Development of a Tracking System of Exotic Nuclear Beams for FAIR

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Abstract. New accelerators like SPIRAL2 (GANIL, France) or FAIR (GSI, Germany) will be soon constructed, and they will be able to produce radioactive ion beams (RIB) with high intensities of current ($\geq 10^6$pps). These beams, at low energy, lower than 20 MeV/n, usually have high emittance, which imposes the use of tracking detectors before the target in order to reconstruct the trajectory of the ions. The group of Nuclear Physics at CNA (Centro Nacional de Aceleradores), is in charge of developing a tracking system for the low energy branch of FAIR (the HISPEC/DESPEC project). A collaboration with CEA-SACLAY was established, with the aim of developing, building and testing low pressure Secondary electron Detectors (SeD). Within this proposal we have projected and constructed a new Nuclear Physics Line in the CNA in order to be able to receive any kind of detector tests and the associated nuclear instruments.

Keywords: low pressure gas detectors, radioactive ion beams, tracking techniques.
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THE NEW BASIC NUCLEAR PHYSICS LINE OF CNA

The Basic Nuclear Physics line in the CNA, was projected and constructed to study the trajectory of nuclear particles using the low energy stable nuclear beams of the 3 MV TANDEM accelerator to simulate the characteristics of RIB. The installation includes two reaction chambers with high currents and voltages connections, a cooling system, a gas control station, and a high vacuum system (P~10^{-6} mb). This line provide the ideal environment to test any detector used in the biggest radioactive beam facilities as a tracking system, and nuclear instruments associated, like fast electronics.

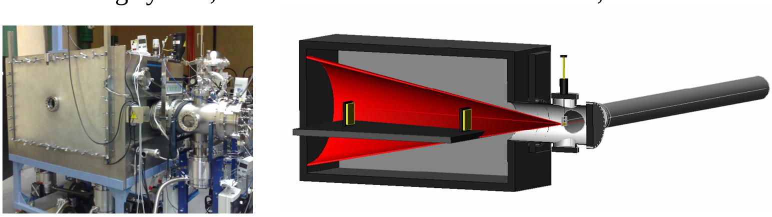

FIGURE 1. Layout and the new nuclear Physics line constructed to simulate RIB in the CNA.

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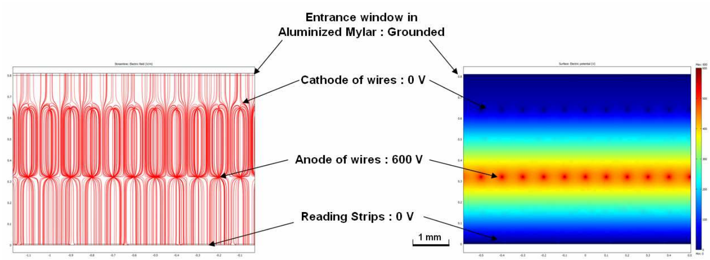
THE MINI-SED DETECTOR PROTOTYPE

The mini-SeD is a low pressure gaseous detector; it is a mini prototype (70x70 mm^2 active area) of the Secondary electron Detector (SeD) developed at CEA-Saclay [1,2]. The ion beam passes through an emissive foil of aluminized Mylar of 0.9 μm. The impact of ions on this emissive foil produces secondary electrons, which are drained and focused toward the detector by a parallel electric (10KV) and a magnetic field (100 G) [3]. The mini-SeD is filled with pure isobutane at 4 torr. Once the secondary electrons pass through another 0.9 μm thick aluminized mylar window of the detector, they ionize the gas. The amplification occurs over two different zones: the "parallel-plate" zone where the field is constant and a zone of amplification around the anode wires where the gradient of the electric field is high [1,2]. The electric field inside the mini-SeD could very well influence the performance of the detector. Therefore we study the behavior of this electric field, which is very important to determine the gain of the detector.



(a) (b)

FIGURE 2. (a) Lines of the electric field in the mini-SeD; (b)Intensity of the electric field in the mini-SeD, both obtained with Femlab.

CONCLUSIONS

In collaboration with IRFU / SEDI CEA Saclay, we have built and tested using a ^{252}Cf source, a first prototype candidate of tracking detector for FAIR, the mini-SeD. In the near future, this detector will be tested at the ion beam facility of GANIL and, later on, at a new nuclear Physics line projected and constructed in the CNA, which has been prepared to receive any kind of tracking detectors and related instruments tests. The complete set of results will be published in the future.

REFERENCES

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