VMM DEVELOPMENT AND TESTING IN MAINZ

VMM DEVELOPMENT INFRASTRUCTURES

DETECTORS

CERN detector

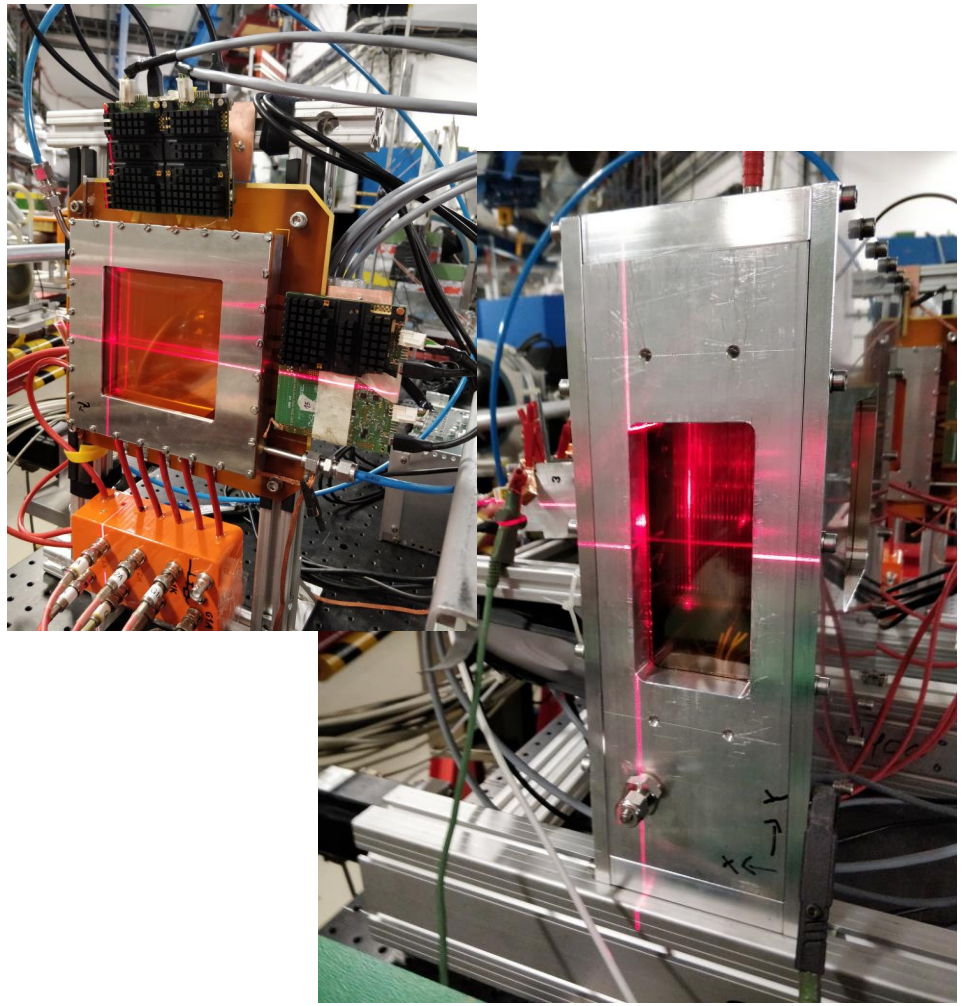
- 10x10 cm active surface
- 256x256 crossed strips (0.4 mm pitch)

Small TPC

- 10x10x10 cm active volume
- 64 pads (2x8 mm) x 12 parallel rows

Test detector

- Gas box with interchangeable readout board for special purposes



DETECTOR INFRASTRUCTURE

Gas distribution system

- 3 Gas mixing system with PT sensors, oxygen and moisture monitoring
- Mass spectrometer

Clean workbench

- Small one to assemble GEM detectors
- Large one with a flatness measurement system for quality control

Power supplies and electronics

- Movable rack with all the necessary components for detector operation:
  - NIM and VME crate
  - Low and high voltage power supplies
  - Computer, and SRS readout system

