direct digitization will resolve the position of the two counter-rotating LHC beams occupying a common vacuum chamber. The farther button and stripline BPMs will provide not only the transverse beam position, but also timing signals for the experiments, and diagnostics for the new HL-LHC crab cavities. This contribution summarizes the HL-LHC BPM specifications, gives an overview of the new BPM designs, reports on the pre-series BPM production status and plans for series manufacturing, outlines the foreseen acquisition system architecture, and highlights the first beam measurements carried out with the proof-of-concept electronics for the directive stripline BPMs.

WEP13 **Status of the uTCA Digitizer BPM Design for SARAF Phase II**

***P. Gil**, J. Fernández (7S) G. Desmarchelier, R.D. Duperrier (CEA-DRF-IRFU) G. Ferrand, N. Pichoff, C. Simon (CEA-IRFU)*

One of the crucial monitoring systems of any particle accelerator is the Beam Position Monitor (BPM). The purpose of a BPM is to provide information on the position, phase and current of the beam along the accelerator line. CEA Saclay must provide all beam diagnostics for SARAF-LINAC PHASE II in particular BPM. Based on the technical specifications of the CEA, Orolia-Spain is in charge of the design, development, manufacture and testing of the electronic system. A preliminary version of this system has been already tested at Orolia's and CEA installations and the first results are going to be shown. The architecture, design and development as well as the performance of the BPM system will be presented in this paper. The benefits of the proposed architecture and the first results obtained under different conditions will be detailed

WEP14 **Cavity BPM Electronics for SINBAD at DESY**

***B. Lorbeer**, H.T. Duhme, T. Lensch, D. Lipka, S. Vilcins, M. Werner (DESY)*

The SINBAD(Short and INnovative Bunches and Accelerators at DESY) R&D accelerator is planned for studying new concepts for high gradient electron beam acceleration and the generation of ultra-short electron bunches. The accelerator called ARES(Accelerator Research Experiment At DESY) is composed of S-band accelerating structures. In order to achieve the goal of very short electron bunches the electron beam charges generated in the RF Gun can vary in a range from 1nC down to 500fC. In order to measure the beam position with good resolution at the small charge end of 500fC a new cavity BPM(beam position monitor) has been developed. One key component in the BPM system is the custom RF electronics to meet the resolution requirements in the entire charge range. The entire BPM system with a focus on the system design requirements and the utca based RF electronics are presented in this paper.

WEP15 **XFEL Photon Pulse Measurement Using an All-Carbon Diamond Detector**

***C. Bloomer** (DLS) W. Freund, J. Grünert, J. Liu (EuXFEL) M.E. Newton (University of Warwick)*

The European XFEL can generate extremely intense, ultra-short X-ray pulses at MHz repetition rates. Single-crystal CVD diamond detectors have been used to transparently measure the photon beam position and pulse intensity. The diamond itself can withstand the power of the beam, but the pulses can deposit sufficient energy into the detector that surface electrodes may be damaged by the radiation. Presented in this work are pulse intensity and position measurements obtained at the European XFEL using a new type of all-carbon single-crystal diamond detector developed at Diamond Light Source. Instead of traditional surface metallisation, the detector uses laser-written graphitic electrodes buried within the bulk diamond. There is no metallisation in the XFEL X-ray beam path that could be damaged by the beam. The results obtained from a prototype detector are presented, capable of measuring the intensity and 1-dimensional X-ray beam position of individual XFEL pulses. These successful measurements demonstrate the feasibility of all-carbon diagnostic detectors for XFEL use.

WEP16 **PSF Characterization of the ALBA X-Ray Pinholes**

U. Iriso, *A.A. Nosych (ALBA-CELLS Synchrotron)*

ALBA is currently equipped with two x-ray pinhole cameras for continuous beam size monitoring using the synchrotron radiation from two different bending magnets. The first pinhole was installed in day-1 and it is working properly since 2012 as the work-horse for the ALBA emittance measurements, while the second one has been commissioned in beginning 2021 for redundancy purposes. This paper summarizes the exercises to characterize the Point Spread Function (PSF) of both pinhole cameras using analytical calculations, SRW simulations, and experimental measurements using the beam lifetime.

WEP17 **Electron Emission (SEM) Grids for the FAIR Proton Linac**

J. Herranz *(Proactive Research and Development) I. Bustinduy, Á. Rodríguez Páramo (ESS Bilbao) P. Forck, T. Sieber (GSI)*

New SEM-Grid has been developed for FAIR Proton Linac, the instrument consists of 2 harps fixed together in an orthogonal way. This SEM-Grid will provide higher resolution and accuracy measurements as each harp consists of 64 tungsten wires 100 µm in diameter and 0.5 mm pitch. Each wire is fixed to a ceramic PCB with an innovative dynamic stretching system, this system assures wire straightness under typical thermal expansion due to beam heat deposition. Electric field distribution has been performed, 3 main parameters have been optimized, wires distribution, quantity of polarization electrodes and distance between electrodes and wires. The design and production of the SEM-Grids have been performed by the company Proactive R&D that has count on the expertise of ESS-Bilbao to define safe operation limits and signal estimation by means of a code developed specifically for this type of calculations. Preliminary validations of the first prototypes shown good values of electric field behaviour signal. After additional beam test validations to be performed on June 2022, final series of the SEM-Grid will be produced and installed on FAIR proton LINAC.

WEP18 **Diagnostic Station of Proton Beam at KAHVELab (PTAK)**

***D. Halis**, M. Serin (YTU) A. Adiguzel, S. Esen, S. Oz (Istanbul University) H. Cetinkaya (Dumlupinar University, Faculty of Science and Arts) T.B. Ilhan (Bogaziçi University, Kandilli Accelerator) S. Ogur (Université Paris-Saclay, CNRS/IN2P3, IJCLab) E.V. Ozcan (Bogazici University) G. Unel (UCI)*

A testbeam using a Radio Frequency Quadrupole (RFQ) operating at 800 MHz, to accelerate a 1.5 mA proton beam to 2 MeV energy has been designed, manufactured and is currently being commissioned at KAHVELab, Istanbul. The beam from the microwave discharge ion source (IS) must be matched to the RFQ via an optimized Low Energy Beam Transport (LEBT) line which also contains an integrated measurement station, called MBOX. The MBOX is designed to measure the beam current and profile, as well as the beam emittance, to ensure an accurate match between IS and RFQ. It includes a number of diagnostic tools: a Faraday Cup, a scintillator screen, and a pepper pot plate (PPP). During the commissioning, beam images were taken at different points on the beamline. Other measurements were also taken with different screen materials and different plates in the MBOX box. The analysis software was also developed and tested for the PP photo analysis. This contribution will present the proton beamline components, MBOX diagnostic tools and will focus on the measurements, especially on the PPP emittance analysis.

