PROTOTYPE DEVELOPMENT of a GEM-TPC for the Super-FRS of the FAIR FACILITY

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One major component included in the first phase of the FAIR facility will be the Super-FRS separator. The NUSTAR experiments will benefit from this separator, which will deliver an unprecedented range of radioactive ion beams (RIB). Helsinki Institute of Physics, Comenius University and the Detector Laboratory at GSI are in a joint R&D of GEM-TPC diagnostic chambers . The current status this development will be shown.

Introduction

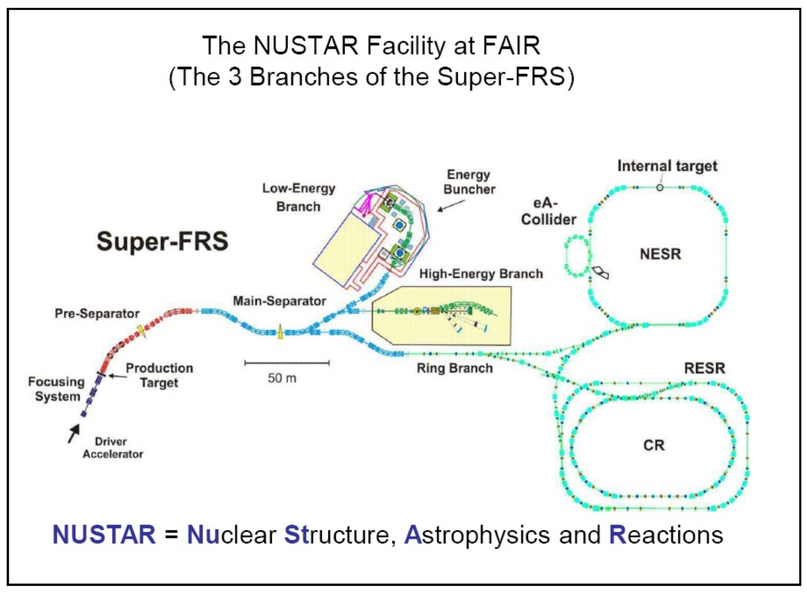
FAIR is a **F**acility for **A**ntiproton and **I**on **R**esearch[1] and it is being built at Darmstadt, Germany as an extension to the current GSI research institute. The concept of the FAIR facility aims for a multifaceted forefront science program, beams of stable and unstable nuclei as well as antiprotons in a wide range of intensities and energies, with optimum beam qualities.

Artists view of FAIR. The synchrotrons on the right will be located 10 to 13 m underground and will not be visible in reality.

The Finnish Contribution to FAIR will be mainly dedicated to the NUSTAR (**Nu**clear **St**ructure, **A**strophysics and **R**eactions) experiments, which are the experiments that will be located at the end of the Super-FRS branches. These branches are the Low Energy, the High Energy and the Rare Ion Beams.

Super FRS

One important part of the accelerator will be the Super-FRS[2] separator. The NUSTAR experiments will benefit from the Super-FRS, which will deliver an unprecedented range of radioactive ion beams (RIB). These experiments will use beams of different energies and characteristics in three different branches; the high-energy which utilizes the RIB at relativistic energies 300-1500 MeV/u as created in the production process, the low-energy branch aims to use beams in the range of 0-150 MeV/u whereas the ring branch will cool and store beams in the NESR ring.

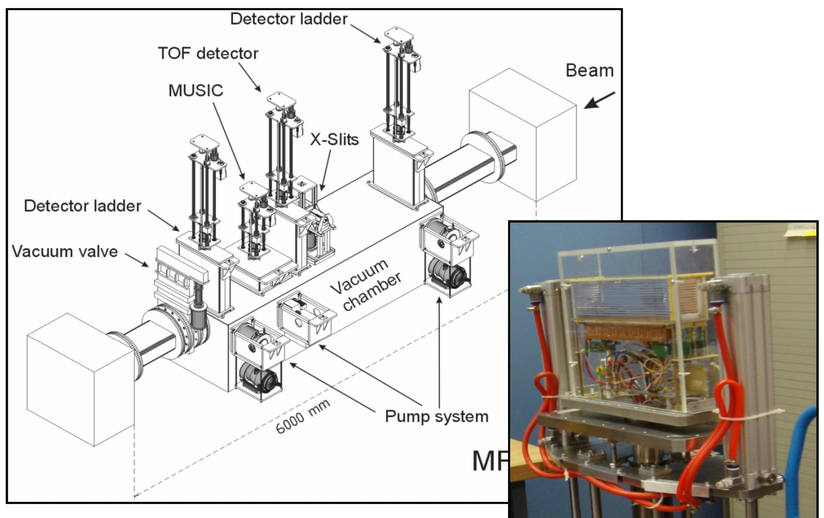


The main tasks for the Super-FRS beam diagnostics chambers will be for the set up and adjustment of the separator.