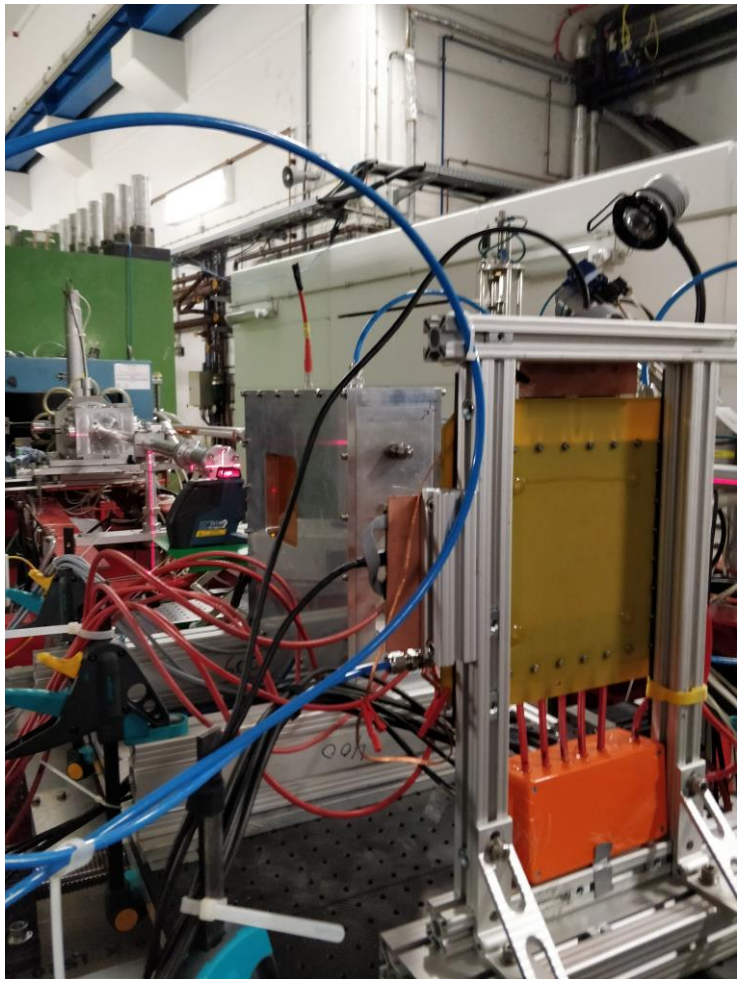
MAMI TEST-BEAM LINE

Dedicated detector test line

- 95-855 MeV electrons
- Currents up to several nA but typically used in the pA range, up to approx. 10 MHz hit rate
- Typically 3-4 test-beam opportunities every year

2D moving table

- Size approx. 1x2 m
- Vertical movement range approx. 50 cm
- Steerable through an EPICS interface



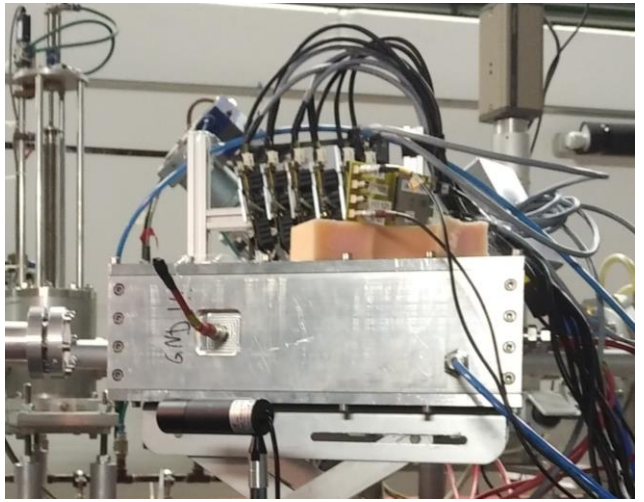
VMM EQUIPMENT

Current available hardware

- SRS Minicrate with two FECs
- 2x DVM-Card v4 (1 in Bonn)
- 8 VMM hybrids shared with Bonn (3 fully working currently in Mainz)
- 2 VMM currently on loan from CERN

New hardware to be delivered

- 2 DVM-Card v5
- 7 VMM 3a hybrids
- 1 CTF card (clock distribution)
- Will allow to use TPC and CERNdet in parallel



