

# Front-End Electronics of the Electromagnetic Barrel-Calorimeter for the PANDA Target Spectrometer

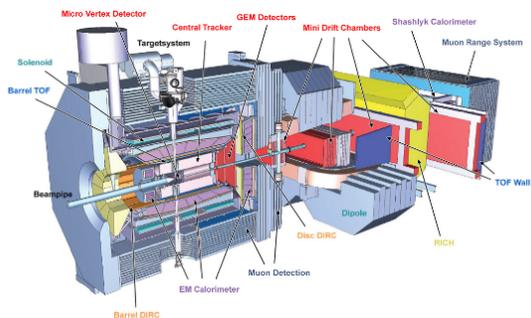
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14th Pisa Meeting on Advanced Detectors

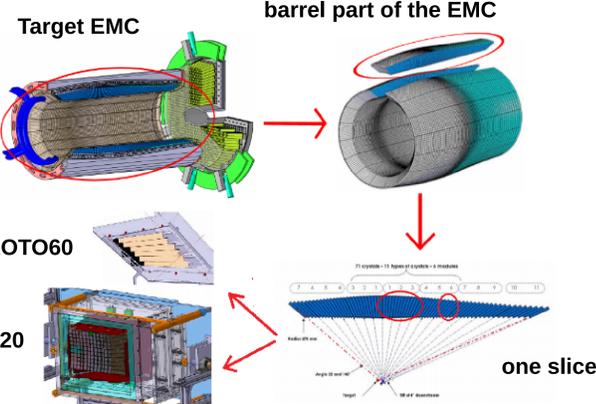
## The PANDA electromagnetic calorimeter (EMC) and the recent prototypes

### The planned PANDA detector @ FAIR

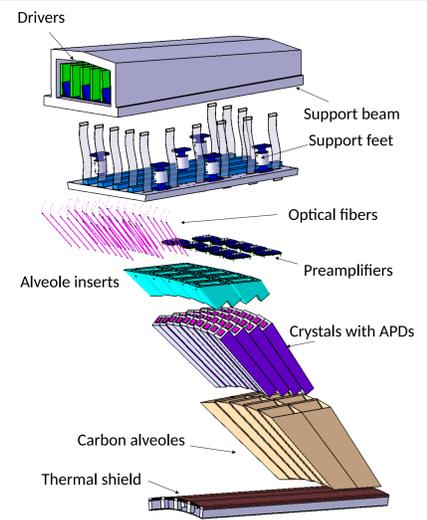


#### Barrel EMC:

- 15552 PbWO<sub>4</sub> crystals (length: 20 cm ~ 22 X<sub>0</sub>)
- 13 crystal types (different degree of tapering)
- Type 1: most tapered, type 13: least tapered
- Operation temperature: -25 °C



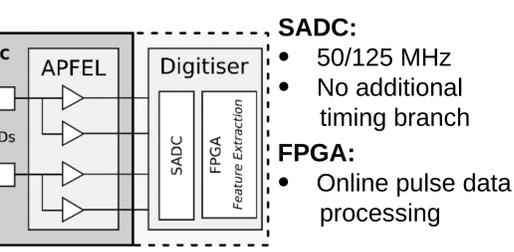
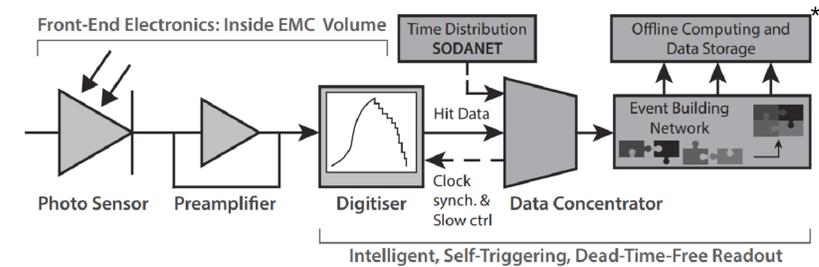
**Prototypes:**  
Small sections of one barrel slice



## The EMC Front-End Electronics

### Schematics of the EMC readout chain

- Raw data output of the EMC would be ~275 Gb per second → mainly background and noise
- Intelligent, triggerless and dead-time free readout is being developed → preprocessing on the fly
- Signal of LAAPDs would be too low for further processing → amplification and signal shaping by customized APFEL ASIC (low-noise and low-power charge preamplifier)
- Signal of preamplifiers is digitized by Sampling Analog-to-Digital converters (SADCs) sampling continuously at 80 MHz and featuring a 14-bit resolution



- SADC:**
- 50/125 MHz
  - No additional timing branch
- FPGA:**
- Online pulse data processing

