

Overview of the Diagnostics Systems of SOLEIL and DIAMOND

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Abstract

SOLEIL and DIAMOND are two third-generation light sources in construction in France and in Great Britain respectively. SOLEIL is scheduled to deliver its first photons to its users in 2006 and DIAMOND in 2007. This talk will present the beam diagnostic systems of both projects with emphasizing technological novelties and the instruments that are essential to their performances: BPM system, profile monitors and feedback systems.

Paper not received

(See slides of talk on
following pages)

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Jean-Claude Denard and Lodovico Cassinari: SOLEIL
Mike Dykes and Rob Smith : DIAMOND

DIPAC 2003 (IT02)
Mainz, Germany; 4-7 May 2003

Outline

- Machines
- Status and construction schedules
- Diagnostics challenges
- Beam Stability and BPMs
- BPM electronics
- BPM mechanics
- Other diagnostics

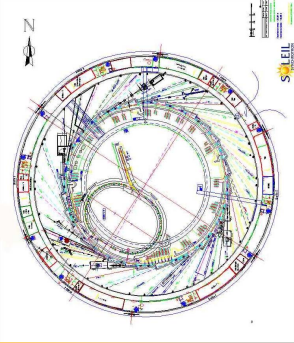
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SOLEIL
SYNCHROTRON

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of SOLEIL and DIAMOND; Jean-Claude Denard*

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SOLEIL



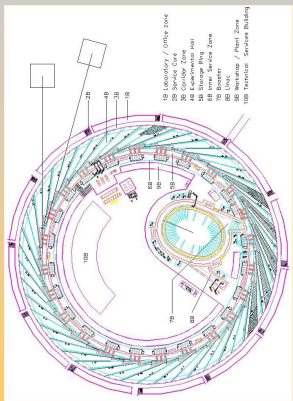
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DIAMOND




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SOLEIL, Artist view



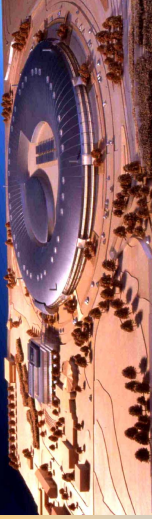
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DIAMOND; Artist View




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SOLEIL Site April 2003




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DIAMOND Site April 2003



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Time Schedules

Milestones	SOLEIL	DIAMOND
Start LINAC Commissioning	Aug 2004	May 2005
Start Booster Commissioning	Jan 2005	Aug 2005
Start Storage Ring Commissioning	Apr 2005	Jan 2006
Start operation for users	Jan 2006 (10 beamlines)	Jan 2007 (7 beamlines)

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Diagnosics Challenges

- Tight schedules and budget + slow build up in manpower
 - Buy on-the-shelf components whenever possible
 - Subcontract diagnostics design and/or construction
 - Non-essential diagnostics built after commissioning
- Submicron beam stability → → → Submicron BPM resolution and stability

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Beam Stability and BPMs

Basic Principle: users are more sensitive to drifts than beam quality is sensitive to quad centering (1 μm versus 100 μm)

- Steer beam to quad centers $\pm 0.1\text{mm}$ ⇒ golden orbit
- Global orbit feedback looks beam on BPMs
- Beam stability ≈ BPM stability
- Once golden orbit done : reference is the BPMs (not the quads anymore)
- BPMs are supported with respect to the GROUND = reference of users
 - Straight section BPMs on posts fixed on ground (invar posts)
 - Other BPMs fixed on girders (next best thing after the ground)
- Check beam stability with photon-BPMs (no FB with Photon-BPMs)
- Orbit expected to stay close to golden orbit until next alignment

