

Calibration of a GEM-TPC prototype for PANDA with Kr-83m

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The main purpose of the PANDA experiment at the new international Facility for Antiproton and Ion Research (FAIR) is the high-precision spectroscopy of hadrons in the charm quark sector. This requires an excellent central tracker (CT) which provides an efficient reconstruction of charged particle trajectories and secondary vertices, high spatial and vertex resolution ($\sigma_{r\phi} \sim 150 \mu\text{m}$, $\sigma_z \sim 1 \text{ mm}$), good momentum ($\delta p/p \sim 1.5 \%$) resolution with minimal material budget ($X/X_0 \sim 1 \%$), high rate capability and an angular acceptance of almost 4π .

As one of the two proposed options for this CT, a cylindrical time projection chamber (TPC) could provide additional dE/dx measurements which are extremely useful for particle identification especially in the sub-GeV region. In order to operate in a continuous mode without gating and efficiently suppress ion backflow, a stack of GEM foils is used as an amplification stage instead of conventional multi-wire chambers.

To show the feasibility, a prototype TPC with an outer diameter of 300 mm and a drift length of 725 mm has been built and is being tested within the FOPI experiment at GSI Darmstadt since the end of 2010. It uses a triple GEM stack for the charge amplification. The readout plane of the detector has 10254 hexagonal pads of 1.5 mm outer radius which are read out using 42 front end cards based on the AFTER/T2K chip.

In order to perform an accurate pad-wise, as well as an absolute gain calibration, a 83m Kr source was chosen. Its gaseous form in combination with the rich conversion electron spectrum, mainly between 9 and 42 keV, makes it perfectly suitable for this purpose. Additionally the short half life of 1.83 h allows to resume normal detector operation after only a few hours. This method has already been used in various large drift chambers (e.g. HARP, ALICE, NA49) and has been performed on a prototype TPC for different gas mixtures and gain settings.

Details of the production process, the integration into the setup, the calibration method and first results will be presented.

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