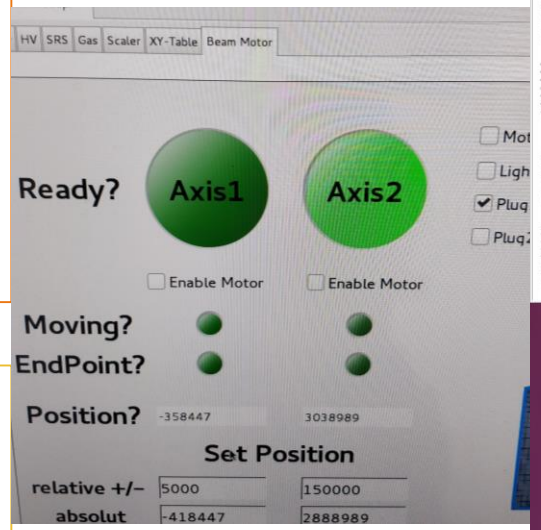
SOFTWARE

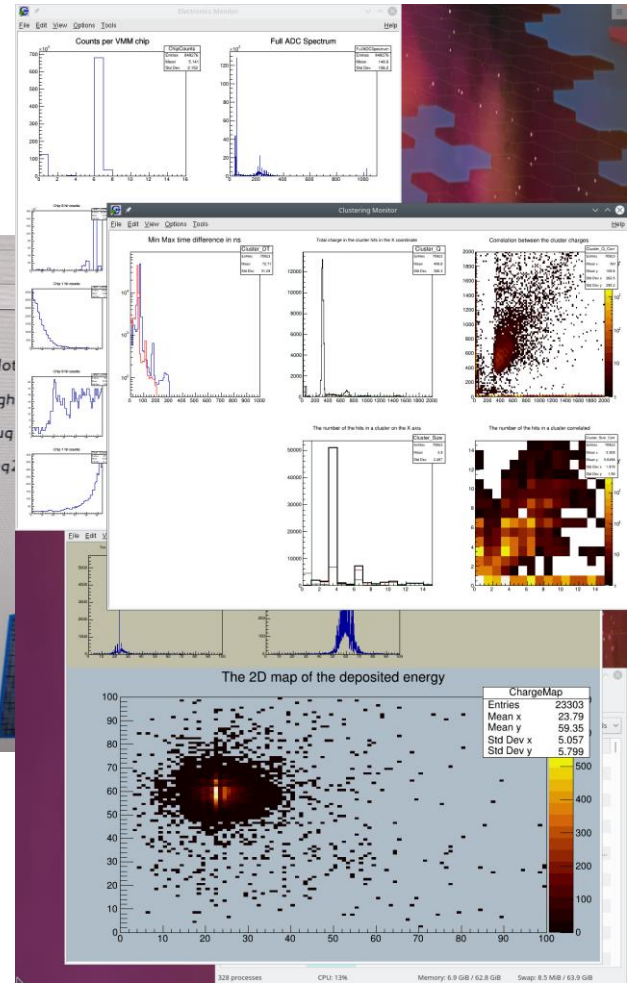
EPICS based slow control

- All our equipment controlled through EPICS
- An EPICS service allows to control the SRS as well
- A limited set of the VMM functionalities can also be controlled through EPICS
- VMM DCS used to access the complete set of functionalities

VMM DAQ software

- Simple prototype DAQ used in the last few months
- Listen to the SRS ports and dumps the UDP packages on disk
- Optionally the file can be monitored with a ROOT macro