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BPM Requirements for SOLEIL

	Slow FB	Fast FB	First turns	Turn-by-turn
Absolute accuracy	$\leq 20 \mu\text{m}$	$\leq 70 \mu\text{m}$	$\leq 500 \mu\text{m}$	$\leq 200 \mu\text{m}$
Resolution	$\approx 0.2 \mu\text{m}$	$\leq 0.2 \mu\text{m}$	$\leq 300 \mu\text{m}$	$\leq 3 \mu\text{m}$
Measurement rate	$\geq 1000 \text{ Hz}$	$\geq 4000 \text{ Hz}$	847 kHz	847 kHz
Dynamic range	20 - 600 mA	20 - 600 mA	0.4 - 4 mA	4 - 600 mA
Current dependence	$\leq 1 \mu\text{m}$	$\leq 1 \mu\text{m}$	$\leq 500 \mu\text{m}$	x
8-h drift	$\leq 1 \mu\text{m}$	$\leq 1 \mu\text{m}$	$\leq 500 \mu\text{m}$	x
1-month drift	$\leq 3 \mu\text{m}$	$\leq 3 \mu\text{m}$	$\leq 500 \mu\text{m}$	x
bunch pattern dependence	$\leq 1 \mu\text{m}$	$\leq 1 \mu\text{m}$	$\leq 50 \mu\text{m}$	$\leq 500 \mu\text{m}$

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DIAMOND BPM Electronics

- Straight section BPMs equipped with 4-channel system (i-Tech)
 - Low noise for Fast feedback (~ 3 to 100 Hz)
 - 1st-turn and machine study (turn-by-turn) on straight section BPMs
 - Current dependence and long term stability not a problem on fast FB
- Arc BPMs equipped with multiplexed electrode system (Bergoz)
 - Very good stability for slow feedback (0 to $\sim 3 \text{ Hz}$)
 - Very good stability versus beam current (standard non top up operation)

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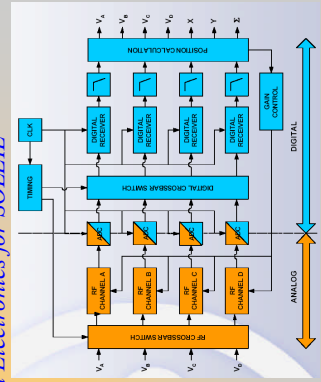


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New i-Tech Electronics for SOLEIL

Has advantages of both worlds: multiplexed and 4-channel systems



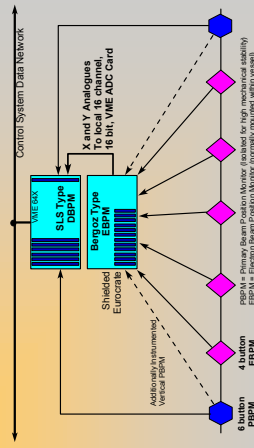
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DIAMOND BPM Electronics (one cell)



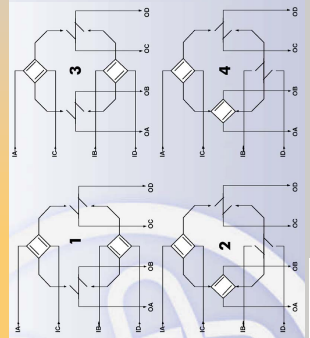
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RF Crossbar Switch



Courtesy of Rok Urste of I-Tech

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SOLEIL BPM Electronics

- Basic Principles: one type of monitor and one type of electronics
 - Keeps system simple
 - Reduces engineering and installation efforts
 - Eases maintenance
- New SOLEIL electronics developed by I-Tech
 - Multiplexing the 4-channels brings the best of both worlds
 - 0.2 μm resolution, submicron stability with current, bunch pattern, temperature → fits Slow and Fast feedback systems
 - All BPMs are equipped with 1st turn and machine study capabilities
 - Beam loss history to all BPMs
 - Adjustable threshold interlock output on all BPMs

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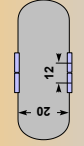


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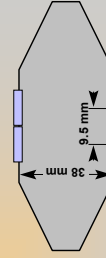
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DIAMOND BPMs

Straight sections BPMs



Arc BPMs



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