WEP19 **A Raster Scanning Laser-Sculptor for Hydrogen Ion Beam Diagnostics**

***S.M. Gibson** (Royal Holloway, University of London) S.E. Alden (JAI)*

A novel scheme for laser sculpting a neutralised hydrogen beam from a parent beam of hydrogen ions circulating in a racetrack accelerator was proposed at IPAC19. Such a method was shown in simulation to produce a particle beam with reduced transverse emittance, based on a simple static laser sculptor geometry. This paper investigates effects of translating or raster scanning a focussed laser-sculptor transversely within the hydrogen ion beam, which creates new possibilities for non-invasive beam diagnostics of the transverse phase space. The optimisation of the optical geometry, intensity and the temporal characteristics of the laser beam are investigated for laser-induced extraction of neutralised beamlets, from which the beam profile and emittance can be reconstructed. Photo-detachment simulations are performed in a photon-particle interaction framework that has been implemented in BDSIM, a Geant4 based particle tracking code. We evaluate the design of a potential experimental demonstration at a hydrogen ion linac, the Front End Test Stand, at Rutherford Appleton Laboratory, UK.

WEP20 **Emittance Diagnostics at PETRA IV**

***M. Marongiu**, G. Kube, M. Lantschner, A.I. Novokshonov, K. Wittenburg (DESY)*

The PETRA IV project will be a Diffraction Limited Light Source designed to be the successor of PETRA III, the 6 GeV 3rd generation hard X-Ray synchrotron light source at DESY in Hamburg. It will operate at a beam energy of 6 GeV with a design emittance of 20/4 pm·rad. For a precise emittance online control, two dedicated diagnostics beamlines will be built up to image the beam profile with synchrotron radiation in the X-Ray region. With two beamlines, it will be possible to extract both the transverse beam emittances and the beam energy spread. The beamlines will be equipped with two interchangeable X-Ray optical systems: a pinhole camera system to achieve high dynamic range and a Fresnel Diffractometry system for high resolution measurements in the range 1-18 µm. This paper describes the planned setup and deals with the possible limitations.

WEP21 **Merits of Pulse-Mode Operation of the Residual Gas Ionization Profile Monitor for J-PARC Main Ring**

***K. Satou** (J-PARC, KEK & JAEA)*

Measurement accuracy of an IPM of J-PARC MR depends on gain flatness and stability of a position sensitive micro-channel plate (MCP). The flatness of the MCP is deteriorated after long-term operation; gain of central area is selectively decreased as integrated output charge is increasing. To calibrate the flatness, the beam-based calibration is used, where the beam is shifted by the local bump and the gain distribution was determined so as to reconstruct beam profiles. Additionally, instantaneous gain drop is occurred when the output current from the MCP becomes comparable to the bias current of it; this gain drop depends on DC bias voltage and output current at that time, and thus it is difficult to be calibrated. To resolve the problems, a pulsed HV module of 30 kV, which is to collect ionized electrons, was installed. The pulse-mode operation can modulate the averaged output current from the MCP to improve the gain stability. Profiles of intense beam up to $3.3 \cdot 10^{13}$ ppb were measured and compared with that measured by destructive profile monitors in beam transport lines, 3-50BT (3 GeV) and Abort line (30 GeV). These estimated emittances were in good agreement within ~10% accuracy.

WEP22 **Experimental Investigation of Gold Coated Tungsten Wires Emissivity for Applications in Particle Accelerators**

***A. Navarro Fernandez**, M. Martin Nieto, F. Roncarolo (CERN)*

The operation of wire grids and wire scanners as beam profile monitors, both in terms of measurement accuracy and wire integrity, can be heavily affected by the thermal response of the wires to the energy deposited by the charged particles. Accurate measurements of material emissivity are crucial, as Radiative Cooling represent the most relevant cooling process. In this work, we present a method for emissivity measurements of gold coated tungsten wires (diameters between 10-100 um) based on calorimetric techniques. The dedicated electrical set up allowed for precise current and voltage measurements up to 2 A and 6 V respectively, which allowed transient and steady state measurements for temperature measurements up to 2000 K. Temperature determination as a function of current intensity probed to be a big part of uncertainty due to the non-uniformity of the thermal wire profile. A theoretical description of the measurement technique will be followed up by the electrical set up description and a detailed discussion about the measured results and uncertainties.

WEP23 **Assessing the Performance of the New Beam Wire Scanners for the CERN LHC Injectors**

S. Di Carlo *(CERN)*

The ability of reliably measuring the transverse beam profile in its injectors is essential for the operation of the LHC. This report aims to assess the reliability, stability, and reproducibility of the new generation of beam wire scanners developed at CERN in the framework of the LHC Injectors Upgrade (LIU). The study includes data from the over 60000 scans performed in 2021 and 2022, with a special focus on reproducibility, investigation of optimal operational settings to ensure a large dynamic range, and evaluation of absolute accuracy through comparison with other instruments present in the injectors.

WEP24 **Modeling and Experimental Evaluation of a Bunch Arrival-Time Monitor with Rod-Shaped Pickups and a Low-Pi-Voltage Ultra-Wideband Traveling Wave Electro-Optic Modulator for X-Ray Free-Electron Lasers**

K. Kuzmin, *E. Bründermann, A.-S. Müller, G. Niehues (KIT) W. Ackermann, H. De Gersem (TEMF, TU Darmstadt) M.K. Czwalinna, H. Schlarb (DESY) C. Koos, A. Kotz (IPQ KIT) A. Penirschke, B.E.J. Scheible (THM)*

X-ray Free-Electron Laser (XFEL) facilities, such as the 3.4-km European XFEL, use all-optical links with electro-optic bunch arrival-time monitors (BAM) for a long-range synchronization. The current BAM systems achieve a resolution of 3.5 fs for 250 pC bunches. Precise bunch arrival timing is essential for experiments, which study ultra-fast dynamical phenomena with highest temporal resolution. These experiments will crucially rely on femtosecond pulses from bunch charges well below 20 pC. The state-of-the-art BAMs are not allowing accurate timing for operation with such low bunch charges. Here we report on the progress in development of an advanced BAM (system) based on rod-shaped pickups mounted on a printed circuit board and ultra-wideband travelling-wave electro-optic modulators with low operating voltages. We perform modeling and experimental evaluation for the fabricated pickups and electro-optic modulators and analytically estimate timing jitter for the advanced BAM system. We discuss an experimental setup to demonstrate joint operation of new pickups and wideband EO modulators for low bunch charges less than 5 pC.

