Development of the HADES Electromagnetic Calorimeter *

P. Tlustý[1], *A. Kugler*[1], *Y. Sobolev*[1], *O. Svoboda*[1], *B. Kardan*[2], *T. Galatyuk*[3], *A. Rost*[3], *J. Pietraszko*[4], *E. Bayer*[4], *P. Salabura*[5], *G. Korcyl*[5], *F. Guber*[6], *A. Reshetin*[6], *and A. Ivashkin*[6]

[1]Nuclear Physics Institute of ASCR, Rez, Czech Republic; [2]Goethe-Universität, Frankfurt; [3]TU Darmstadt, Darmstadt; [4]GSI, Darmstadt; [5]Smoluchowski Institute of Physics, Jagiellonian University of Kraków, Poland; [6]Institute for Nuclear Research, Russian Academy of Science, Moscow, Russia

The electromagnetic calorimeter (ECAL) for the HADES experiment is currently under design[1]. The ECAL will replace the Pre-Shower detector located at forward angles $18° < \theta < 45°$ and allows to measure neutral meson (π^0 and η) production, which is essential for the interpretation of dilepton data, but up to now unknown in heavy-ion reactions in the energy range of the planned FAIR experiments at SIS100. An additional advantage of such a upgrade would be the improvement of the electron/pion separation at large momenta ($p > 400$ MeV/c).

The ECAL will consist of 978 modules divided in six trapezoidal sectors. Each module will based on lead-glass modules (obtained on loan from the OPAL experiment at CERN) assembled with photomultiplier (PMT) and highvoltage-divider in a housing construction (see Fig. 1).

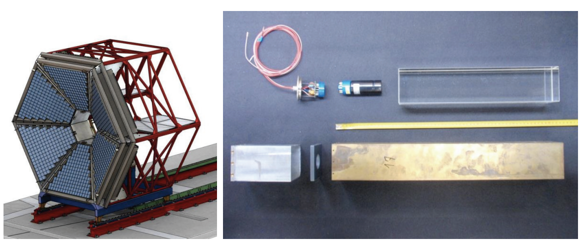

Figure 1: Schematic drawing of the ECAL detector (left) and construction parts of one module (right).

EMI 1.5inch PMT (9903KB) were tested with small scintillator and gamma source to sort out those with low gain or defect ones. Since there will be not enough EMI PMT, 130 Hamamatsu 3inch PMT (R6091) were ordered and 65 of them were already delivered. Performance of modules equipped with the two different types of PMTs are comparable (see Fig.2). Special housing for these photomultipliers were developed, manufactured and successfully tested. Own high voltage dividers were designed and mounted. First tests show that their properties are comparable with original Hamamatsu HV dividers.

For stability-monitoring a light distribution system based on common blue LED light source is foreseen. Totally 15 modules equipped with optical fiber were assembled and tested both with LED light and cosmic muons.

The readout of ECAL will be based on TRB3[2] boards and dedicated frontend-electronics (FEE). Prototype FEE were designed and manufactured at Jagiellonian University of Cracow and intensively tested with a HADES-like DAQ based on TRB2 for time measurement (TDC) and Shower-Addon board for amplitude measurement (ADC). The trigger signal was processed in a central trigger system board (CTS) and distributed to the ADC and TDC boards. The current version of the FEE has eight input channels, separated outputs for time and amplitude and is powered by 5V. The threshold for time signal can be set separately for each of the eight channels. The FEE were tested in detail with pulser- and PMT-signals from LED-light and cosmic muons and modified at GSI Darmstadt to optimize the energy resolution.

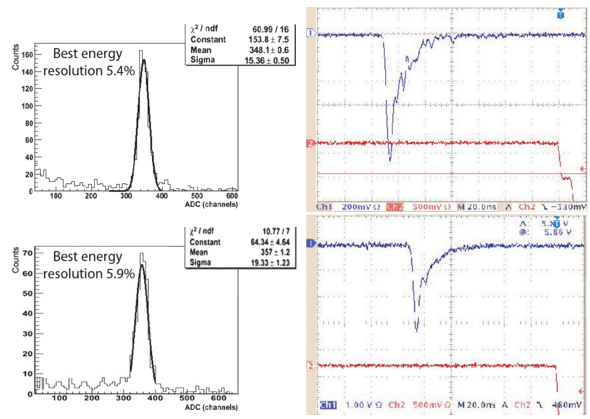

Figure 2: Best measured energy resolution with cosmic muons with EMI 1.5inch PMT 5.4% (top) and Hamamatsu 3inch PMT 5.9% (bottom). right: PMT signal (blue) and trigger signal (red).

New FEE are in developement based on the idea of charge digitisation in FPGAs[3]. The concept is to use a QDC by implementing a modified Wilkinson ADC. The width of the digital pulse is measured using a FPGA-TDC, delivering the time measurement of the leading edge as well as the charge encoded in the width of the pulse.

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References

[1] W. Czyzycky et al.: Electromagnetic Calorimeter for HADES, arXiv:1109.5550

[2] C Ugur et al.: 2012 JINST 7 C02004, doi:10.1088/1748-0221/7/02/C02004

[3] C Ugur et al.: 2013 JINST 8 C01035, doi:10.1088/1748-0221/8/01/C01035