Diagnostics Experts of European Light Sources

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ALBA Synchrotron

Book of Abstracts

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Welcome

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FERMI Machine Protection System

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At FERMI, beam losses and radiation doses are real-time monitored by an active Machine Protection System (MPS) to protect the facility's permanent undulator magnets from radiation-induced demagnetization. We have implemented dedicated Beam Loss Monitors with high spatial resolution; these rely on the detection of Cherenkov light in quartz fibers using multi-pixel photon counters. Furthermore, conventional Ionization Chambers have been installed equipped with a new front-end electronics package, as well as solid-state RADFET dosimeters providing an online measurement of the absorbed dose in the undulator magnets.

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Status of optimized BeamLoss Detector tests & developments at Petra-3 & ESRF

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At Petra-3 it is discussed to replace the existing Beam Loss Detector (BLD) system by a new one. A first test was made at the ESRF with an existing detector system from the E-XFEL. We review this test together with results and future plans of a fast BLD system at the ESRF, allowing beam loss detection on a turn-by-turn scale.

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BPM layouts for the new ESRF

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The layout of the ESRF-LE Ring has now been defined with 10 BPMs per cell. There are 2 versions of BPM-block geometry with different sizes of the button diameter (6 and 8mm). In addition to that a certain (small) number of additional BPMs will be equipped with a 6 button BPM-block version. The fixation of the BPM blocks (to what and how) is still under study and also the impact of (any too close proximity of) bellows with associated RF-finger structures.

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Commissioning of the new BPM electronics in the ESRF Booster

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This system was installed & commissioned in February. The 75 Spark units are inside the Tunnel, at about 3m RF cable length from their BPM heads, improving thereby sensitivity and resolution and also reducing much RF cable costs. The results will be presented, notably on the now extended functionalities with the processing of the T-b-T position data and the Sum data that reveals interesting features & characteristics of the accelerated beam. Also the pros & cons of the compact Spark with Power-over-Ethernet system and In-Tunnel installation with respect to more classical signal acquisition systems will be discussed.

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Parasitic and leakage RF fields affecting the BPM readings at the ESRF

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The installation of so-called Solid-State-Amplifiers (SSA) for the RF-cavities nearly 2 years ago had initially produced an excessive level of perturbation to the results of nearby BPM through the SSA leakage fields being picked-up by low-quality RF cables. The replacement of these, and additional shielding plates around the cabinets holding the Libera-electronics, has reduced this impact to acceptably low levels., but still noticeable when operating with low SR beam currents. This has given rise to investigate further this point of the entire BPM system (BPM-head, RF-cables, Liberas) being sensitive to (even very) low levels of parasitic RF fields. For this we have devised a portable low-power RF-emitter with a hand-held antenna, and took a full recording of all BPM signal levels while walking this antenna around the Ring (both inside & outside Tunnel). The obtained results will be presented and high-light the impact of any parasitic RF fields on BPM stability.

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Modeling of spin depolarisation at ESRF and ALS

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The difficulty to find a sharp spin depolarsiation resonance at the ESRF (see DEELS 2014) motivated a careful analysis of the depolarisation process. A spin tracking code was developed by collegues in the Beam Dynamics Group. It allows to follow the electron spins of many particles as they propagate in the storage ring lattice while being excited by an oscillating magnetic field. The output of the code is the polarisation of the electron beam after N turns in the storage ring. Simulations were done for the ESRF and the Australian Synchrotron. The results reveal substantial differences in the

depolarisation behaviour of the two storage rings in accordance with the experimental findings. We would be interested in simulating the depolarisation at other light sources and compare the results with measurements in order to validate the code and get a deeper understanding on which parameters are favourable for the detection of distinct spin depolarisation resonances.

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Electron Energy Measurements at ANKA

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We have performed electron beam energy measurements via resonant spin depolarization and more recently also via Compton Backscattering under 90° (first time at a storage ring).

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Feedback systems at ALBA

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ALBA Fast Orbit Feedback is now in operation since last month. Eventhough there are still many utilities to be developed, the system has shown great performance without failures. The parallel implementation of the Fast Archiver turned to be a perfect tool for the FOFB commissioning. The archiver stores position data from the BPMs at the 10kHz rate used by the FOFB, being a powerful device for feedback failure detections and analysis of possible noise sources like magnets power supplies.
The Bunch-by-Bunch feedback system was recently tested with beam. It's based on the Libera BbB electronics and the Diamond EPICS controls. Collaboration with Diamond colleagues has proved the possibility of system integration into ALBA machine.

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Coping with the future top up mode of operation at ESRF

Author: Eric Plouviez[None]

In 2016 the ESRF storage ring will be operated in top up mode in order to suppress the temperature drift in the beam lines due to the beam current decay. The benefit coming from this improved beam current stability must not be spoiled by the degradation of others beam parameters caused by the frequent injections required by this new mode of operation.
In order to deal with this issue, we are trying to develop systems aiming at:
1- Reducing the orbit perturbation and the parasitic betatron oscillation caused by operation of the pused magnets (kickers and septum) of the injection system. These perturbations are not an issue when the injection is performed every 6 hours but are not acceptable when the injection occurs every few minutes.
2- Avoiding the injection of electrons in the buckets of the storage ring which should be left empty according to the filling patterns of the ring defined for the time structured mode of operation of the

storage ring. Presently, we perform a cleaning sequence on the SR beam after each injection, but this scheme will not be possible anymore in the top up mode.

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Beam angle interlock

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Anatomix and Nanosopium beamlines are collecting photons generated by two insertion devices installed on the same (canted) straight section. Simultaneous operation of those two beamlines requires particular precautions in terms of alignment of the undulators. To avoid any damage on the downstream undulator due to mis-steering of the beam in the upstream one, the machine safety system has been modified. An interlock on the beam angle has been implemented. A description of the system and its performances will be presented.