WEP25 **Installation and Commissioning of the Pulsed Optical Timing System Extension**

***F. Rossi**, M. Ferianis (Elettra-Sincrotrone Trieste S.C.p.A.)*

The FERMI facility has been operated with an optical timing system since the beginning of machine operations. In the past years the system has been progressively extended to support more clients. The latest upgrade is focusing on the pulsed subsystem which is providing the phase reference to remote lasers and the bunch arrival monitor diagnostic stations. In origin the pulsed system had a capacity to feed simultaneously six stabilized fiber links. After the upgrade to the original layout it is possible to install up to eight new additional links. Here we will describe the new setup and the results achieved in terms of short and long term stability.

WEP26 **Status of a Monitor Design for Single-Shot Electro-Optical Bunch Profile Measurements at FCC-ee**

***M. Reißig**, E. Bründermann, S. Funkner, B. Härer, A.-S. Müller, G. Niehues, M.M. Patil, R. Ruprecht, C. Widmann (KIT)*

At the KIT electron storage ring KARA (Karlsruhe Research Accellerator) an electro-optical (EO) near-field monitor is in operation performing single-shot, turn-by-turn measurements of the longitudinal bunch profile using electro-optical spectral decoding (EOSD). In context of the Future Circular Collider Innovation Study (FCCIS), a similar setup is investigated with the aim to monitor the longitudinal bunch profile of each bunch for dedicated top-up injection at the future electron-positron collider FCC-ee. This contribution presents the status of a monitor design adapted to cope with the high-current and high-energy lepton beams foreseen at FCC-ee.

WEP28 **Studies on Radially Coupled Fast Faraday Cups to Minimize Field Dilution and Secondary Electron Emission at Low Intensities of Heavy Ions**

***G.O. Rodrigues**, S. Kumar, K. Mal, R. Mehta, C.P. Safvan (IUAC) R. Singh (GSI)*

Fast Faraday Cups (FFCs) are interceptive beam diagnostic devices used to measure fast signals from sub-nanosecond bunched beams and the operation of these devices is a well-established technique. However, for short bunch length measurements in non-relativistic regimes with ion beams, the measured profile is diluted due to field elongation and distortion by the emission of secondary electrons. Additionally, for short bunches with the expected intensities envisaged in the High Current Injector at the Inter University Accelerator Centre, the impedance matching of the EM structure puts severe design constraints. This work presents a detailed study on the modification of a radially-coupled coaxial FFC. The field dilution and secondary electron emission aspects are modelled through EM simulations and techniques to minimise these effects are explored. This has resulted in a new design, which has a better signal to noise ratio and benefits from a more accurate bunched beam measurement.

WEP29 **Optimization Study of Beam Position and Angular Jitter Independent Bunch Length Monitor for Awake Run 2**

C. Davut *(The University of Manchester) Ö. Apsimon (The University of Liverpool) P. Karataev (Royal Holloway, University of London) T. Lefèvre, S. Mazzoni (CERN) G.X. Xia (UMAN)*

In this paper, a study using the Polarization Current Approach (PCA) model is performed to optimize the design of a short bunch length monitor using two dielectric radiators that produce coherent Cherenkov Diffraction Radiation (ChDR). The electromagnetic power emitted from each radiator is measuring a different part of the bunch spectrum using Schottky diodes. For various bunch lengths, the coherent ChDR spectrums are calculated to find the most suitable frequency bands for the detection system. ChDR intensities measured by each detector are estimated for different impact parameters to explore the dependence of bunch length monitor on beam position and angular jitter. It is found that, in the present configuration, the effects of beam position and angular jitter are negligibly small for bunch length measurement.

WEP30 **Creation of the First High-Inductance Sensor of the CCC-Sm Series**

***V. Tympel**, T. Stöhlker (HIJ) L. Crescimbeni, D.M. Haider, M. Schwickert, T. Sieber, T. Stöhlker (GSI) F. Machalett, T. Stöhlker (IOQ) M. Schmelz, T. Schoenau, R. Stolz, V. Zakosarenko (IPHT) F. Schmidl, T. Schoenau, P. Seidel, M. Stapelfeld (FSU Jena) V. Zakosarenko (Supracon AG)*

Cryogenic Current Comparators (CCC) are presently used at CERN-AD (100 mm beamline diameter) and in the FAIR project at CRYRING (150 mm beamline diameter) for non-destructive absolute measurement of beam currents below 20 µA (current resolution 10 nA). Both sensor versions (CERN-Nb-CCC and FAIR-Nb-CCC-XD) use niobium as superconductor for the DC-transformer and magnetic shielding. The integrated flux concentrators have an inductance of below 100 µH at 4.2 Kelvin. The new Sm-series (smart & small) is designed for a beamline diameter of 63 mm and uses lead for the superconducting shield. The first sensor (IFK-Pb-DCCC-Sm-200) has two core-based pickup coils (2x 100 µH at 4.2 K) and two SQUID units, to eliminate Barkhausen current jumps as part of the low frequency 1/f-noise. During the construction some basic experiments on noise behavior (fluctuation' dissipation theorem, white noise below 2 pA/sqrt(Hz)) and magnetic shielding (flux concentrator and shielding as LC circuit resonance, additional mu-metal shielding) were undertaken, the results of which are presented here. Finally, a current resolution of 500 pA could be achieved in the laboratory.

14 Sep – Wed

WEP31 **Booster Fillpattern Monitor**

F. Falkenstern, *J. Kuszynski, G. Rehm (HZB)*

The "Booster Fillpattern Monitor" is used to measure currents in each individual electron bunch in the booster of the BESSY II machine. The booster with its circumference of 96 meters has space for max. 160 electron bunches. The distance between the electron bunches of 60 cm (96 m/160) is determined by the RF Master Clock ~499.627 MHz. In practice, fill patterns of a one to five equally spaced bunches are in use. The fill pattern monitor digitizes electrical pulses generated from a strip line using a broadband ADC. The sampling frequency is selected as an integer fraction of the bunching frequency, acquiring the full fill pattern over a number of turns. Experiments performed at BESSY II demonstrate the performance of the setup and will be discussed.

