

# UPGRADE OF THE BEAM PROFILE MONITORING SYSTEM IN THE INJECTION BEAM LINE OF COSY

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IBIC15  
TUPB016

## Introduction

The cyclotron Julic is used as an injector for the COSY synchrotron and storage ring of 183 m circumference. The 95 m long injection beam line (IBL) transports polarized and unpolarized  $H^+/D^-$  ions which are injected into the ring via multi-turn stripping injection. 8 profile monitoring stations are installed in the IBL. Each station contains two harps having 39 wires at 1mm spacing. Each harp is read out by a multichannel pico-amperemeter electronics designed by iThemba LABS, South Africa, delivering profile data to the COSY control system. The technical details of the upgrade and recent beam profile measurements are presented.

## Motivation and Boundary Conditions

### Problems with initial setup

- Initial harp readout electronics has reached end of life
- Centralized architecture, numerous harps are multiplexed to one current measurement device
- No simultaneous profile measurements at multiple locations possible
- Outdated communication protocols

### Reasons for upgrade

- Reliable operation of a profile/position measurement system in the IBL is vital for achieving reasonable beam transfer efficiency from the cyclotron to COSY
- Simultaneous measurements at all harp stations are useful

### Boundary conditions

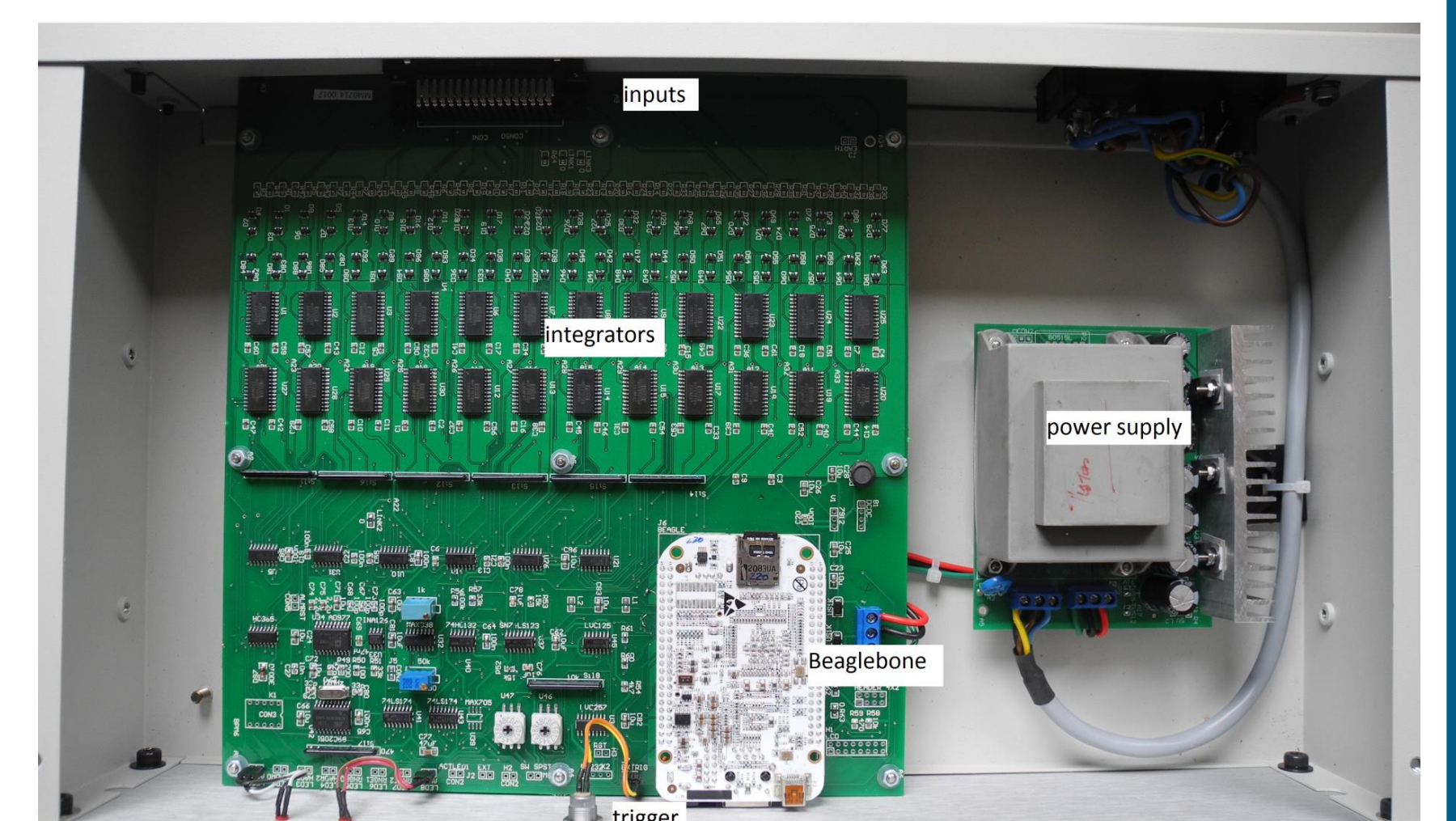
- The harps stay unchanged
- No changes to the vacuum parts or drives
- Modular approach
- Place readout electronics as close to the harps as possible
- Ethernet based communication
- Built in EPICS server preferred
- Time frame < 1 year