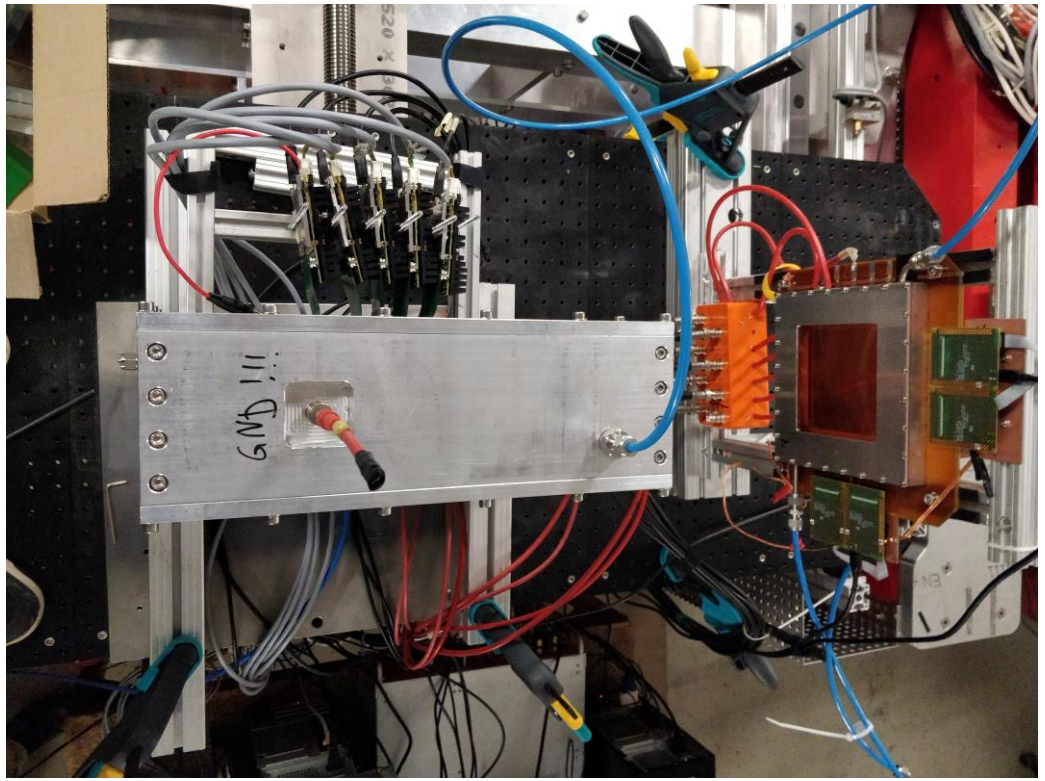


TEST CAMPAIGNS

TPC TEST MAY 2019

First VMM experience

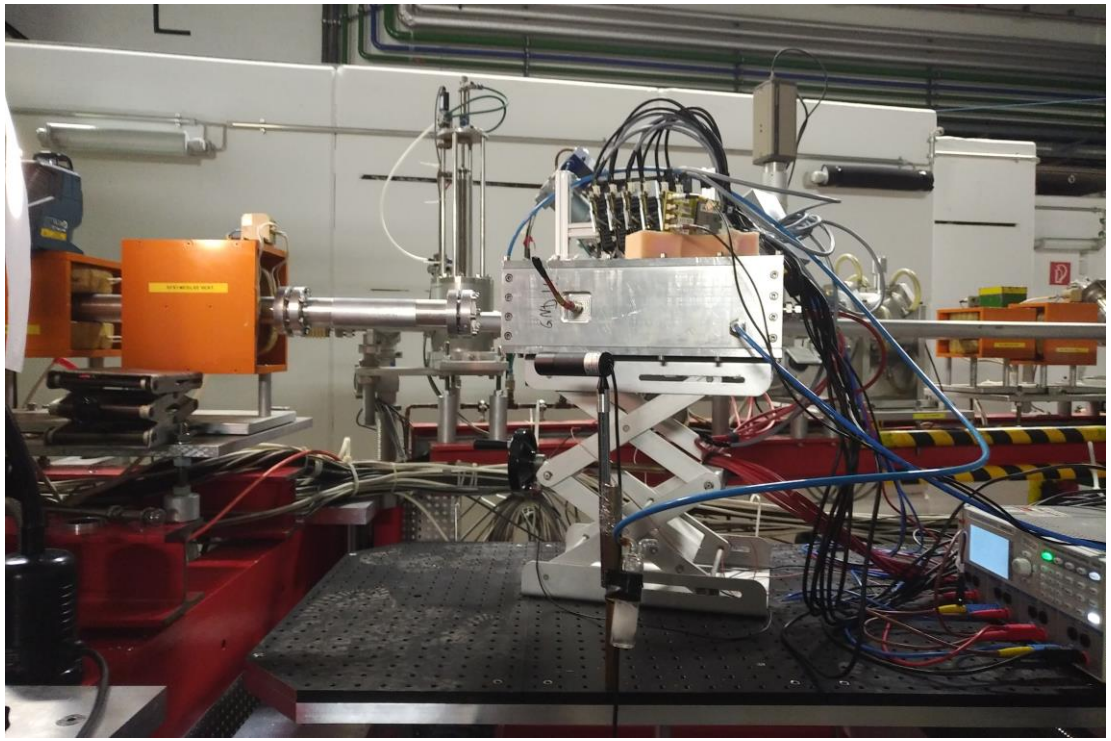
- 4.5 VMMs on the TPC for tracking
- 4 APVs on the CERN detector for position reference
- ESS acquisition chain
- Analysis incomplete due to some data corruption
- VMM/APV synchronization is not trivial
- Useful to understand all the features of the VMM and develop the next test campaign