WEP32 **Secondary Emission Monitor Simulation, Measurements and Machine Learning Application Studies for CERN Fixed Target Beamlines**

L. Parsons França, *M. Duraffourg, F. Roncarolo, F.M. Velotti (CERN) Ö. Apsimon, E. Kukstas, C.P. Welsch, H.D. Zhang (The University of Liverpool) Ö. Apsimon, C.P. Welsch, H.D. Zhang (Cockcroft Institute)*

Ongoing and newly proposed experiments in CERN fixed target experimental areas, such as Physics Beyond Colliders (PBC) activities, have generated a renewed interest in these areas and highlighted the need for upgrading ageing instrumentation in use. Assessing the current performance of accelerator and beamline instrumentation is crucial for smooth operation. Finding solutions that are stable over long time frames, resistant to radiation and deliver the precision needed by users is challenging. Secondary emission monitors (SEMs) are currently used for measuring beam current, position, size in fixed target beamlines at CERN. Measurements and simulations are being conducted to investigate ageing effects on these devices. These investigations are carried out with the aim to calibrate and optimise SEM design for future use in these beamlines, including feasibility studies for the application of machine learning techniques, with the objective of expanding the range of tools available for data analysis.

WEP33 **Operational and Beam Study Results of Measurements with the Transverse Feedback System at the Canadian Light Source**

S.J. Martens *(University of Saskatchewan), T. Batten (CLS)*

A transverse bunch-by-bunch feedback system has been installed in the storage ring at the Canadian Light Source (CLS) to counteract beam instabilities. The 2.9 GeV electron storage ring is 171~m in circumference with 13 insertion devices currently installed, each contributing to the impedance of the ring and lowering the instability threshold. The new Transverse Feedback System (TFBS) provides improved bunch isolation, higher bandwidth amplification and diagnostics to study, understand and damp these instabilities. This paper will show and overview of the system setup, examples of operational performance and results of the diagnostic capabilities, including tune feedback, grow/damp measurements and excite/damp measurements.

WEP34 **Orbit Correction Upgrade at the Canadian Light Source**

***T. Batten**, M. Bree, J.M. Vogt (CLS)*

The Canadian Light Source is a 3rd generation Synchrotron which began user operations in 2005. In the fall of 2021 the Orbit Correction System was upgraded to improve performance and diagnostic capabilities. The flexibility of this new system supports future upgrades and improvement of existing correction schemes. In this paper we will present an overview of this new system and introduce the plans for future enhancements.

WEP35 **Design and Status of Fast Orbit Feedback System at SOLARIS**

***G.W. Kowalski**, K. Gula, R. Panaś, A.I. Wawrzyniak, J.J. Wiechecki (NSRC SOLARIS)*

SOLARIS storage ring has been built with basic set of diagnostic and feedback systems. FOFB system, as much more advanced and not as critical for startup was envisioned as later addition to the design. Now, we are in the process of implementing this addition. The system's workhorse is Instrumentation Technologies Libera Brilliance^{+} with its Fast Acquisition data path and customizable FPGA modules. Feedback algorithm running in hardware provides fast calculations and direct communication with fast power supplies. The hardware installation is almost finished with configuration and software works running in parallel. First measurements of response matrix and proof-of-concept tests were performed.

WEP36 **Conceptual Design of the Transverse Multi-Bunch Feedback for the Synchrotron Radiation Source PETRA IV**

***S. Jabłoński**, H.T. Duhme, J. Klute, S. Pfeiffer, H. Schlarb (DESY)*

PETRA IV will be a new, fourth-generation, high-brilliance synchrotron radiation source in the hard X-ray range. To keep the emittance low at high beam current an active, low noise feedback system to damp transverse multi-bunch instabilities is required. The particular challenge to the system is very low noise, while maintaining high bandwidth, which is defined by the 2 ns bunch spacing. In this paper, we present the conceptual design of the multi-bunch feedback (MBFB) system and technical challenges to fulfill the performance requirements. An overview is given on the hardware and the method for detecting and damping the coupled-bunch oscillations. Using modern high-speed ADCs enables direct sampling of pulses from beam pick-ups, which removes the necessity for down-converters. Powerful digital signal processing allows not only for the effective feedback implementation, but also for developing versatile tools for the machine diagnostics.

WEP37 **Measurements of Emittance Excitation for a Feedback based on Resonant Excitation at Diamond Light Source**

S. Preston, *L. Bobb, A.F.D. Morgan, T. Olsson (DLS)*

In the Diamond Light Source storage ring, the vertical emittance is kept at 8 pm rad by an emittance feedback based on modifying the strength of skew quadrupoles. A new feedback using a stripline kicker to control the vertical emittance by exciting the beam resonantly at a synchrotron sideband is planned to avoid the modifications of the optics caused by the skew quadrupoles. This is especially of importance for the planned Diamond-II upgrade of the storage ring which will have a much smaller horizontal emittance than the existing machine and thus require a larger coupling to keep the vertical emittance at the same level. The new feedback also has the potential to control the horizontal emittance which could be of importance for the Diamond-II storage ring where the impact on the equilibrium emittance from the insertion devices is significant. Measurements have been done at the Diamond storage ring of the beam oscillation and emittance to characterise the effect of chromaticity and impedance on the optimal excitation frequency. The results have also been benchmarked against simulations to understand the agreement between reality and model and the implications for Diamond-II.

WEP38 **Control System Suite for Beam Position Monitors at MAX IV**

Á. Freitas, *V. Hardion, M. Lindberg, R. Lindvall, R. Svärd, C. Takahashi (MAX IV Laboratory, Lund University)*

MAX IV is a fourth generation synchrotron facility at Lund, Sweden. It is composed by a linear accelerator and two storage rings with 1.5 and 3GeV, which requires hundreds of beam position monitors. In this context, Libera Single Pass and Libera Brilliance$^+$ are employed as BPM instruments. This paper will present an overview of the control system suite used in the facility, including the communication, data acquisition and storage pipelines, monitoring, configuration and software maintainability.

