

EMC FWEC Calibration Setup at COSY

Lukas Linzen

Ruhr-Universität Bochum
Institut für Experimentalphysik I

Collaboration Meeting
DAQ Session
30.06.2022

RUHR
UNIVERSITÄT
BOCHUM

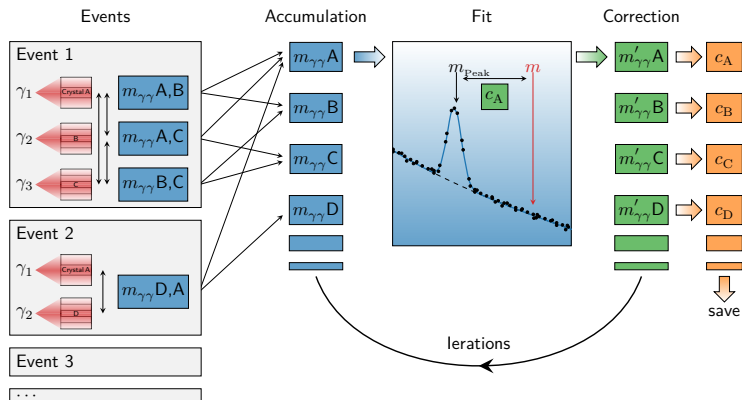
RUB



Precalibration Overview

- initial calibration with cosmic rays in Bonn
- aim at COSY is twofold
 - test the fully assembled FWEC
 - pre-calibrate FWEC for $\bar{\text{PANDA}}$
- calibration with π^0 decays into 2γ
- p^+ -beam at COSY will be used
- target of light nuclei is planned

Calibration Algorithm

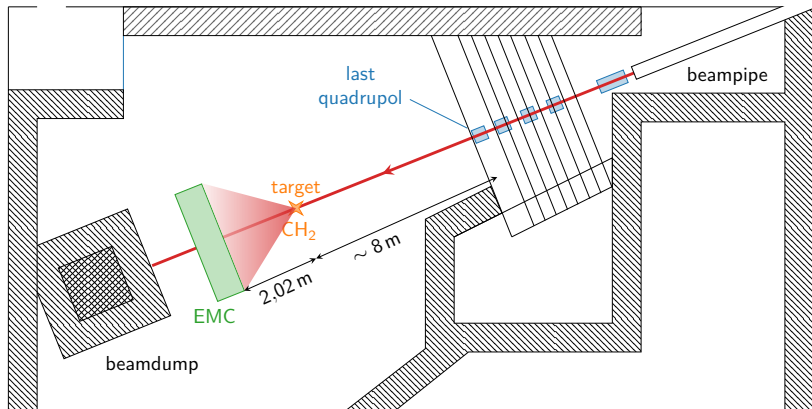


- $$m_{\gamma_1\gamma_2}^2(\pi^0) = f(E(\gamma_1), E(\gamma_2), \theta_{12})$$

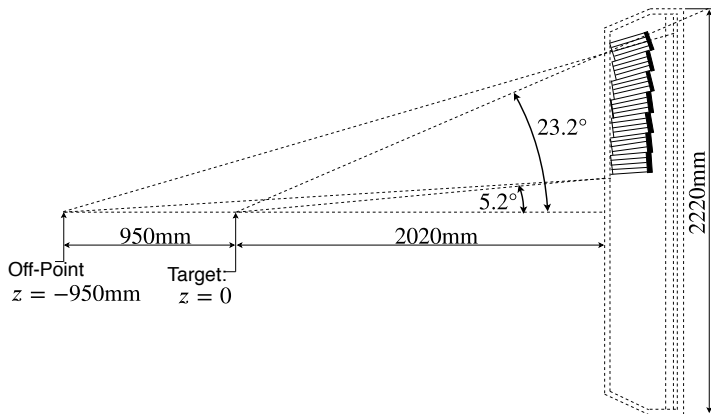
Calibration at COSY

- simulations suggest that higher energies are preferable considering calibration time and range of γ -energies
- highest energy available at external experimental setups of $\sim 2,5$ GeV will be used
- p^+ rate up to 10^9 s^{-1}
 - leads to luminosity of up to $10^{30} \text{ cm}^{-2} \text{ s}^{-1}$
 - $\sim 50\%$ events result in hits in the FWEC
 - usable rate will depend on bandwidth of readout system
- beam diameter in order of 1 cm
- expected time of data taking with a rate of 10^3 s^{-1} in the order of 55 h