TPC TEST NOVEMBER 2019

VMM for trigger readout

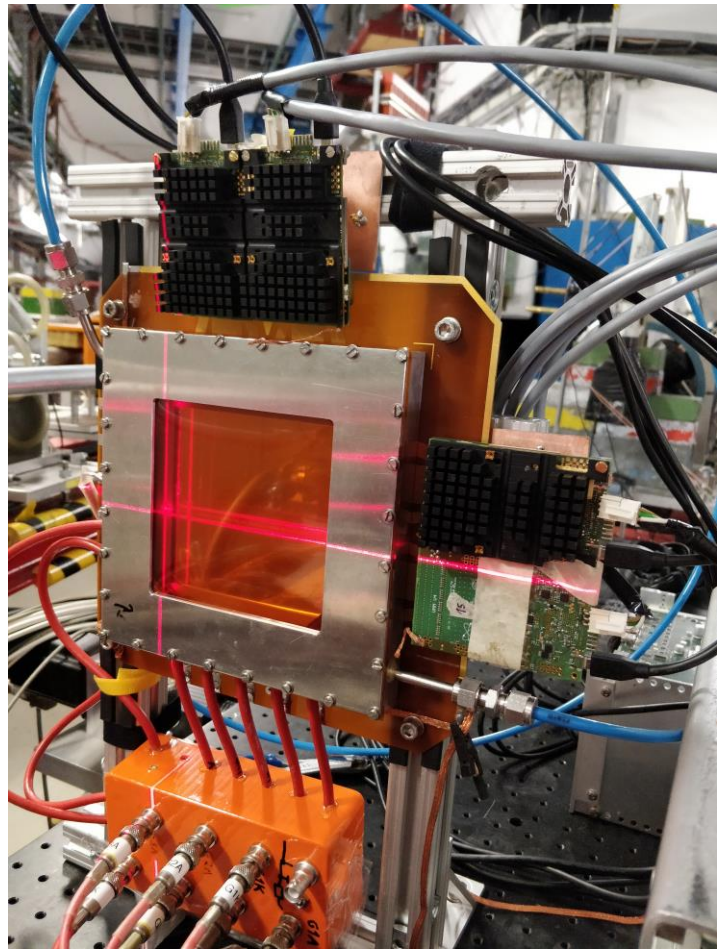
- 6 VMMs on the TPC for tracking
- 1 VMM connected to the trigger scintillators
- A new DAQ prototype with EPICS slow control
- Tested at rate up to approx. 1 MHz
- More information in P. Gülker talk on Tuesday



STUDENT EXPERIMENT JANUARY 2020

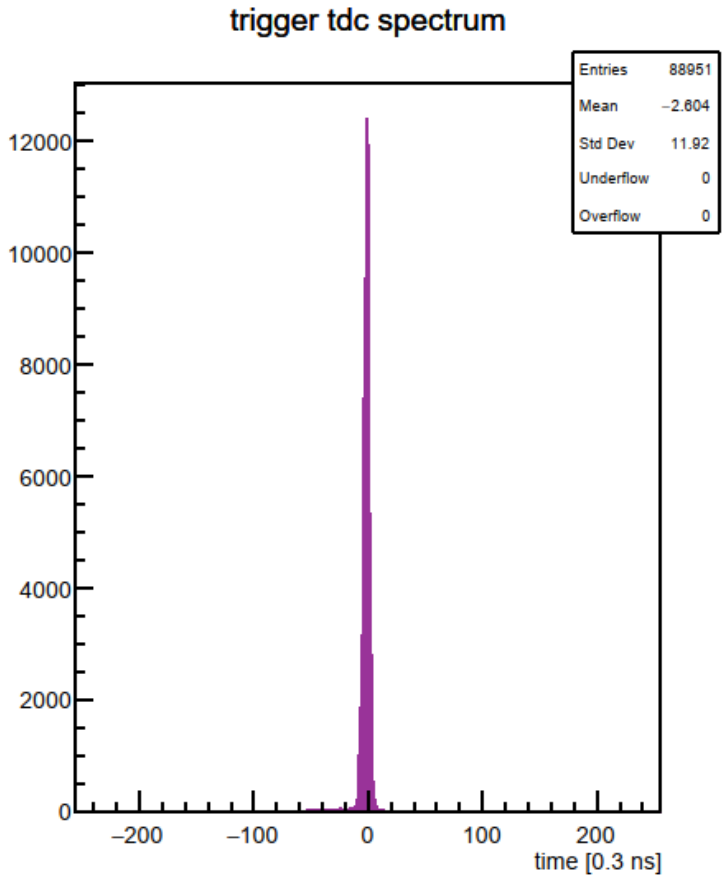
VMM easy-to-use

- 4 VMMs connected to the CERN detector
- No external triggering
- 4 master students measuring the radiation length of different materials
- 2 hours setup and manual calibration
- 4 hours data taking