WEP39 **Development of a Sticker Sealed Microfluidic Device for In Situ Analytical Measurements Using Synchrotron Radiation**

L. Castro *(Université Paris Science et Lettres)*

Shedding synchrotron light on microfluidic systems, exploring several contrasts in situ/operando at the nanoscale, like X-ray fluorescence, diffraction, luminescence, and absorption, has the potential to reveal new properties and functionalities of materials across diverse areas. In this work, we present the micro-fabrication and characterization of a multifunctional polyester/glass sealed microfluidic device well-suited to combine with analytical X-ray techniques. The device consists of smooth microchannels patterned on glass, where three gold electrodes are deposited into the channels to serve in situ electrochemistry analysis or standard electrical measurements. It has been efficiently sealed through an ultraviolet-sensitive sticker-like layer based on a polyester

film, and the burst pressure is determined by pumping water through the microchannel (up to 0.22 MPa). The device potentialities, and its high transparency to X-rays, have been demonstrated by taking advantage of the X-ray nanoprobe Carnaúba/Sirius/LNLS, by obtaining 2D X-ray nanofluorescence maps on the microchannel filled with water and after an electrochemical nucleation reaction.

WEP40 A Modern Ethernet Data Acquisition Architecture for Fermilab Beam Instrumentation

R.R. Santucci, *J.S. Diamond, N. Eddy, A. Semenov, D.C. Voy (Fermilab)*

The Fermilab Accelerator Division, Instrumentation Department is adopting an open-source framework to replace our embedded VME-based data acquisition systems. Utilizing an iterative methodology, we first moved to embedded Linux, removing the need for VxWorks. Next, we adopted Ethernet on each data acquisition module eliminating the need for the VME backplane in addition to communicating with a rack mount server. Development of DDCP (Distributed Data Communications Protocol), allowed for an abstraction between the firmware and software layers. Each data acquisition module was adapted to read out using 1GbE and aggregated at a switch which up linked to a 10GbE network. Current development includes scaling the system to aggregate more modules, to increase bandwidth to support multiple systems and to adopt MicroTCA as a crate technology. The architecture was utilized on various beamlines around the Fermilab complex including PIP2IT, FAST/IOTA and the Muon Delivery Ring. In summary, we were able to develop a data acquisition framework which incrementally replaces VxWorks & VME hardware as well as increases our total bandwidth to 10Gbit/s using off the shelf Ethernet technology.

WEP41 ENeXAr: An EPICS-Based Tool for User-Controlled Data Archiving

J.F. Esteban Müller *(ESS)*

ENeXAr is a data archival tool for EPICS-based systems. It is intended as a complement for traditional data archiving solutions, to cover use cases for which they are usually not designed: mainly for limited-duration high-data rates from a subset of signals. The service is particularly useful for activities related to machine commissioning, beam studies, and system integration testing. Data acquisition is controlled via PV Access RPC commands and the data is stored in standard HDF5-based NeXus files. The RPC commands allow users to define the acquisition parameters, the data structure, and metadata. The usage of EPICS RPC commands means that the users are not required to install additional software. Also, acquisitions can be automatized directly from EPICS IOCs.

WEP42 **Application of Machine Learning towards Particle Counting and Identification**

S.E. Engel *(University of Essex, Physics Centre) P. Boutachkov, R. Singh (GSI)*

The contribution presents machine learning methods to identify and count events in the detectors used for particle counting. A convolutional neural network, a shape-based template matching algorithm and an algorithm based on peak properties were developed to accurately count the number of particles without domain-specific knowledge required to run the current solution. The results of the three classification approaches were compared to find a solution that best addresses particle pile-ups which creates complex, hard-to-count, peak shapes. The algorithms were trained on a labelled set of over 150 000 real experimental particles recorded using the slowly extracted beam at GSI SIS-18 as well as 416 synthetically generated experimental particles used for validation. All three approaches use a different methodology and have individual strengths and weaknesses in terms of their application. Regardless, they all achieve an accuracy of over 95% with the best achieving an accuracy of 99.97%.

WEP43 **Control Systems of DC Accelerators at KAHVELab**

T.B. Ilhan *(YTU) A. Adiguzel (Istanbul University) E.V. Ozcan (Bogazici University) G. Unel (UCI)*

KAHVE Laboratory has two functional particle sources: thermal electrons and ionized hydrogen. Each of these are followed by DC acceleration sections, for obtaining an electron beam to accelerate electrons MeV energy level and for providing protons to the radio frequency quadrupole accelerator which are being built. So far both systems have keV energy levels. Both systems employ LabVIEW based GUIs to interact with the user and to control and monitor the DC power supplies. The vacuum gauges, turbomolecular pumps, stepper motors and high voltage power supplies are all controlled with PLCs. The equipment under high voltage, are monitored and controlled via Arduino based wifi and bluetooth wireless communication protocols. The proton beamline has additional devices for beam diagnostics which are being commissioned like pepper pot plate, scintillator screen and faraday cup. Both systems are being standardize before MeV energy level for generalize to national labs which are working on detectors and accelerators. We believe such a setup could be a low budget control and readout example for modern small experiments and educational projects.

14-Sep-22 16:30 – 18:00	Pleanry

WE3 — Wednesday Session 3

Chair: C. Kim (PAL)

WE3I1 16:30 30 **Novel Fast Radiation-Hard Scintillation Detectors for Ion Beam Diagnostics**

***P. Boutachkov**, A. Reiter, M. Saifulin, P. Simon, C. Trautmann, B. Walasek-Höhne (GSI) E.I. Gorokhova (GOI) P. Rodnyi, I.D. Venevtsev (SPbPU)*

Novel radiation-hard scintillators were developed in the last years based on indium-doped zinc oxide ceramic with an extremely short decay time in the ns range. Fast counting detectors and fast screen were considered as potential beam diagnostic applications of this material. At the GSI-FAIR facility, scintillation detectors are commonly used for measuring the intensity and detailed time structure of relativistic heavy ion beams. The scintillating material is inserted directly into the beam path. Signal from individual ions are counted, providing systematic-errors-free beam intensity information. Standard scintillators require frequent maintenance due to radiation damage. To address this limitation a large area ZnO radiation hard detector was developed. The detectors are operated at orders of magnitude higher irradiation level, at higher counting rates and has better time resolution compared to a plastic scintillator. In addition, the material opens the possibilities for applications in other beam diagnostics systems, for example scintillation screens for transverse profile measurements. Therefore, this novel material is of general interest for the beam diagnostics.