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Soleil transverse projects and collaborations in Diagnostics

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Soleil diagnostic group is implied in different transverse projects and collaborations that represent a substantial part of its activities:
• Femto-slicing operation at SOLEIL
• ThomX project (Compton backscattering X-ray source)
• COXINEL project: FEL demonstrator based on LWFA
This presentation reports on the status of those three projects with a focus on the diagnostic equipment.

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FERMI: an overview with insights on the Optical Timing system and Longitudinal Diagnostics

Author: Mario Ferianis[None]

Fermi is the seeded FEL facility in operation at Elettra Trieste (Italy), since Aug 2009. It is proving its unique coherent radiation, in the 100 to 4nm spectral range, to a growing Community of Scientists from all over the world. In this talk, after a short introduction to FERMI, a deeper insight into FERMI state of art Timing system and longitudinal diagnostics is provided.

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(Vertical) Beam Size Measurements at ANKA

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For transverse beam size measurements we have the following diagnostics devices at hand at ANKA:
- Synchrotron light monitor (can resolve the horizontal beam size nicely, but not the vertical beam size)
- Double-Slit Interferometer (can resolve the vertical beam size nicely)
- DIAX (can resolve the vertical beam size nicely, but only above 2.3 GeV)
- Fast-Gated Intensified Camera with a flipping mirror (can resolve the horizontal beam size with single-shot measurements even in a multi-bunch environment

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Interferometry measurements at ALBA

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Synchrotron radiation interferometry is used at ALBA to measure the horizontal and vertical beam size (~50 and 20 um). Since the quantity of light is relatively low, a double pinholes system was preferred to the double slit one and, as a consequence the theoretical formula for the fitting process had to be updated. Moreover the diagnostic beamline is almost all "in air"and the light fan suffer for air turbulence and mechanical vibrations. To overcome these inconvenient the exposure time of the CCD has to be set as low as possible. To be sure of the linearity of the CCD at such a low exposure time the device was tested with an "home-made"setup. Finally to achieve an appreciable dynamic range, images are superimposed by a dedicated matching algorithm.

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Pinhole Camera issues at Diamond

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Our Pinhole assembly has clogged up frequently with 'something', possibly Tungsten Oxide. We have explored a variety of mitigations (including those used at other labs) and will report on success and failure.

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(Mysterious) Vertical beam size measurements using in-air X-ray Detector

Author: Andriy Nosych[None]

An in-air x-ray detector (IXD) is used for vertical beam size measurements at ALBA. The IXD intercepts the residual x-rays (above 120 keV) which are left of the main flux after passing through copper

absorbers. These x-rays generate a visible footprint on a sensitive scintillator and are observed by a CCD camera equipped with simple optics with the exposures in the order of 1-10 seconds. This measurement allows evaluation of the original electron beam size; however, at the moment, several unexpected systematic effects are not understood and forbid the reliable application of IXD for ALBA diagnostics. Among these effects are a) enlarged x-ray fan size w.r.t. theoretical value, b) varying (very low) intensity of the residual x-rays if sampled at different but geometrically identical locations of the machine, c) attenuation effect of the absorber "teeth" on the x-ray fan.

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Challenges for emittance diagnostics for the ESRF low emittance lattice

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The ESRF will install a new low emittance lattice from 2019 onwards. The horizontal design emittance of about 110 pmrad will give rise to a very small vertial emittance which in the extreme/ideal case of a perfectly well corrected machine may reach values below 1 pmrad. The measurement of such emittances is a challenge for mainly two reasons : the small source beam sizes and the very limited space available in the layout of the new lattice. Some estimations of the reachable theoretical resolution of an X-ray pinhole and a lens imaging setup will be presented as well as a first sketch of the mechanical layout. A discussion on alternative high resolution emittance diagnostics will follow.

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Streak camera optimisation at Diamond

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The presentation will show:
a) How to get a small point spread function with high flux and dispersion free optics
b) How to quickly re-calibrate the timescales using an electrical delay rather than an optical delay

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Ultra-Fast Linear Array Detector Development

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In collaboration with PSI, DESY, Lodz University and HZDR, we are developing an ultra-fast linear array detector system at KIT. The main development purpose of the system is for turn-by-turn based electro-optical spectral decoding diagnostics for which the spectrum of a single laser pulse has to be recorded at 2.7 MHz in order to reconstruct the longitudinal bunch profile. We are producing both an InGaAs-based version (sensitive in the near-infrared range) and a Si-based version (sensitive in the visible range).

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Time Correlated Single Photon Counting at ALBA

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The (almost) final version of the time correlated single photon counting at ALBA is operative since the beginning of 2015. The setup had been implemented using a copper absorber as mirror for visible radiation, a fast PMT as photon detector and the PicoHarp 300 as photon counter. A tango version for the PicoHarp software was also implemented from the ALBA computing staff. Dynamic ranges of the order of 10^4 had been reached and the setup is ready to be used to drive the top-up injection.

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Insertion Device Antennas

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We recently put three antennas inside an in-vacuum insertion device to see what resonances are excited by wakefield. First observations of spectra as a function of ID gap will be shown.

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Picking up the 100th RF harmonic

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Next to our 7-channel Schottky Barrier Diode Detector array (which covers 33-750GHz), we also attempted mixing to receive harmonics of the RF between 50-75GHz from coherent emissions of the bunches.

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Final Remarks

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Impact on Relative Humidity on EBPM readings

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A correlation between EBPM readings and relative humidity has been discovered in archived data at Diamond. The main impact is on the signal strength (common mode of all four signals), but due to differences between the individual cables there are also X,Y and Q changes. This talk will review how much of the phenomenon is currently understood and what remains to be explained.