Control Software for the Ionization Profile Monitor of ESR@GSI

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After installation and successful commissioning of the new ESR@GSI Ionization Profile Monitor (IPM) [1,2] a capable control and readout software was required to support experiments like [3,4]. Due to the distributed system architecture several software tools and graphical user interfaces were developed for image-data network-storage, MCP calibration, defect pixel correction, high voltage control, user action logging, graphical user interfaces, digital IO configurtaion, etc.

Basic principle of IPM: The heavy ion beam ionizes the residual gas along the beam path. The ionized gas particles are accelerated transverse to the beam direction onto a phosphor screen. Before the residual gas particles hit the phosphor they are multiplied by a MCP in chevron configuration. The impacting particles create light spots on the phosphor screen which are viewed by a digital CCD camera from outside the vacuum. The phosphor screen has a rectangular shape of approximately 100 mm by 50 mm. On the phosphor screen the impacting residual gas particles create a luminous path in beam direction whose width corresponds to the width of the ion beam. These 2 dimensional images of the beam path are recorded by digital CCD cameras. Afterwards the images are integrated in beam direction to gather the beam profiles. To consider the defect pixel of the CCD a correction table is created at times. The number of beam profiles is equivalent to the cameras frame rate.

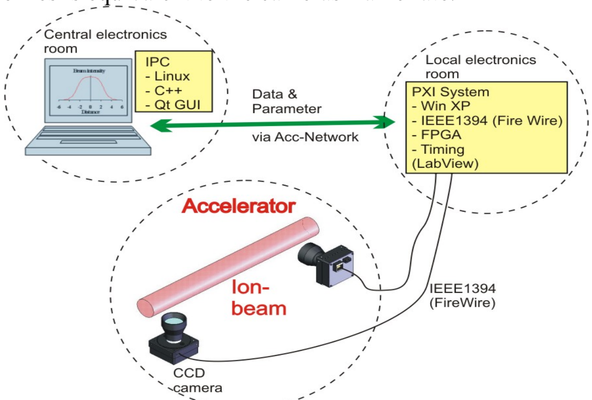

Figure 1: IPM DAQ system overview.

The data readout and analysis system consists of a DAQ (data acquisition) frontend system located in a local ESR electronics room and a DAN (data analysis) system located in the central electronic room. Both systems (DAQ and DAN) communicate with xml command strings sent via the GSI accelerator network. The splitting is necessary because of the strong deterministic timing requirements of the beam profile measurement.

The DAQ system consists of a PXI Crate with a 2.2 GHz pentium mobile controller with 1 GByte Ram and a 40 GByte hard disc drive to store the beam profile images during the measurement. The commercial frontend software is LabView® running on a XP® operating system. The two digital CCD cameras are connected to a PXI FireWire card. A PXI FPGA Module controls the external triggering of the cameras and the UV lamp calibration of the in-vacuum detector. Furthermore the FPGA includes several scaler channels. The frontend system is directly controlled by the new control software.

IPM Control Software

The control software is written in C++ with the Qt GUI framework. The main features of the software concern the readout of the two digital CCD cameras, the control of the IPMs high voltage system, the access to the digital IO ports, the data processing and display of measurement data.

When a start trigger occurs from machine timing or manually by an operator, the PXI system starts triggering the CCD cameras with a deterministic frame rate. Each time a beam image is measured all scaler channel are readout by the FPGA module. The scaler data represent amongst others the qualitative signals of the beams dc current, the dipole excitation and the rf signal. After the end-trigger the DAQ system waits until all measured data are downloaded to the DAN system. Then the DAQ system is initialized for the next start trigger.

Additionally, a new MCP-PH-Holder was developed providing much better performance at reduced risk for flashovers. This device was CAD designed and tested under vacuum conditions with an UV light calibration lamp of 120 nm wavelength.

Outlook

The new developed software will also be used for the new IPM@SIS18. The ipmproved MCP-PH-Module will be installed in the IPM@SIS18.

References

[1] M. Schwickert et al., “Beam Diagnostic developments for FAIR”, Proc. DIPAC09, Basel (2009).
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[3] M. Bussmann, D.F.A. Winters, et al., COOL09 Proceedings, IMPCAS Lanzhou, Atomic Energy Press, 22 (2009).
[4] D.F.A. Winters, “Laser cooling of stored relativistic C^{3+} ions at the ESR”, GSI scientific report 2013.