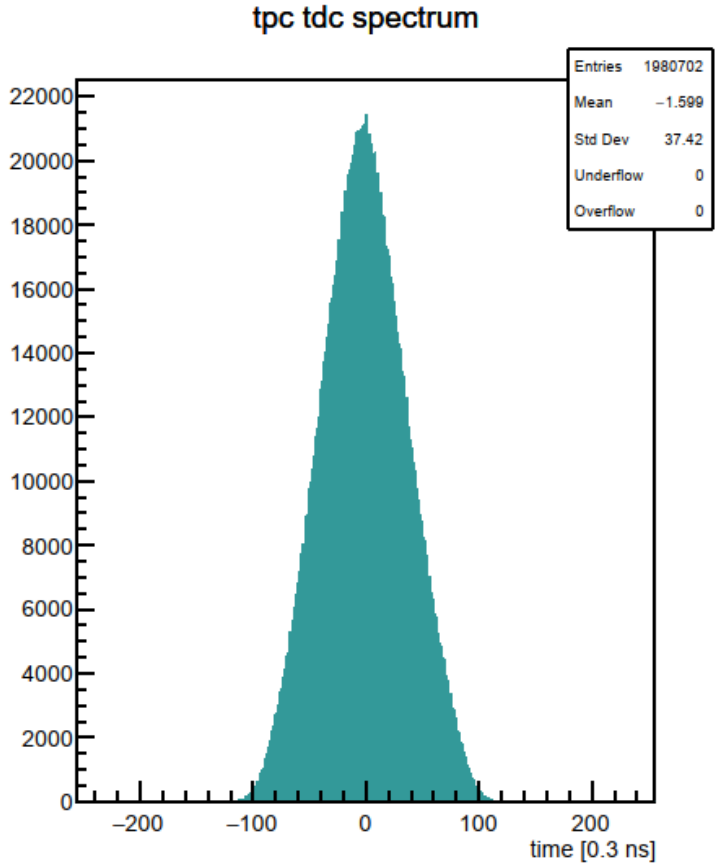
UNDERSTANDING AND DEVELOPING THE VMM-SRS SYSTEM

TRIGGER READOUT & PRECISE TIMING



We can make an SRS-VMM only experiment readout

- PMT signals connected through an adapter board
- Approx. 3 ns time resolution on the trigger signals
- Approx. 10 ns time resolution on the TPC signals
- Removed the problem of synchronizing different readout chains



NOISE AND AUTOMATIC CALIBRATION

Finding the right working point

- Manually adjust the threshold of each VMM so that the noise level is "low enough"
- Mask possible noisy/broken channels
- Do it again if something changes
- Time consuming, arbitrary

An automated system

- Lower the threshold systematically until we see the noise fluctuations
- Fit the shoulder of this distribution for each channel to evaluate the pedestal value and width
- Adjust the discriminator threshold with fine tuning for each channel
- Additionally automatically mark noisy or dead channels
- The DAQ and the slow control should work together for this type of operation

DAQ AND CONTROL

Libraries for control and acquisition

- Independent from the specific front-end tool they are used into
- Allows to build and extend those tools in a community friendly way

Simple DAQ service

- Generic acquisition tool for SRS
- Plugin decoders for different frontends (VMM, APV, eventually SAMPA maybe)
- Serialization to disk and network forwarding to attach monitoring software

Dedicated EPICS IOC

- To integrate the SRS into an EPICS network

OUTLOOK AND CONCLUSION

OUTLOOK

Laboratory measurements

- Develop the complete GEM characterization chain based on VMM
- Testing the new DVM V5
- Use multiple FECs in parallel. Parallel read of TPC and CernDet

Software development

- Create the basic control API and open them to the community for further contributions
- Develop a set of basic tools to use the SRS+VMM system (DAQ server, online monitor, EPICS and standalone slow control based on the VMM DCS)
- Implement the automatic calibration system

CONCLUSION

VMM is a powerful tool

- Can be used for different types of detector simplifying the experiment readout
- Once it is tuned, it is very efficient and reliable
- It can be very complicated and time consuming to tune and setup the first time

Non-expert tools can be useful

- Universal libraries/API for control and acquisition
- Simple tools for common operations (DAQ and slow control with and w/o EPICS)
- Automated operations for calibration and tuning