# Low Current Profile Measurements using a Current-to-Frequency-Converter (QFW)

*M. Witthaus, J. Adamczewski-Musch, H. Flemming, J. Frühauf, S. Löchner, H. Reeg and P. Skott*

GSI, Darmstadt, Germany

## Overview

The development of a prototype system with 8 Current-to-Frequency Converter (QFW) ASICs [1] is a collaboration between the Beam Diagnostics and the Experiment Electronics departments at GSI since 2010 [2]. This electronic device will provide an economic alternative readout for Secondary Electron Monitor (SEM)-profile grids or similar beam diagnostic devices like Multi-Wire Proportional Chambers (MWPC) or Ionization Chambers. Transverse beam profiles with a time resolution down to the microsecond range have been recorded successfully during different test campaigns at GSI beam lines.

## Hard- and Software

The developed and used hard- and software is described in [2]. The software (FPGA control unit and GO4) was improved to measure up to 100 time slices. As a result, the time resolution during the beam pulse measurement is significantly increased. Additionally, the prototype was extended to 2*32-input channels recently, whereby the control unit operates with two existing prototype motherboards.

## Measurement Results

Further measurements were performed with a 2*32-wire MWPC in the HEBT beam line at GSI.

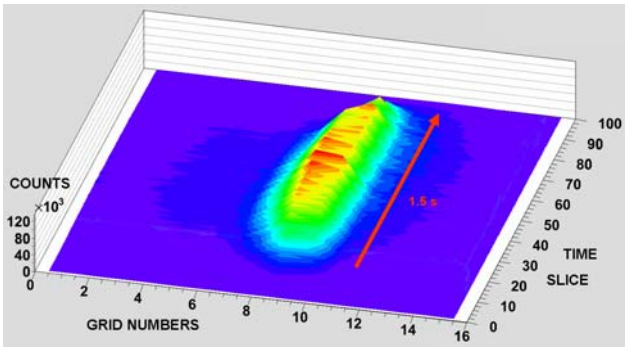


Fig. 1: Time-dependent profile of a MWPC, 300 MeV/u $^{40}Ar^{18+}$ beam

Fig. 1 shows the vertical time-dependent beam profile from the first half of the MWPC x-plane (16 out of 32 wires). The beam duration is about 1.5 s and each time slice represents 20 ms. The profile data is analysed with GSI Object-Oriented Online Offline system (GO4).

## Next Development Step

After promising and successful beam campaigns with different ion species it was decided to develop a revised prototype motherboard, now with 64 input channels.

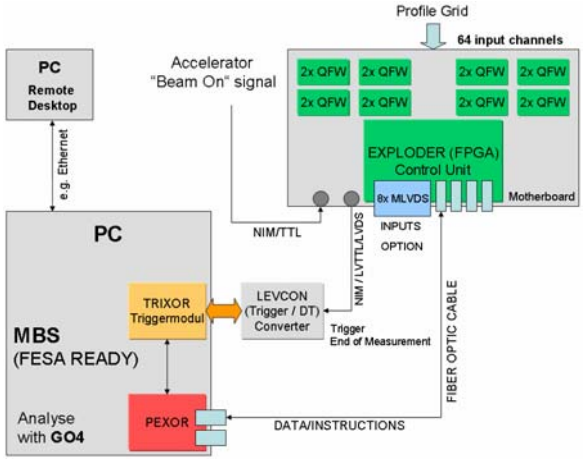


Fig. 2: Block diagram of the prospected readout system

The next development step of the readout system is shown in Fig. 2. This new board contains 16 QFW-II ASICs for 64 channel inputs in total and a FPGA Control Unit called EXPLODER [3] providing also the network communication electronics. The board sends the measured data to a PEXOR card [3] and in turn receives all the QFW parameters. The QFW parameters are set via EPICS (Experimental Physics and Industrial Control System). The measured data of the profile grids are transferred to the MBS (Multi Branch System) DAQ system by the PEXOR card. The LEVCON [3] and TRIXOR [3] modules are necessary for the MBS trigger operation. The last one is installed in a PC which is controlled by Remote Desktop Protocol. For now, the beam profiles are analyzed and displayed by GO4 software.

In this stage the VME-crate with various VME-boards is no longer necessary. The new compact design is ready for Front-end Software Architecture (FESA), and presents an economic solution for future applications at GSI and FAIR. The use of MBS will be continued for testing purposes or in case of experiments with beam, until it is replaced by FESA.

## References

[1] H. Flemming and E. Badura, "A high dynamic charge to frequency converter ASIC", GSI Sci. Rep., 2004

[2] M. Witthaus et al., "SEM-Grid Prototype Electronics with Charge-Frequency-Converter", GSI Sci. Rep., 2010

[3] EXPLODER, PEXOR, TRIXOR and LEVCON are hardware boards, developed by GSI Experiment Electronics department; see: *http://www.gsi.de/informationen/wti/ee/elekt_entwicklung/module.html*