Setup in Time of Flight (ToF) Hall



Target

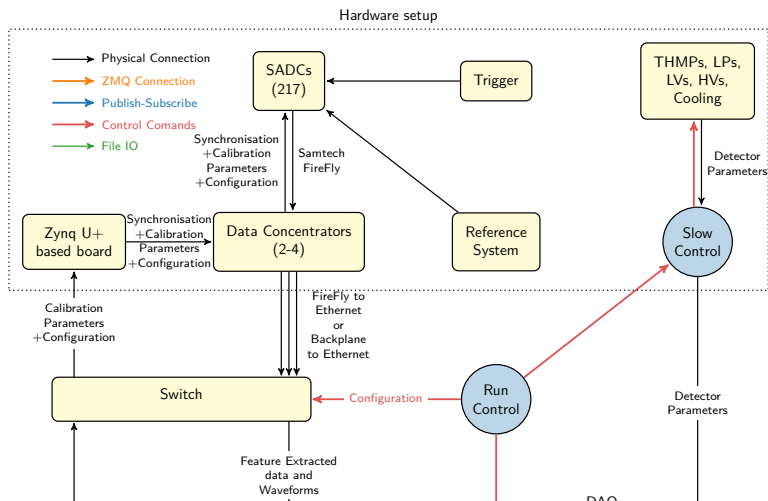


- PET-foil of $\sim 200\ \mu\text{m}$
- target position same as in $\bar{\text{P}}\text{ANDA}$

Proposed Hardware Setup

- 3856 crystals read out by 6176 APDs and 768 VPTTs
- 6944 channels
- readout by 217 SADCs (32 channels each) connected to 4 data concentrators
 - data concentrators send data to PC over fibre connections
 - synchronisation of SADCs with Aurora Sync instead of SODA to ensure fast development
 - storage in readout server as SSD or HDD array depending on size and bandwidth requirements

