

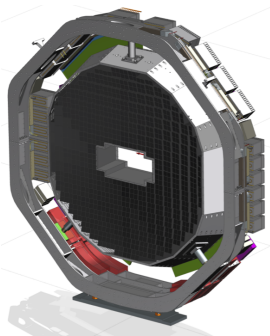
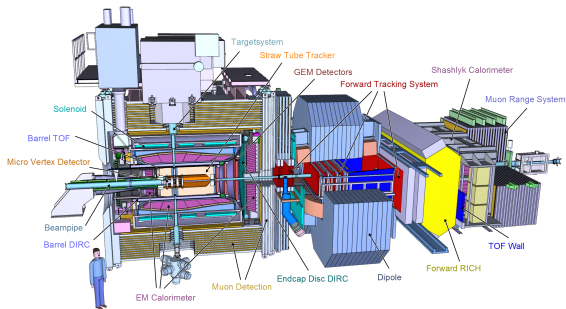
Status Forward Endcap EMC

PANDA Collaboration Meeting 23/1, March 2023, Bochum

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PANDA Electromagnetic Calorimeter, Forward Endcap



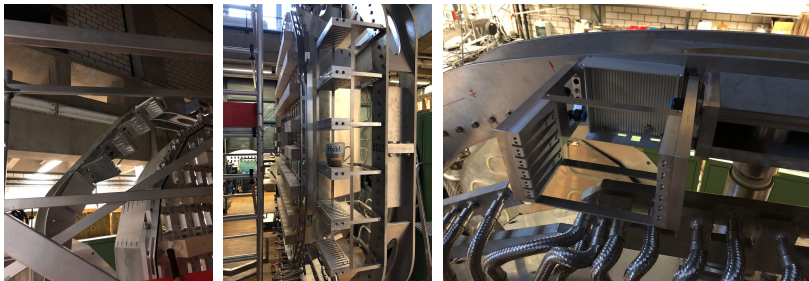
- First PANDA subdetector to be completed
- Lead tungstate calorimeter, 3856 crystals, $-25\text{ }^{\circ}\text{C}$
- Frame, base plate, cooling devices etc. all built up in Bochum

Forward Endcap Assembly



- Frame height 2.5 m, need to disassemble in the lab in Bochum
- Mounting of crystal submodules where space and proton test beam is (still) available: COSY
- CBAC meeting outcome: 1 week of beam

Forward Endcap Assembly



- Final drillings to Forward Endcap frame:
 - ▶ Mounting threads and boreholes for SADC-crates,
 - ▶ THMP housings,
 - ▶ Light pulser units,
 - ▶ And HV controllers

Forward Endcap Assembly



- Light pulser units, THMPs, and HV controllers sit inside Forward Endcap frame
- Backplate suspended/protected by wood

Forward Endcap Disassembly



- Backplate removed, screwed to custom made pallet
- Transportation to and mounting in Jülich next week

Shipping to Jülich



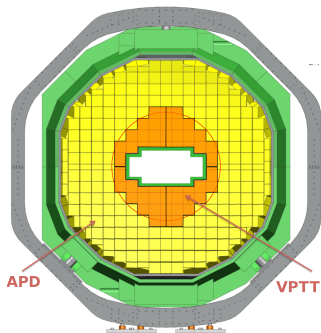
- First truck load already in Jülich (Chillers, pipes etc.)
- Next truck with Forward Endcap backplate and frame will follow next week
- Probably one truck load more needed (HV-, LV- etc. 19" crates, etc.)

Prepared COSY-TOF Hall



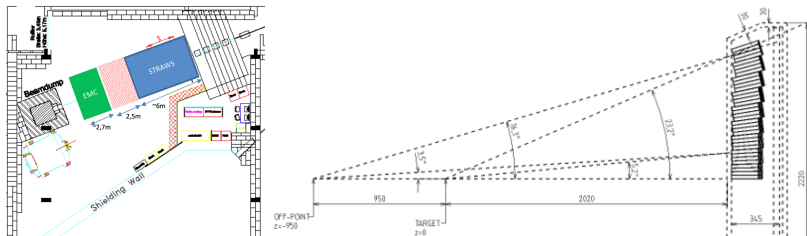
- Heavy support structure for suspension during set-up and transportation (7 t weight!), pedestal for lifting to beam height
- Large methanol-water chiller system
- Manipulator arm for submodule mounting borrowed from CMS

Preparation for Beam Time



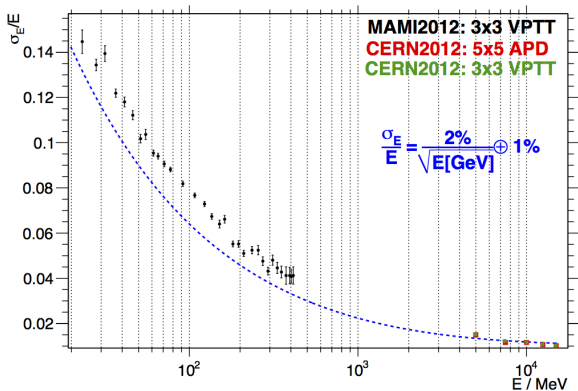
- Two types of photo detectors:
 - ▶ Vacuum photo tetrodes in high rate inner part (mounted first)
 - ▶ Avalanche photo diodes (fully mounted after beam time?)