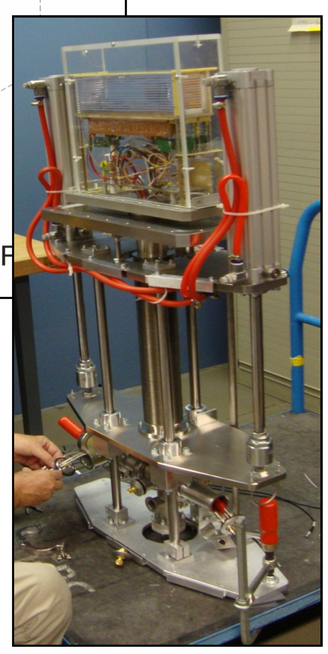
S-FRS Diagnostic chambers

Beam diagnostics systems will be installed in all intermediate foci MF(1-12) with a standardized active area of (40 x 20) cm² in order to:

- Provide on-line data about the production and separation process in the S-FRS
- Allow angular measurement
- Measure beam particles event-by-event



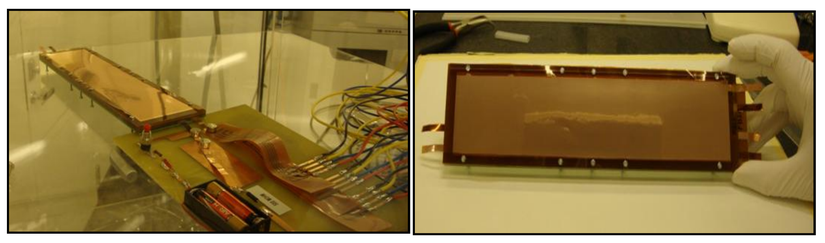
Super-FRS beam diagnostics chamber at the Middle Focus 4



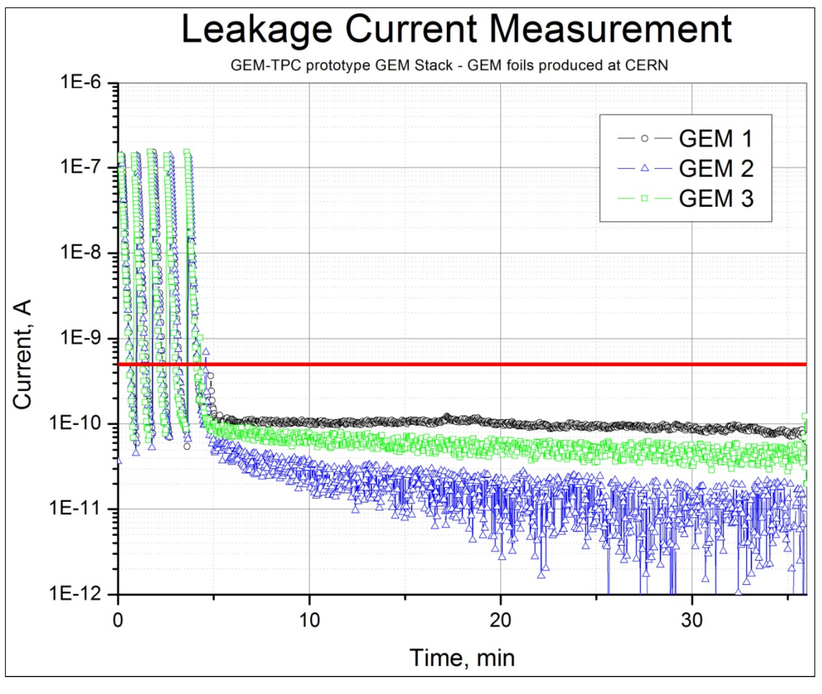
The remaining particle identification and tracking can be realized, using a conventional trigger scheme. The existing VME readout scheme will be gradually updated with the NUSTAR DAQ.

GEM Stack for the GEM-TPC

A GEM stack was developed and tested at the Detector Laboratory of the Helsinki Institute of Physics[3]. This stack was used for the GEM-TPC prototype under test.



