

Compact position-sensitive detector for in-ring diagnostics at the Rare-RI Ring

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We have developed a large area position-sensitive detector for the Rare-RI Ring.^{1,2)} The position resolution achieved was less than 2 mm. A higher resolution closer to that of the PPAC is needed for emittance matching confirmation at the injection of particles in the ring as well as for particle tracking inside the ring. To improve further the resolution we designed a compact version of the same detector. The horizontal size was kept the same (an opening of 200 mm), however the vertical size was reduced by 30%. We simulated the effect on the resolution of this size reduction for different acceleration potential applied to the secondary electrons (SEs) emitted from the foil (see Refs. 1) and 2) for the detector's principle). According to the simulation performed with SIMION,³⁾ the resolution of the detector should improve by about 25% in both horizontal and vertical direction, see Fig. 1. This is due to the reduction of the time-of-flight of SEs inside the detector. We built and tested the compact detector as shown in Fig. 2. The test experiment was conducted at HIMAC with a 200 MeV/nucleon ⁸⁴Kr beam. The experimental setup is the same as previous experiment.¹⁾ A mask of 4 mm thick copper with rectangular openings of 12 × 17 mm separated with 3 mm in between was placed in front of

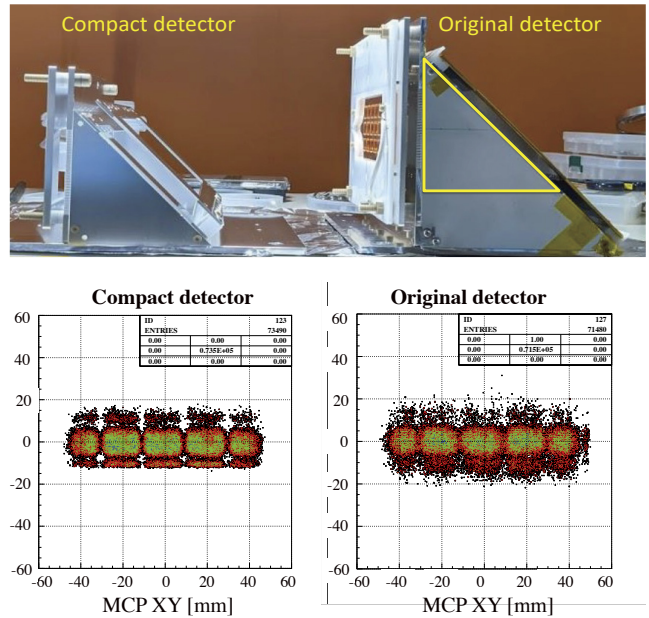


Fig. 2. (top) Picture of the compact and original size detectors with the size of the compact detector drawn in yellow on the original detector for reference. (bottom) Beam image modified with a copper mask placed in front of the detectors.

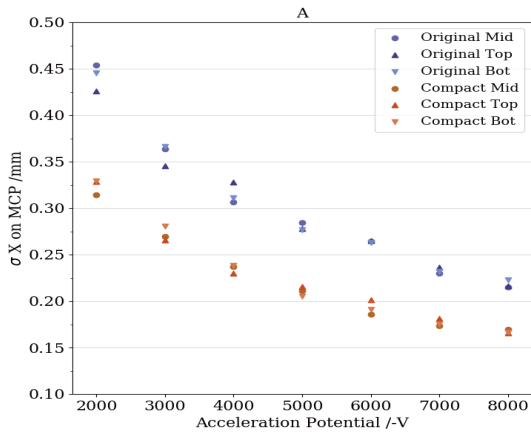


Fig. 1. Simulation results of position resolution for different SEs acceleration voltages in the original detector (blue) and compact detector (orange). Mid, Top, Bot correspond to different position in the detector, middle, top and bottom, respectively.

the detector. The beam image captured by both detectors under the same conditions is shown in the bottom of Fig. 2. As it can be seen, the resolution of the compact detector is improved and the rectangular openings of the mask are more distinct compared to the original detector. Detailed analysis of the resolution showed an improvement of 24% in the horizontal direction and 20% in the vertical direction. The compact detector was placed inside the Rare-RI Ring during the last experiment.⁴⁾ The trajectory of the beam was confirmed. However, due to large noise further diagnostics was not possible. The source of the noise, as well as possible future improvements are under investigation. Further improvements of the detector design are under consideration to limit the outgassing, which will improve the vacuum in the detector chamber and lead to less discharge.

References

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- 3) SIMION, <https://simion.com/>.
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