Setup in COSY-TOF hall



- Plastic target in same distance to detector (2.02 m) as proton target in $\overline{\text{PANDA}}$
- $pp \rightarrow pp\pi^0$, $pp \rightarrow pp\pi^+\pi^-$
- Calibration of Forward Endcap via $\pi^0 \rightarrow \gamma\gamma$
- Charged pions: Crystal position determination (fibre hodoscope), charged particle response of Forward Endcap, effect of material in front of detector

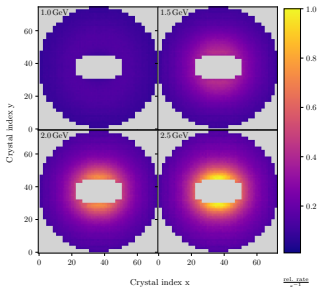
Energy resolution



- Energy resolution determination:
200 crystal prototype → full Forward Endcap
- Improvements since prototype test beams: Optical coupling, signal shaping, feature extraction, optimized preamp gain

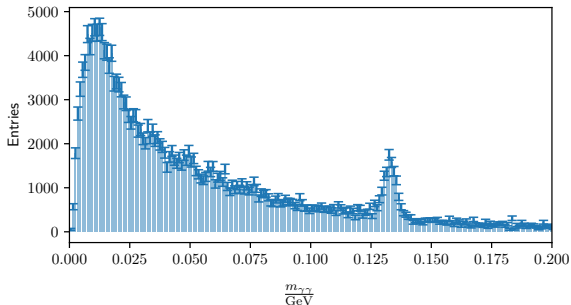
Optimum Beam Energy/Momentum

- Relative photon rates of events $pp \rightarrow pp\pi^0$, $\pi^0 \rightarrow \gamma\gamma$ with both photons hitting the Forward Endcap



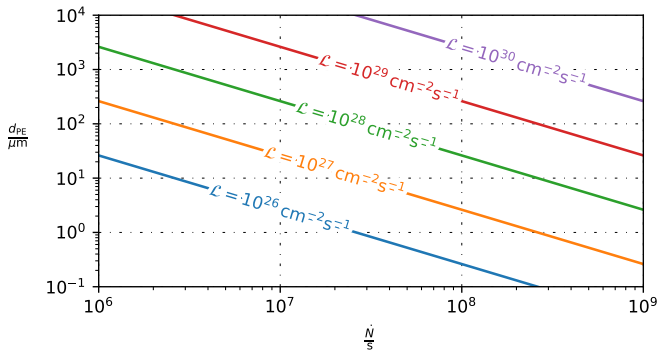
- Beam energy optimized for maximum number of events in crystal(s) with lowest relative hit rate
- Optimum proton energy (momentum): 2.5 GeV (2.3 GeV/c)

Beam Time Estimation



- Sufficient invariant $\gamma\gamma$ mass spectra to calibrate every crystal in Forward Endcap:
 $1.3 \cdot 10^9$ events ($3.8 \cdot 10^8$ hitting the detector)
- Limit: DAQ rate (10^3 s^{-1})
- 105 h of data taking needed in order to calibrate all crystals

Proton Rate



- Polyethylene foil as target: $\sigma_{PET} = 350$ mb (estimated using pp, pn cross sections)
- In order to produce the $1.3 \cdot 10^9$ events: $L = 10^{28} cm^{-2}s^{-1}$
- 200 μm foil: 10^7 protons per second

Timeline

- February/March: Transport of FWEC to FZ Jülich and preparation of submodule mounting, connecting chillers
- March/April: Mounting of all VPTT-submodules
- April/May: Remaining cabling, mounting of lightpulser units, THMPs and SADCs
- May/June: Mounting of insulation, first readout tests
- June: Cooling of Forward Endcap to $-25\text{ }^{\circ}\text{C}$, finishing of DAQ, target, fibre hodoscope
- July: Earliest beam time (exact date still to be determined)
- After beamtime mounting of remaining APD-submodules

- We prepare for COSY beam time with the Forward Endcap in 2023
- Tight schedule, only VPTT equipped submodules may be ready for beam time
 - ▶ Implying several additional problems:
 - ▶ Cable feedthrough insulation
 - ▶ Covering of non-equipped parts of backplate
- SADC-Crates, DAQ still in finishing phase
- Full number of light pulser units, THMPs still to be finished
- Awaiting exact date of beam time at COSY

22 years ago at Bochum University - all still with PANDA