## Hardware

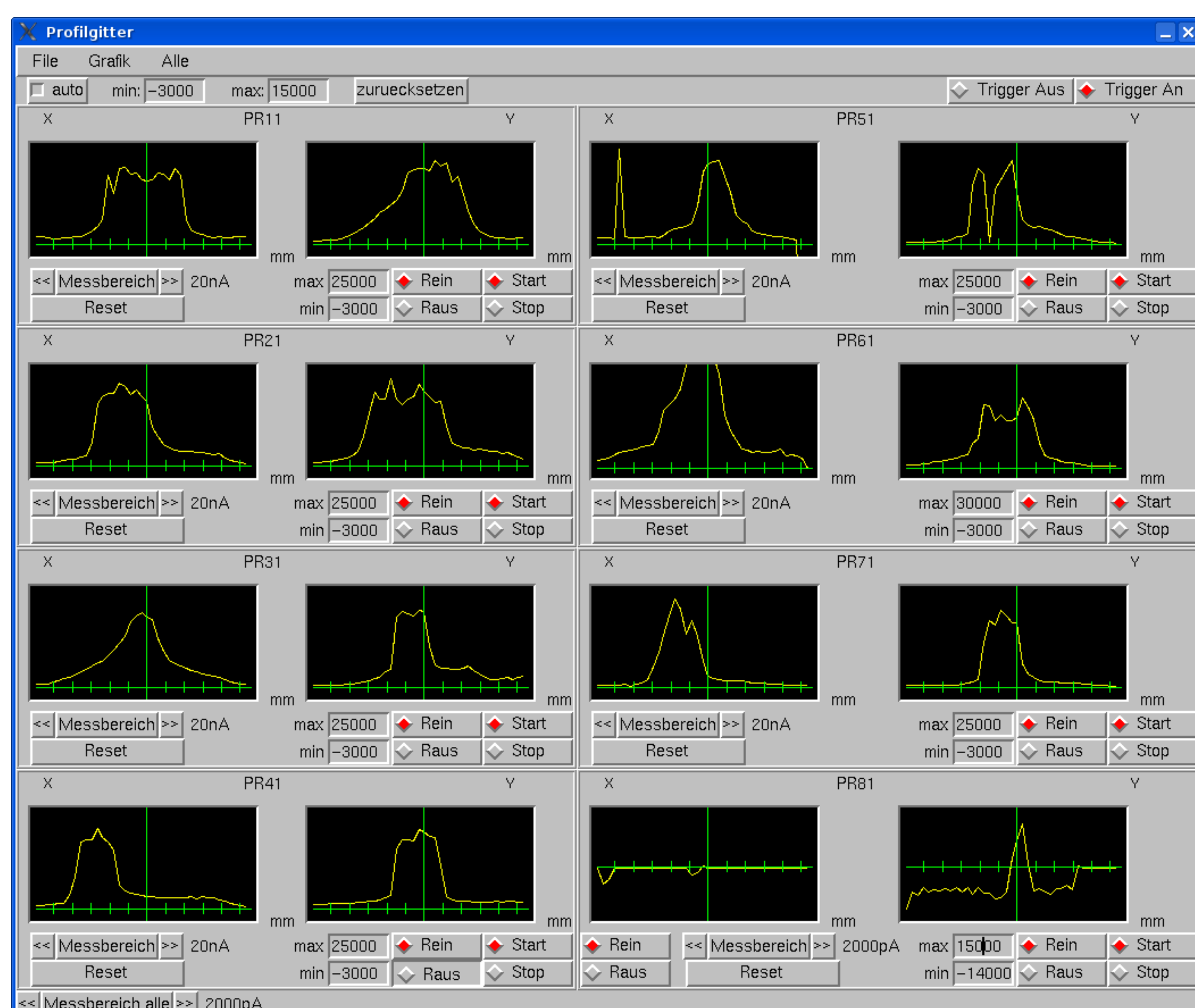
- 8 profile monitoring stations
- 39 wires in each harp at 1mm spacing
- Pneumatic drives
- One drive for both X and Y harps

### New readout electronics

- Designed and built by iThemba LABS
- Based on Burr Brown ACF2101 chip
- Beaglebone board running Ubuntu is used for control of integrator chips, ADC, timing and communication
- Built in EPICS server
- 10 pA – 200  $\mu$ A
- 6 measuring ranges
- 1 pA resolution
- 48 channels



## Results



An example of a simultaneous beam profile measurement at all 8 stations using the new readout electronics and the modified GUI.

## Summary & Outlook

- The upgrade of the profile monitoring system of the COSY IBL was completed by the beginning of 2015.
- The GUI was modified to work with the new hardware
- New features implemented in the GUI
- The readout electronics is installed in the IBL tunnel
- Occasional hardware resets required due to radiation and software issues

### To do

- Automatic beam position and width measurements and logging
- Using the position and width values for an automated model based IBL optimization procedures

## References

- G.W. Tautfest and H. R. Fechter, A Nonsaturable High Energy Beam Monitor, Rev. Sci. Instr. 26, 229 (1955)
- Böhme, C., Untersuchungen zur Profilmessung von Hadronenstrahlen mittels Restgaslumineszenz und -ionisation, Technical University Dortmund, 2011