Hardware Test for PANDA

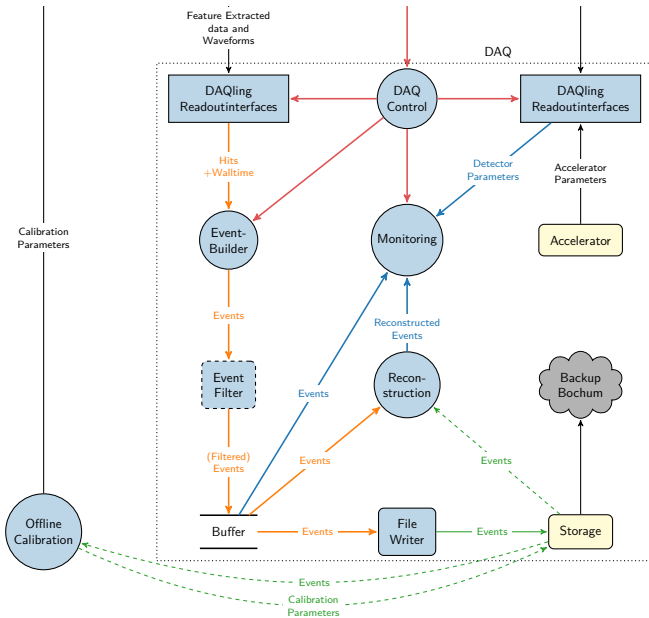


Proposed Hardware Setup

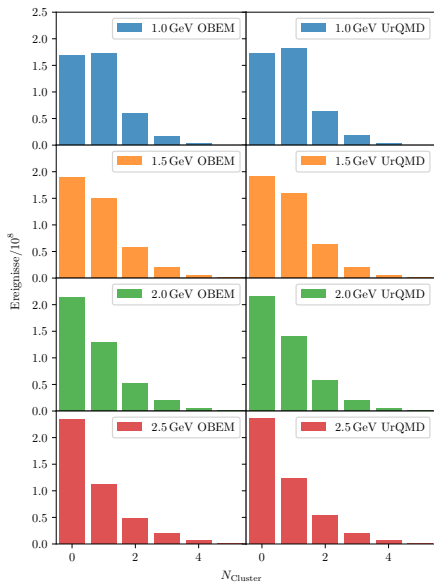
- SADCs in crates in detector frame
 - 10 crates for 15 SADCs
 - 12 crates for 6 SADCs
- ISEG high voltage in 7 10 slot crates
 - 8 modules with 16 channels at 2 kV for VPTTs
 - 8 modules with 8 channels at 2 kV for VPTTs
 - 49 modules with 16 channels at 1 kV for APDs
- 4 Wiener PL-512 low voltage PSUs

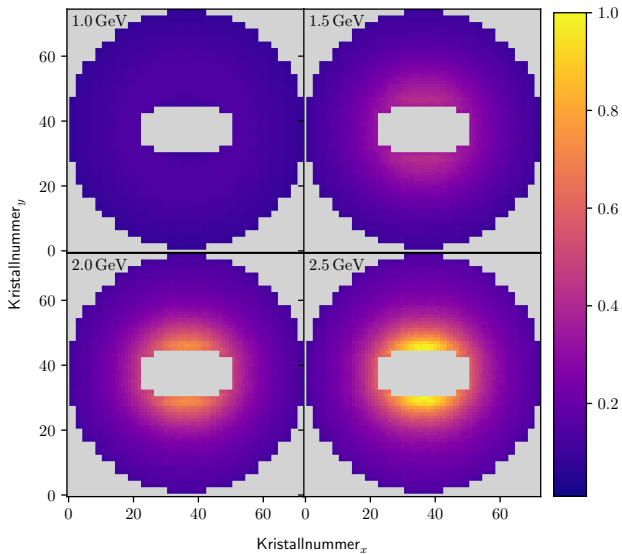
Tracking or Veto Detector

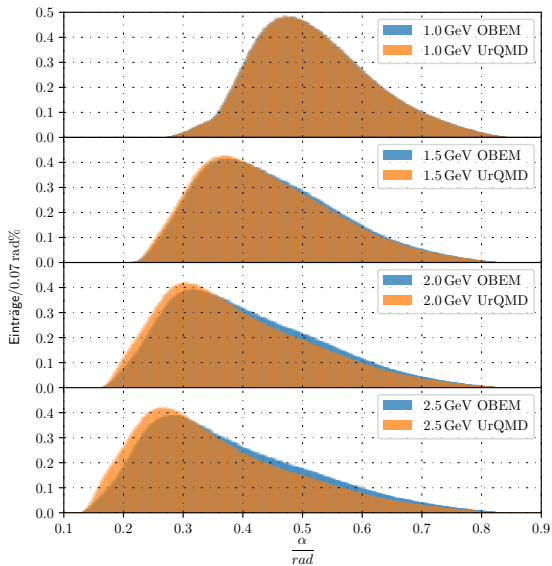
- tracking detector would be helpful with checking crystal positions and triggering
- alternatively simple veto detector to reduce data rate could be used
- could be read out by SADCs to ensure streamlined readout



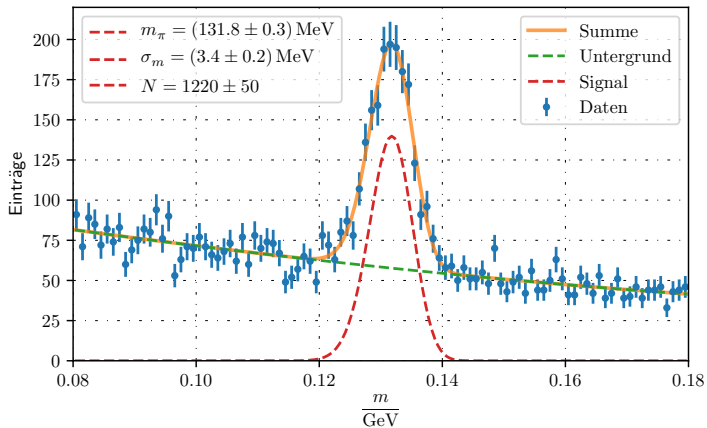
Thank you for
your attention!



