WP2: Novel Methods for Accelerator Beam Instrumentation (ABI)
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Keywords: Tools & diagnostic systems for luminosity,
Wire for beam-beam compensation,
Advanced transverse beam diagnostics,
Feedback loops for orbit, chromaticity and coupling,
Advanced beam halo diagnostics,
Remote diagnostics and maintenance of instrumentation.


Active collaboration/coordination on Beam Instrumentation issues has been established with the US-LARP programme and H. Schmickler has attended a coordination meeting at Fermilab on 26-27 February 2004.

Organization of a workshop on Trajectory and Beam position measurements using digital techniques, held in Aumuehle (near Hamburg), on 22-23 June 2004. The presentations are available on the web at http://care-hhh.web.cern.ch/care-hhh/events/CARE-HHH-ABI-Aumuehle-Agenda.htm and proceedings are in preparation. The aim of this workshop was to understand specific problems of implementing new digital technologies for beam orbit and position measurements in hadron machines. The new digital methods have already been successfully implemented in various synchrotron light sources. In these applications submicron resolution and long-term stability over days, even independent of seasonal changes, are the most important design criteria. The digital solutions profit from the electron beams being fully relativistic (no change of revolution frequency) and from the very small variation of bunch intensities. Proposing similar digital technologies for hadron machines confronts the designers with several additional problems:

- A large variation in bunch intensities and filling patterns,
- Change of harmonic numbers with beam in the machine,
- Varying revolution frequency,
- Demands for multi-bunch and multi-turn data.

The purpose of the workshop was also to bring together people with experience from digital orbit systems in Synchrotron Light Sources and people who intend to implement this technology in hadron machines (GSI and CERN). During the three half-day sessions the following was done:

- Review of performance and design issues in light source implementation,
- Review of specifications for hadron machines,
- Attempt of technical solutions and proposal of test measurements.

The workshop had found interest in related industrial partners and those visited the workshop at their own cost. About 20 people from the following labs participated: ESRF, PSI, DESY, GSI, CERN, COSY, TU Darmstadt (plus Bergoz company and i-tech company). Proposed subjects for upcoming CARE-HHH-ABI events include

- Halo measurements (profiles down to $10^{-5}$),
- Lifetime (100 h within 1 sec),
- (PLL) tune tracking, including chromaticity and coupling,
- Longitudinal density monitor (within $10^{-4}$),
- Profiles in high density beams.
Workshop held in Lyon on 1 and 2 December 2004, with about 10 participants. The title is ‘Fast beam current measurements and beam loss monitors for machine protection’ and the presentations are in the web site: http://desyntwww.desy.de/mdi/CARE/Lyon/ABI-Lyon.htm.

During the workshop the presently available technologies were reviewed. It became clear, that for the LHC the demands on signal to noise ratio for the beam current measurements (in particular in order to calculate beam lifetimes from the difference of two consecutive beam current measurements) are such, that the present technology based on magnetic modulators is missing almost an order of magnitude. There is almost no hope to gain this factor from a sequence of small improvements. For the case of the LHC a solution can be found by using the magnetic modulator for standard beam current measurements, but for the more demanding beam life time measurements an uncalibrated system based on bunch to bunch measurements will be used. For the upcoming FAIR project it is likely that due to the high pick currents a magnetic modulator can not be used at all. GSI has launched an R&D program to search for alternatives.

Active contribution to US-LARP collaboration steering on Beam Instrumentation issues.