WE3C2 17:00 20 **Time-Resolved Proton Beam Dosimetry for Ultra-High Dose-Rate Cancer Therapy (FLASH)**

***P. Casolaro**, S. Braccini, G. Dellepiane, A. Gottstein, I. Mateu, P. Scampoli (AEC) P. Scampoli (Naples University Federico II)*

A new radiotherapy modality, known as FLASH, is a potential breakthrough in cancer care as it features a reduced damage to healthy tissues, resulting in the enhancement of the clinical benefit. FLASH irradiations are characterized by ultra-high dose-rates (>40 Gy/s) delivered in very short irradiation times (<1s). This represents a challenge in terms of beam diagnostics and dosimetry, as detectors used in conventional radiotherapy show saturation or they are too slow for the FLASH regime. In view of the FLASH clinical translation, the development of new dosimeters is therefore fundamental. Along this line, a research project is ongoing at the University of Bern aiming at setting-up new beam monitors and dosimeters for FLASH. The proposed system features sub-millimeter fast scintillators coupled to optical fibers, which transport the light pulses to SiPMs, readout by a high bandwidth digitizer. The first prototypes were exposed to the 18 MeV proton beam of the Bern medical cyclotron. The new beam dose monitors have been found to be linear in the range 20-210 Gy/s, with 10 μs resolution for a

655 ms acquisition. These characteristics fulfill the challenging requirements of FLASH.

WE3C3 17:20 ²⁰ **Fast Spill Monitor Studies for the SPS Fixed Target Beams**

F. Roncarolo *(CERN)*

At the CERN Super Proton Synchrotron (SPS) the proton beam is supplied to the fixed target experiments in the North Area facility (NA) via a slow extraction process, taking place at 400 GeV. The monitoring of the spill quality during the extraction, lasting 4.8 seconds with the present SPS setup, is of high interest for minimising beam losses and providing the users with uniform proton-on-target rates. The monitor development challenges include the need for detecting, sampling, processing and publishing the data at rates ranging from few hundred Hz to support the present operation to several hundreds of MHz to serve future experiments proposed within the Physics Beyond Collider (PBC) programme. This paper will give an overview of the ongoing studies for optimizing the existing monitors performances and of the R&D dedicated to future developments. Different techniques are being explored, from Secondary Emission Monitors to Optical Transition Radiation (OTR), Gas Scintillation and Cherenkov detectors. Expected ultimate limitations from the various methods will be presented, together with 2022 experimental results, for example with a recently refurbished OTR detector.

WE3C4 17:40 20 **Tests and Simulations on Carbon Nanotube Yarns as a Material for Beam Intercepting Instruments in HiRadMat**

A. Mariet*, B. Moser, R. Veness (CERN) M. Devel, J.E. Groetz (UFC)*

With the planned increase of luminosity at CERN for HL-LHC and FCC, instruments for beam quality control must meet new challenges. The current wires, made up of plain carbon fibers and golden tungsten would be damaged due to their interactions with the higher luminosity beams. We are currently testing a new and innovative material, with improved performance: carbon nanotube yarns (CNTY). The HiRadMat (High Radiation for Material) experimental line at the output of the SPS can irradiate targets at 440 GeV/c. Numerous Carbon Nanotube Yarns (CNTY) with various diameters were irradiated with different intensities, later imaged with a SEM microscope and tested for their mechanical properties. In addition, simulations have been carried out with the FLUKA particle physics Monte-Carlo code, in order to better understand the mechanisms and assess the energy deposition from protons at 440 GeV/c in those CNTY wires, depending mainly on their diameters and densities. This could lead to a good estimation of the CNTY temperature during irradiation. In this contribution, we first present the HiRadMat experimental setup and then we discuss the results of our Fluka simulations.

TH1 — Thursday Session 1

Chair: T. Lefevre (CERN)

TH1I1 09:00 30 **First Measurement of Longitudinal Profile of High-Power and Low-Energy H Beam by Using Bunch Shape Monitor with Graphite Target**

R. Kitamura *(JAEA/J-PARC)*

At J-PARC Linac, bunch shape monitors (BSMs) have been used to measure a longitudinal profile of high power H^- beam. Operational principle of the monitor is similar to that of the streak-camera. The BSM inserts a biased-solid target into H^- beam to extract and accelerate secondary electrons. These electrons are then modulated with synchronized RF. After passing through dipole B field, a longitudinal profile is converted to a transverse one. For the BSM, a choice of target material is essential to reduce beam loss and to have sufficient tolerance for breakage by the interaction with high power beams. The BSM with graphite target realized the measurement of high-power 3 MeV beam for the first time.

TH1I2 09:30 30 **Experimental Verification and Analysis of Beam Loading Effect Based on Precise Bunch-by-Bunch 3d Position Measurement (remote contribution)**

Y.M. Zhou *(SSRF)* ***Y.M. Zhou*** *(SARI-CAS)*

Beam loading effect is one of the main bottlenecks of synchrotron radiation light source to further improve performance. The theoretical analysis and numerical simulation of beam loading effect had been done very well, but the corresponding diagnostics tools relatively poor, usually only streak camera is used to observe the synchronous phase distribution and the intensity distribution in bunch train. SSRF developed precise bunch-by-bunch 3D beam position measurement system. Equipped with this system not only steady-state beam parameters (filling pattern, synchronous phase, bunch lifetime), can be accurately measured and recorded, but also transient stage data can be perfectly captured and recorded. Therefore, the beam loading effect can be more comprehensive and accurate experimental verification and analysis. In this paper, the measurement results of synchronous phase, synchronous tune, synchronous oscillation damping time and other parameters with and without third harmonic cavity are introduced and discussed.

TH1C3 10:00 20

Single-Shot Electro-Optic Detection of Bunch Shapes and THz Pulses: Fundamental Temporal Resolution Limitations and Cures Using the DEOS Strategy

***C. Szwaj**, S. Bielawski, C. Evain, E. Roussel (PhLAM/CERLA) C. Gerth, B. Steffen (DESY) B. Jalali (UCLA)*

Recording electric field evolutions in single-shot and with sub-picosecond resolution is required in electron bunch diagnostics, and THz applications. A popular strategy consists of transferring the unknown electric field shape onto a chirped laser pulse, which is eventually analyzed. The technique has been investigated and/or been used as routine diagnostics at FELIX, DESY, PSI, Eu-XFEL, KARA, SOLEIL, etc. However fundamental time-resolution limitations have been strongly limiting the potential of these methods. We review recent results on a strategy designed for overcoming this limit: DEOS (Diversity Electro-Optic Sampling). A special experimental design enables to reconstruct numerically the input electric signal with unprecedented temporal resolution. As a result, 200 fs temporal resolution over more than 10 ps recording length could be obtained at European XFEL - a performance that could not be realized using classical spectrally-decoded electro-optic detection. Although DEOS uses a radically novel conceptual approach, its implementation requires few hardware modifications of currently operating chirped pulse electro-optic detection systems.