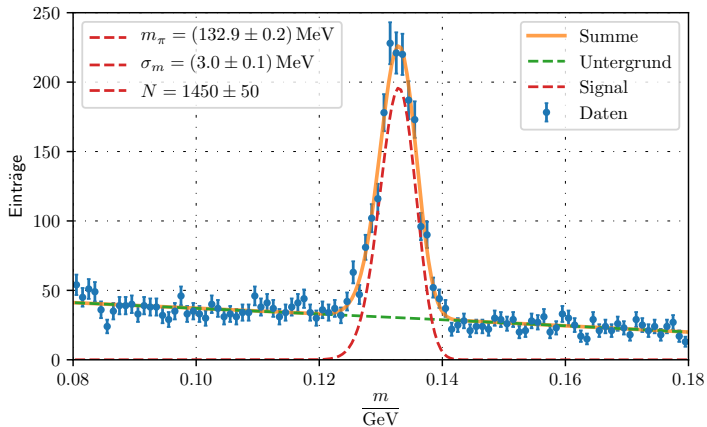




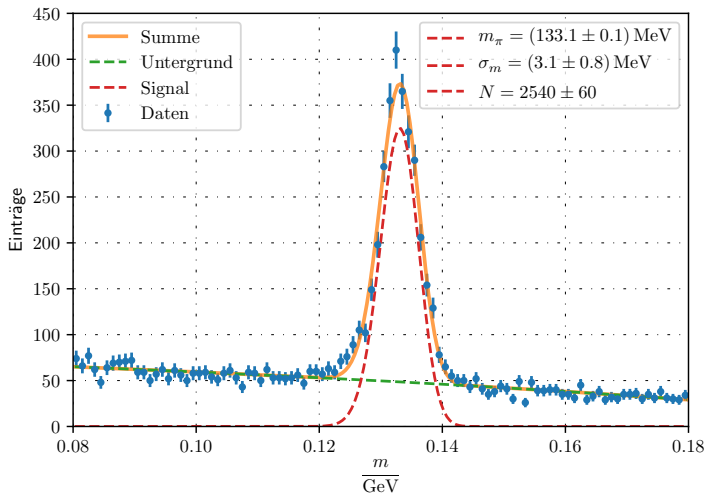
Spectrum of outer Crystal (2,5 GeV)



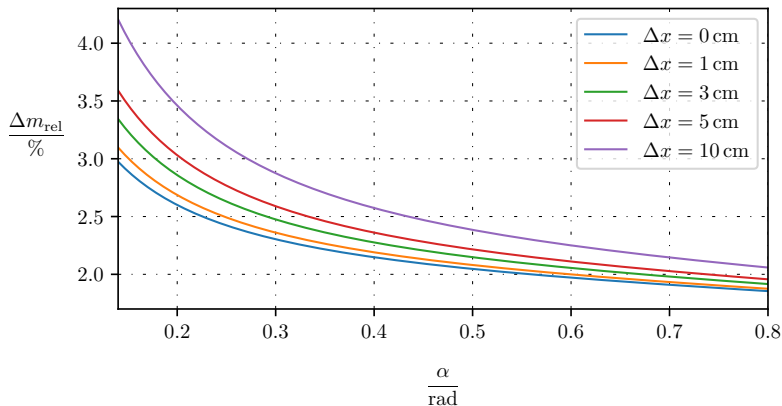
Spectrum of middle Crystal (2,5 GeV)



Spectrum of inner Crystal (2,5 GeV)



Error in Mass Calculation from Beamdiameter



Simulation Overview

- EvtGen as event generator
- $\bar{\text{PANDARoot}}$ with FWEC as only detector
- $4 \cdot 10^8$ events simulated
- approximation of pC-scattering as scaled p(p+n)-scattering

$$m_{\pi^0} = 4E_1 E_2 \sin^2(\theta_{12}/2)$$

$$m_{\pi^0} \simeq 135 \text{ GeV}/c^2$$