WEPO011: Upgrading the Beam Diagnostic of the HZB- Cyclotron from an Analogue to a new Digital Platform
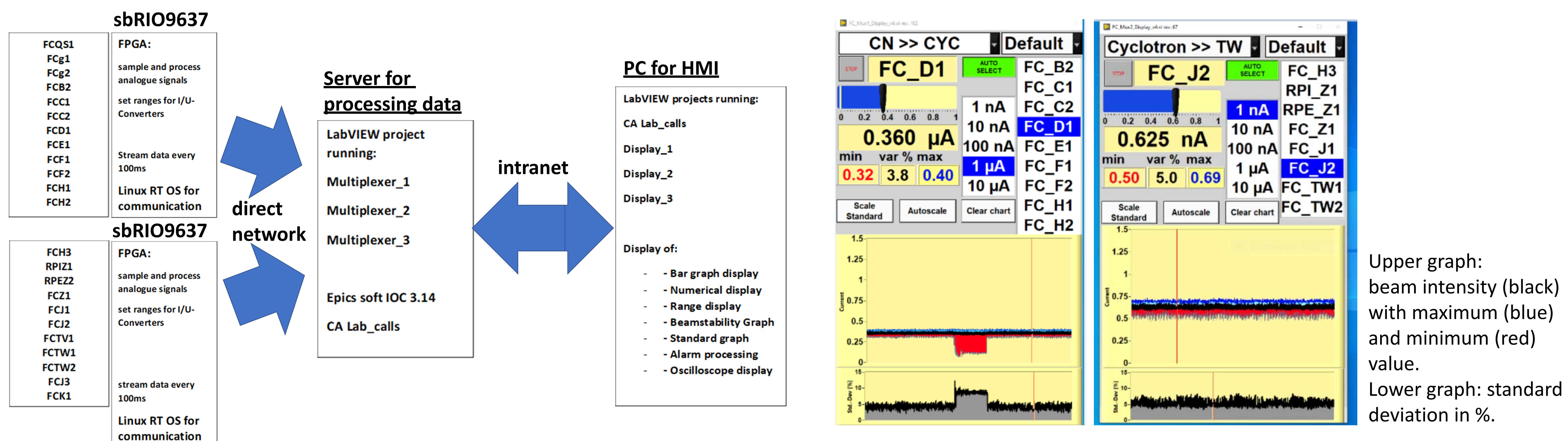
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Motivation

- old analogue Multiplexers extremely difficult to service (wire-wrap technique)

- the same hardware base for Faraday cups (FC) and beam profile monitors (BPM), both have to be replaced

- new demands, e.g. FC: beam stability given in standard deviation or logfiles
  BPM: save signal and compare with former beam settings

well-proven and hence retained:

- home made I/U-converters work fine

- interconnections between I/U-converter and multiplexer can be reused
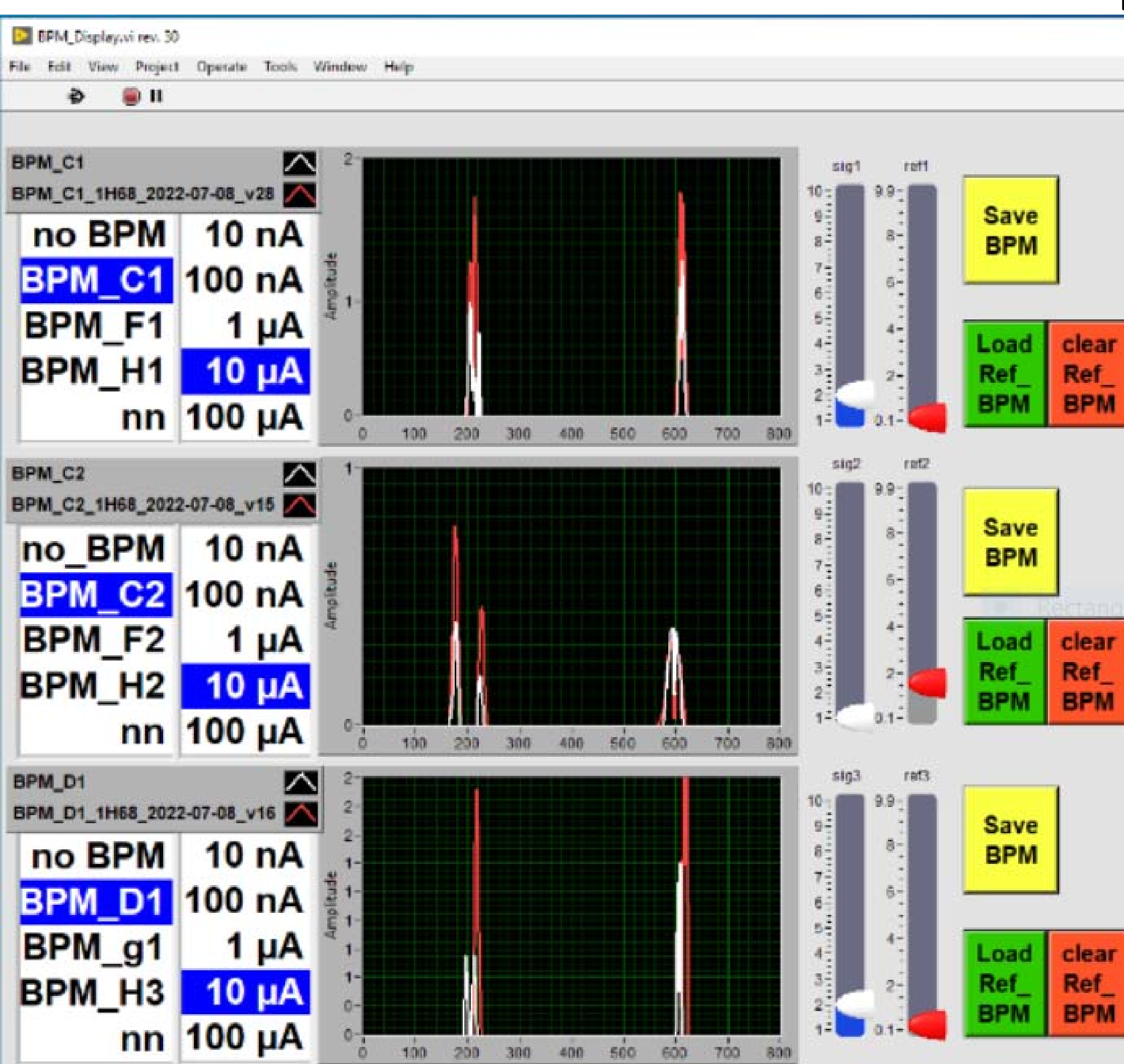
New Faraday cup multiplexer

30 channels for Faraday cups, measuring up to 200 µA with a resolution down to 1 pA. Sampling rate is 10 kHz
Selecting the appropriate beam line section gives access to the corresponding Faraday cups.

Upper graph: beam intensity (black) with maximum (blue) and minimum (red) value.
Lower graph: standard deviation in %.

New setup: 30 channels for Faraday cups are connected to two PCB´s interfacing between I/U-converters and 2 boards of NI-sbRIO9637. These boards process analogue values with 10kHz and stream every 100 ms the data to the server, where these data are processed and published to the intranet via the EPICS softIOC.

In the control room a display shows the current of the Faraday cups obtained via Intranet and EPICS-variables. This is updated every 100 ms with minimum-maximum-average values and calculated standard deviation for the last 100ms. The left graph shows the influence of a Beam Profile Monitor, a rotating wire interacting with the beam in front of FCD1.

New Multiplexer for Beam Profile Monitors (BPM)

It is built with the same new hardware like the multiplexer of the Faraday cups (see middle left), but has only one PCB and sbRIO9637. One further server processes the data and runs softIOC to transfer the BPM-data as EPICS process variables.
Left: display of the BPMs in the control room.
Three out of 16 BPM´s can be displayed simultaneously. The distribution of the BPMs to the displays is chosen that the focussing in dedicated beam line sections is visible. They are updated with 25 Hz, each signal consists of 400 points.
It is possible to save the BPM images and reload them for comparison of the focussing. This reference signal (red) from the same BPM can be overlayed to the live signal, allowing easy beam adaptation.

Conclusion

- The new multiplexers are running reliable since 2019. The new functions for Faraday cups are very useful in fine tuning the beam stability in respect of focussing of the beam, phases and amplitudes of the RF-systems.
- The save-and-restore function of the BPMs is helpful when comparing beam settings and is often employed.
- The use of nearly the same hardware set-up for both systems made the development easy and straightforward.

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