Beam Instrumentation for CRYRING@ESR

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Introduction

This report gives an overview of the beam instrumentation of the CRYRING@ESR experimental storage ring that is currently in the process of installation at GSI. CRYRING@ESR (see Fig. 1), together with ESR and HITRAP decelerator, will provide new opportunities for various research fields. An independent RFQ injector linac is available for commissioning of the new machine where FAIR standards will be applied for the first time. Three main concepts influence aspects of beam instrumentation:

- FESA: CERN Front-End Software Architecture, a development framework for data acquisition (DAQ) systems. Like any accelerator equipment, a DAQ system is required to provide a FESA control interface for seamless control system integration.
- GMT: General Machine Timing system, a new precision timing system with sub-ns precision based on the White Rabbit protocol. One programmable timing receiver board is installed in each DAQ system and controls execution of real-time actions and DAQ triggers.
- LSA: CERN LHC Software Architecture, the new data supply model for accelerator components. From LSA DAQ systems receive information on beam production, e.g. ion species, energy, charge state, that is needed for on-line calculations.

Linac Injector

The injector beam line will be equipped with dual detectors as used at HITRAP consisting of Faraday cup (FC) and viewing screen (SCR) on a common stepper motor drive. Two units, one before and one after the 90° spectrometer, match the ion source beam to the RFQ entrance. Two further units match the RFQ beam to the CRYRING injection. Longitudinal matching is adjusted by a new debuncher. For phase and energy measurements, three capacitive pickups have been added. The FC readout will be adopted from existing FESA systems. The SCR readout is described in [2].

CRYRING

After transport to GSI at the end of 2012, all detectors, front-end amplifiers and special low-noise electronics were carefully checked. Non-intercepting detectors are the eight beam position monitors (BPM), an integrating/parametric current transformer for bunched/coasting beam (ICT/PCT),

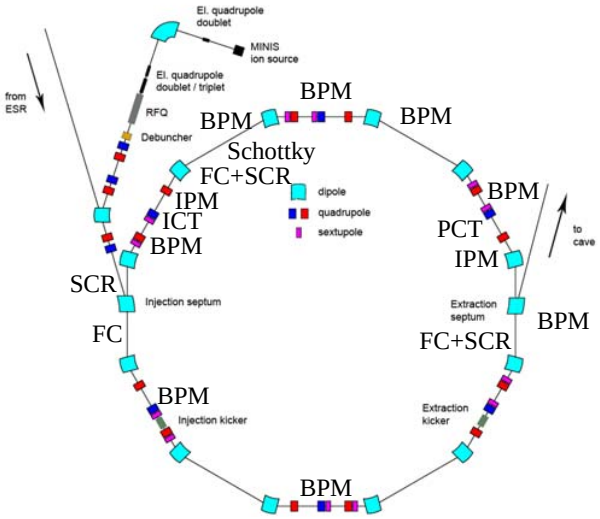

Figure 1: Layout and Diagnostics of CRYRING@ESR.

two ionisation profile monitors (IPM) and Schottky electrodes. Most equipment can be integrated in the new DAQ systems. Only new low-noise BPM amplifiers had to be designed with switchable 40/60 dB gain and bandwidth filter. The BPM DAQ is a new design based on μTCA components, a modern telecommunication standard with high throughput and reliability. The signals are acquired by 250 MSa/s ADCs of 16 bit resolution and position evaluation takes place directly on an FPGA. A prototype system is expected to be ready by the end of this year. For intensity measurements a VME scaler system combines signals of different detectors: Schottky and BPM sum signals, IPM count rates, ICT and PCT transformer signals. For profile measurements the IPMs are equipped with position-sensitive resistive anode encoders. The pre-amplifier signals are shaped in a spectroscopy amplifier and the output signals analysed by a peak-sensing ADC in a VME DAQ which calculates the histograms.
The existing 1st turn FC diagnostics will be upgraded by new FC and SCR detectors of FAIR standard. One special screen will be added at the end of the new injection section that has been upgraded for higher injection energies.

References

[1] M. Lestinsky et al., CRYRING@ESR Study Group Report, June 2012
[2] B. Walasek-Höhne, CUPID, this GSI report

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