

The SuperFRS GEM-TPC Prototype Development

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Introduction

The FAIR facility at GSI will provide a variety of beams from protons and antiprotons to ions up to uranium with highest intensities and excellent beam quality in the longitudinal as well as transverse phase space. The NuSTAR experiments will be dedicated to the study of Nuclear Structure, Astrophysics and Reactions, in particular with the use of high energy spatially separated mono-isotopic beams of radioactive species separated and identified by the Superconducting Fragment Recoil Separator (Super-FRS) [1]. The main task of the detection system [2] installed within the Super-FRS is threefold:

- it can be used to set up and adjust the separator,
- it provides the necessary measures for machine safety and monitoring,
- it allows for an event-by-event particle identification, tracking and characterization of the produced rare ion species.

The requirements for such detectors are:

- no interference with the beam
- large dynamic range
- coping with particle intensities up to 100 kHz

In order to satisfy these needs a further evolution of the existing GEM-TPC [3,4] system was required, now equipped with GEMEX [5] readout cards, each employing two n-XYTER [6] ASICs. The readout geometry was chosen to cope with the expected high particle rates at the FRS.

Results from test beam at the FRS

The S417 campaign gave us the possibility to test prototypes of these detectors. One of the tasks was to study the performance of the GEMEX readout integrated in GEM-based detectors. The ¹⁹⁷Au primary-beam particles of 750 MeV/u energy and intensities around 10⁷ ions per 8-10 s spill was swept horizontally over the whole active area. In addition to that the beam was focused and defocused.

Fig. 3 shows the correlations between the ‘front’ and ‘back’ readout structures of the same detector. It can be stated that both parts of the detector perform identically. The center-position of the primary beam can be seen clearly.

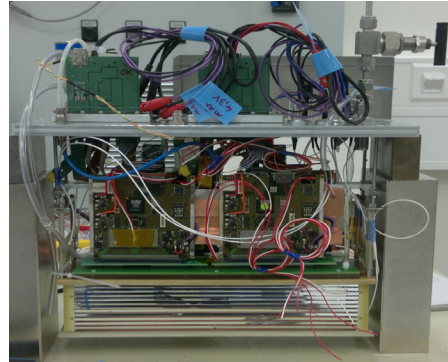


Figure 1: SuperFRS GEM-TPC prototype, equipped with four GEMEX readout cards.

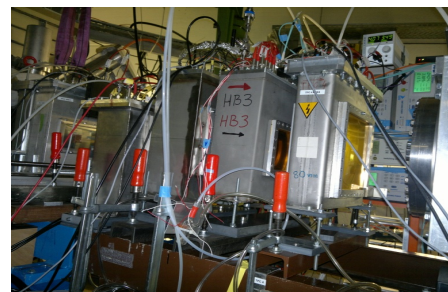


Figure 2: SuperFRS GEM-TPC prototype installed between two conventional TPCs at the focal plane S2 of the FRS/GSI.

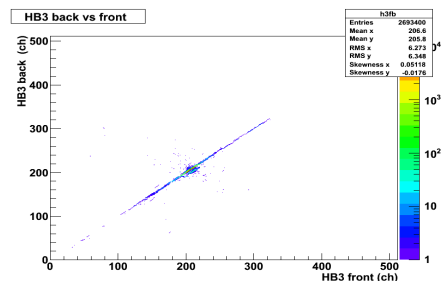


Figure 3: Correlations of hits between front and back readout.

References

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