TH1C4 10:20 20

Advancing the Steady State Microbunching Experiment at the MLS With an Enhanced Detection Scheme

***A. Kruschinski**, J. Feikes (HZB) A. Hoehl, R. Klein, J. Puls (PTB)*

The Steady State Microbunching (SSMB) Proof-of-Principle experiment at the Metrology Light source (MLS) has shown the viability of the concept and investigates the physics behind the mechanism of microbunching, which is envisioned to provide very high power coherent synchrotron radiation at a storage ring facility. In the initial stages of the experiment, it was not possible to detect the coherent radiation of interest directly. A new detection scheme that overcomes this difficulty using fast optical switches is presented, as well as newest results obtained.

TH2 — Thursday Session 2

Chair: W. Blokland (ORNL)

TH2I1 11:00 30 **Experimental Single Electron 6d Tracking in IOTA (remote contribution)**

A.L. Romanov *(Fermilab)*

This talk focuses on the upcoming first ever direct 6-dimensional tracking of a single electron in a storage ring with the goal to enable a new class of beam diagnostic technologies. This will allow high precision characterization of a single-particle dynamics. This works builds off previous experimental 3-dimensional tracking of the dynamics of a single electron in the Fermilab Integrable Optics Test Accelerator (IOTA). At IOTA, we will detect single photons randomly emitted by an electron over many turns to precisely reconstruct its trajectory. State of the art technologies of photon detection have temporal and spatial resolution sufficient for the high-precision tracking if coupled with advanced analysis algorithms. Complete tracking of a point-like object will enable the first measurements of single-particle dynamical properties, including dynamical invariants, amplitude-dependent oscillation frequencies, and chaotic behavior. These single-particle measurements will be employed for long-term tracking simulations, training of AI/ML algorithms, and ultimately for precise predictions of dynamics in present and future accelerators.

TH2C2 11:30 20 **Upgraded CMS Fast Beam Condition Monitor for LHC Run 3 Online Luminosity and Beam Induced Background Measurements**

J.M. Wanczyk *(CERN)*

The fast Beam Condition Monitor (BCM1F) for the CMS experiment at the LHC was upgraded for precision luminosity measurement in the demanding conditions foreseen for LHC Run3. BCM1F has been rebuilt with new silicon diodes, produced on the CMS Phase 2 Outer Tracker PS silicon wafers. The mechanical structure was adapted to include a 3D printed titanium circuit for active cooling of BCM1F sensors. The assembly and qualification of the detector quadrants were followed by the integration with Pixel Luminosity Telescope and Beam Conditions Monitor for Losses on a common carbon fibre carriage. This carriage was installed inside the CMS behind the Pixel detector, 1.9 m from the Interaction Point. BCM1F will provide a real-time luminosity measurement as well as a measurement of the beam-induced background, by exploiting the arrival time information of the hits with a sub-bunch crossing precision. Moreover, regular beam overlap scans at CMS were introduced during Run 2, enabling an independent and non-destructive transverse profile measurement for LHC Operators. The paper describes the improved BCM1F detector design, its commissioning and performance during the beginning of Run 3 operation.

TH2I3 11:50 30

Experimental Demonstration of Optical Stochastic Cooling: Single-Particle Feedback in the Optical Regime

J.D. Jarvis *(Fermilab)*

The first realization of stochastic cooling in the optical regime was recently achieved at Fermilab's Integrable Optics Test Accelerator (IOTA) storage ring using the transit-time method of Optical Stochastic Cooling (OSC). OSC uses free-space electromagnetic waves as the signaling medium, pickup and kicker undulators to couple the radiation to the circulating particle beam, and optical amplifiers for signal amplification. Stable cooling was successfully demonstrated in one, two and three dimensions and OSC experiments were performed with a single electron stored in IOTA. The total cooling force in these non-amplified OSC experiments was approximately an order-of-magnitude larger than the natural longitudinal synchrotron-radiation damping. These achievements required precise alignment and femto-second accuracy of the particles with their respective undulator-radiation pulses along with a wide range of technical and diagnostic elements. We describe the integrated OSC system, its performance and comparison to theoretical expectations, and our OSC R&D program that includes advanced concepts in beam cooling and control.

15-Sep-22 12:20 – 12:50 Pleanry

THC — Conference Closing

Chair: A.I. Wawrzyniak (NSRC SOLARIS)

CLOSE 12:20 30 **Invitation to IBIC 2023**

Tonia Batten *(Canadian Light Source, CLS))*

The Organizing Committee of the next IBIC conference invites to everybody to Saskatoon, Saskatchewan to attend IBIC'23 in September 10–15, 2023.