### 2 LAAPDs (7x14 mm<sup>2</sup>) read out simultaneously by one APFEL ASIC

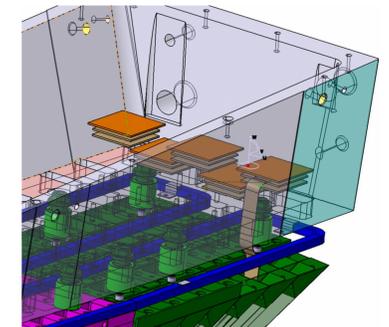
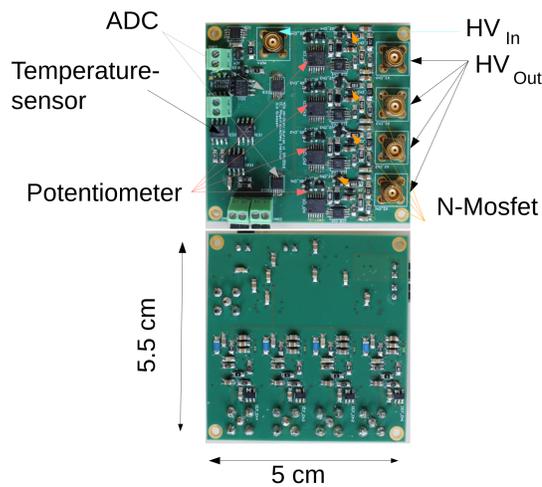
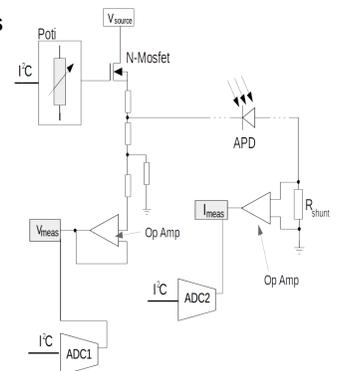
- Two channels with different gains for each LAAPD
- Dynamic range of 10,000 (1 MeV to 12 GeV)
- Programmable amplification of 16/32
- High rate capability (up to 500 kHz)
- Low power consumption: 55 mW/ch



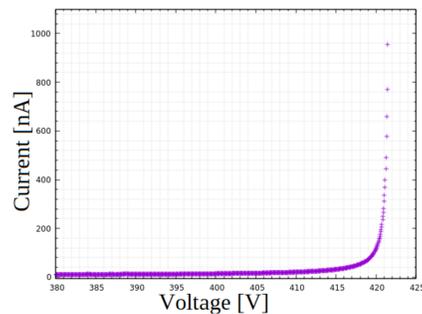
\*Marcel Tiemens -Online Cluster-Finding Algorithms for the PANDA Electromagnetic Calorimeter

### High-Voltage adjustment through specialized electronics

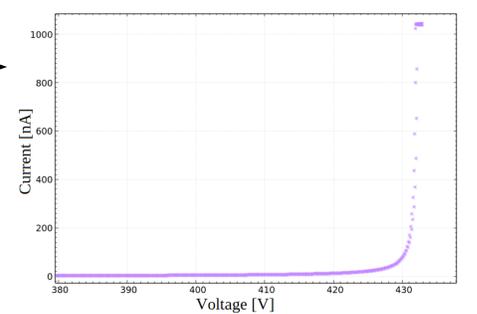
- Voltage controlled by adjustment of a N-MOSFET
- Separately configurable channels (for each LAAPD)
- Precision of adjustment up to exactly 0.1 V
- Voltage and current can be measured
- SPI /I2C Interface
- Voltage adjustment electronics inside detector volume but outside of cooled volume
- Recent prototyping showed proof-of-concept by high-precision measurements of APD characteristics



APD characteristics measured with a multimeter (Keithley 2410)



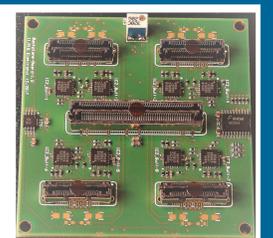
APD characteristics measured with the High-Voltage distribution prototype



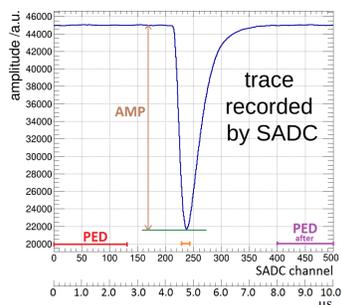
Similar curve

### Outlook

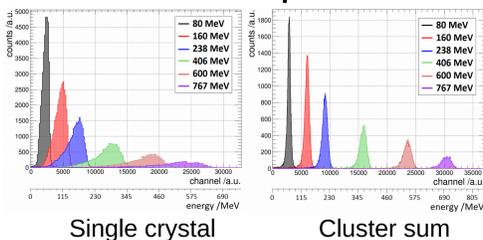
- Final prototype for High-Voltage adjustment is mounted, full characterisation pending
- First of 16 barrel slices is assembled, detailed performance tests pending



### Feature extraction



### Line shapes



Single crystal noise level: 0.9 – 1.0 MeV  
Single crystal threshold: 2.8 – 3.0 MeV

- Energy = maximum - pedestal ✓ Linear energy response

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