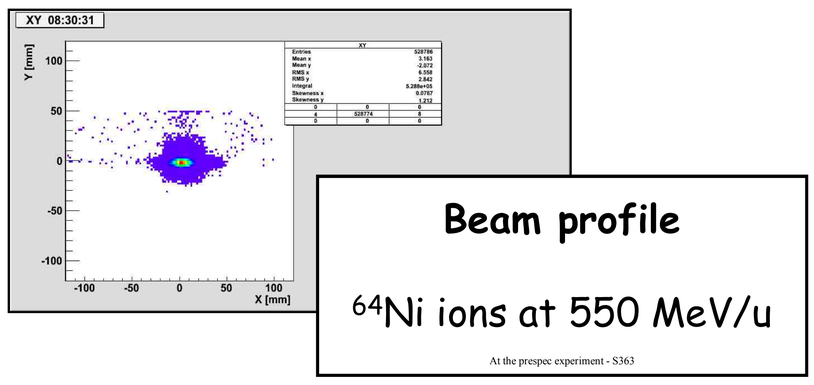
GEM leakage current setup on the left and view of the full GEM stack on the right



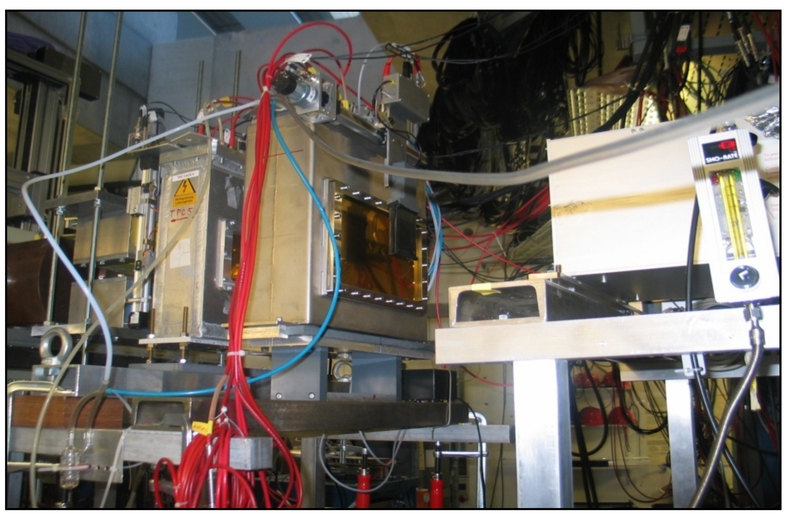
On the top are the results of the leakage current measurement. The red line is the 0.5 nA limit used to reject a GEM foil. These foils has been produce at the PCB Electronic workshop - CERN by Rui de Oliveira

Beam Test at GSI

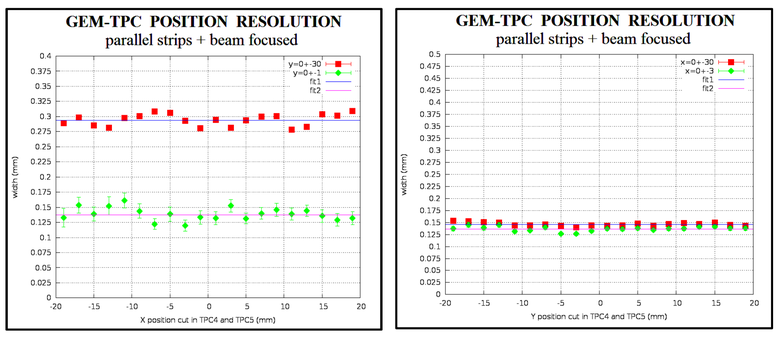
A GEM-TPC detector was tested at GSI during a beam campaign from the prespec experiment S363. The primary particle beam was of ions ^{64}Ni with an energy of 550 MeV/u. The beam was focused at the location of the GEM-TPC.



Beam spot recorded by the GEM-TPC



Beam test geometry; the GEM-TPC was placed in the middle of two TPCs which were used as a tracker



GEM-TPC Position resolution. On the left the X and in the right the Y coordinate

Conclusions

- The GEM foils leakage current was well below 0.5 nA.
- The GEM-TPC was successfully integrated and tested in the Laboratory
- The Resolution in X coordinate was between 120 μm and 300 μm contrary for the Y was of 125 μm

References

[1] Conceptual Design Report (CDR) and Baseline Technical Report (BTR) for FAIR at http://www.gsi.de/fair/reports/index.html

[2] Baseline Technical Report. Experiment Proposals on Nuclear Structure and Astro Physics (NUSTAR). Vol 4

[3] F. Garcia *et al.,* Proceedings 2009 IEEE Nuclear Science Symposium Conference, 2009, pp. 269 – 272.