— C —

— G —

— H —

— K —

— M —

Authors

Scientific program

Start time	Sunday	Monday	Tuesday	Wednesday	Thursday
		MO1: Overview and Commissioning	TU1: Beam Position Monitors // Machine Parameter Measurement	WE1: Trans. Profile and Emi. Monitors // Machine Parameter Measurement	TH1: Longitudinal Diagnostics and Synchronization
		Chair: A. Wawrzyniak	Chair: N. Hubert	Chair: L Bobb	Chair: T. Lefevre
08.45		A. Wawrzyniak: Welcome & Opening Remarks			
09.00			TU1I1: S. Gibson (RHUL): Electro-Optical BPM Development for High Luminosity LHC	WE1I1: A. Novokshonov (DESY): First Observation of Quasi-Monochromatic Optical Cherenkov Radiation in a Dispersive Medium (Quartz)	TH1I1: R. Kitamura (J-PARC): First Measurement of Longitudinal Profile of High-Power and Low-Energy H- Beam by using Bunch Shape Monitor with Graphite Target
09:10		MO1I1: J. Szlachetko (NSRC): Science Directions in Poland at the Large Scale Accelerator's Based Infrastructure			
09:20					
09:30				WE1C2: N. Samadi (PSI): An X-Ray Beam Property Analyzer Based on Dispersive Crystal Diffraction	TH1I2: Y. Zhou (SARI-CAS): Experimental Verification and Analysis of Beam Loading Effect Based on Precise Bunch-by-Bunch 3d Position Measurement (remote, pre-recorded contribution)
09:40		MO1I2: R. Nietubyc (NCBJ): Overview of Beam Diagnsotics for POLFEL	TU1I2 A. Oeftiger (GSI): Diagnostics with Quadrupole Pick-ups		
09:50				WE1I3: P. Klag (Uni-Mainz): High Accuracy Measurement of the Absolute Energy by Synchrotron Radiation Interferometry with Relativistic Electrons	
10:00			TU1C3: S. Takano (Spring-8): Beam-Based Calibration of Sextupole Magnet Displacement with Betatron Tune Shift		TH1C3: C. Szwaj (PhLAM): Single-Shot Electro-Optic Detection of Bunch Shapes and THz Pulses: Fundamental Temporal Resolution Limitations and Cures Using the DEOS Strategy
10:10		MO1C3: Th. Hywel Pacey (STFC): Development of a 6d Electron Beam Diagnostics Suite for Novel Acceleration Experiments at Clara-Febe			
10:20			Plenary Discussion	Plenary Discussion	TH1C4: A. Kruschinski (HZB): Advancing the Steady State Microbunching Experiment at the MLS with an Enhanced Detection Scheme
10:30		Coffee break (10:30 to 11:00) parallel to industrial exhibition			
10:40					coffee break (10:40 to 11:00)
10:50					
		MO2: Overview and Commissioning // Machine Parameter Measurement	TU2: Beam Loss Mon. & Machine Prot.// Machine Parameter Measurement	WE2: Feedback Systems and Beam Stability // Data Acquistion	TH2: Machine Parameter Measurements
		Chair: P. Forck	Chair: K. Wittenburg	Chair: T. Batten	Chair: W. Blokland
11:00		MO2I1: S. Lidia (FRIB): Beam Diagnostics for FRIB Commissioning	TU2T1: J. Dooling (BNL): Collimation and Machine Protection for Low Emittance Rings (tutorial)	WE2T1: G. Wang (BNL): Beam Stability Requirements for ultra-low Emittance Circular Light Sources (tutorial)	TH2I1: A. Romanov (FNAL): Experimental Single Electron 6d Tracking in IOTA (remote, pre-recorded contribution)
11:10					
11:20					
11:30		MO2C2: N. Milas (ESS): Beam Tuning Studies in the ESS MEBT			TH2C2: J. M. Wanczyk (CERN): Upgraded CMS Fast Beam Condition Monitor for LHC Run 3 Online Luminosity and Beam Induced Background Measurements
11:40					
11:50		MO2C3: S. Li (PSI): Novel Approaches for Forecasting of Beam Interruptions in Particle Accelerator	TU2C2: E. Calvo Giraldo (CERN): The Diamond Beam Loss Monitoring System at CERN LHC and SPS	WE2C2: J. Breunlin (MAX IV): Beam Stability in the MAX IV 3 GeV Storage Ring	TH2I3: J. Jarvis (FNAL): Experimental Demonstration of Optical Stochastic Cooling: Single-Particle Feedback in the Optical Regime
12:00					
12:10		Faraday Cup Award: Handout & talk: MO2I4: Ihar Lobach (APS, before FNAL): Statistical Properties of Undulator Radiation	TU2C3: Alan Stephen Fisher (SLAC): Commissioning Beam-Loss Monitors for the Superconducting Upgrade to LCLS	WE2I3: M. Masaki (Spring-8): Adaptive Feedforward Control of Closed Orbit Distortion Caused by Fast Helicity-Switching Undulators	
12:20					T. Batten: Presentation IBIC 2023
12:30			TU2I4: G. Petringa (INFN): Acceleration, Transport and Diagnostic of Protons from Laser-Matter Interaction		A. Wawrzyniak: Closing Remarks, Acknowledgements
12:40				WE2C4: P. Beata (PSI): RF Systems-on-Chip for Multibunch and Filling Pattern Feedback	
12:50		Group Photo			Lunch break (12:50 to 14:00)
13:00		Lunch break (13:00 to 14:30)			
					NSRC SOLARIS visit Leaving conference venue 14:00 Return to venue at 18:00
14:30		MOP: Poster session 1 (14:30 to 16:00)	TUP: Poster session 2 (14:30 to 16:00)	WEP: Poster session 3 (14:30 to 16:00)	
14:40					
14:50					
15:00					
15:10					
15:20					
15:30					
15:40					
15:50					
16:00		Coffee break (16:00 to 16:30), parallel to poster session and industrial exhibition			
16:10					
16:20					
	Registration Start 16:30	MO3: Beam Position Monitors	TU3: Transverse Profile and Emittance Monitors	WE3: Beam Charge & Current Mon. // Transverse Prof. & Emi. Mon.	
		Chair: U. Iriso	Chair: A. Cianchi	Chair: Ch. Kim	
16:30		MO3I1: G. Rehm (HZB): Review of BPM Drift Compensation Schemes	TU3I1: A. Koehler (DLR): Investigating the Transverse Dynamics of Electron Bunches in Laser-Plasma Accelerators	WE3I1: P. Boutachkov (GSI): Novel Fast Radiation-Hard Scintillation Detectors for Ion Beam Diagnostics	
16:40					
16:50					
17:00		MO3C2: L. Stant (DLS): Diamond-II Electron Beam Position Monitor Development	TU3C2: C. Salgado (CLPU): Angular-Resolved Thomson Parabola Spectrometer for Laser-Driven Ion Accelerators	WE3C2: P. Casolaro (AFC-Bern): Time-Resolved Proton Beam Dosimetry for Ultra-High Dose-Rate Cancer Therapy (FLASH)	
17:10					
17:20		MO3C3: H. Aoyagi (Spring-8): Pulse-by-Pulse Photon Beam Position Measurements at the SPring-8 Undulator Beamline	TU3C3: A. Goldblatt (CERN): LINAC4 Laser Profile and Emittance Meter Commissioning	WE3C3: F. Roncarolo (CERN): Fast Spill Monitor Studies for the SPS fixed Target Beams	
17:30					
17:40		MO3C4: N. Baboi (DESY): Beam Position Monitoring of Multi-bunch Electron Beams at the FLASH Free Electron Laser	TU3C4: D. Levin (Uni Ann Abor): A High Performance Scintillator Ion Beam Monitoring System	WE3C4: A. Mariet (CERN): Tests and Simulations on Carbon Nanotube Yarns as a Material for Beam intercepting Instruments in HiRadMat	
17:50					
18:00	Welcome reception				
18:30					
19:00				Conference dinner: Start 19:00	
20:00					
22:00					