Improved position resolution of the beam diagnostics detector for the Rare-RI Ring

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To measure masses of rare isotopes at RIBF using the Rare-RI Ring, it is essential to increase the efficiency by better monitoring the beam condition at the injection into the ring. Therefore, we are developing a large area position-sensitive detector with a thin foil. The principle of the detector operation is based on secondary electrons (SEs) emitted from a thin foil when the beam passes through. The SEs are first accelerated by the acceleration grid and then reflected by the mirror grids potential (see Fig. 1). The beam position is inferred from SEs position measurement with the delay line MCP placed 90° from the foil. To achieve high position resolution the SEs velocity spread should be minimized inside the detector by simply increasing the acceleration voltage. However, increasing the voltage led to undesirable effects such as bending of the grid's wires and electrical discharges. We report here on the improvements introduced to minimize these effects. We tested different versions of the detector during four experiments conducted at HIMAC with a 200 MeV/nucleon ^{84}Kr beam. The details of the experimental setup can be found eslewhere.[1)] The position resolution as well as the accuracy of the detector for each experiment are shown in Fig. 1. In Table 1 are summarized the improvements introduced for each version of the detector as well as the acceleration potential that could be applied. The new wiring method for the grids is based on the method developed in this Ref. 2). With this method, the grids' wires were tighter and higher voltage could be applied resulting in improved resolution. By reducing the thickness of the spacer between the mirrors and acceleration grids, higher voltage up to 7 kV could be applied. This could be understood in the context of the Paschen Curve that related the product of the gas pressure and distance between the grids to the discharge voltage. By a systematic study of different spacer sizes we deduced that reducing the spacer size was necessary for the same vacuum condition. The resolution achieved in this condition was the best resolution ever achieved for large area detector of this type. We also tested the detector with a larger pitch size (2 mm) for a better transparency of the detector. However, it showed the worst performance. To improve further the position resolution we are planning to test a compact version of the same detector.

Table 1. Condition for each experiment (see text)

	Jul. 19	Nov. 19	Oct. 20(1)	Oct. 20(2)
New wiring method	X	O	O	O
Pitch of girds [mm]	1	2	1	1
Mirr Spacer [mm]	8	8	8	6
Acc Spacer [mm]	10	10	10	8
Acc. Potential [kV]	3	4	4	7

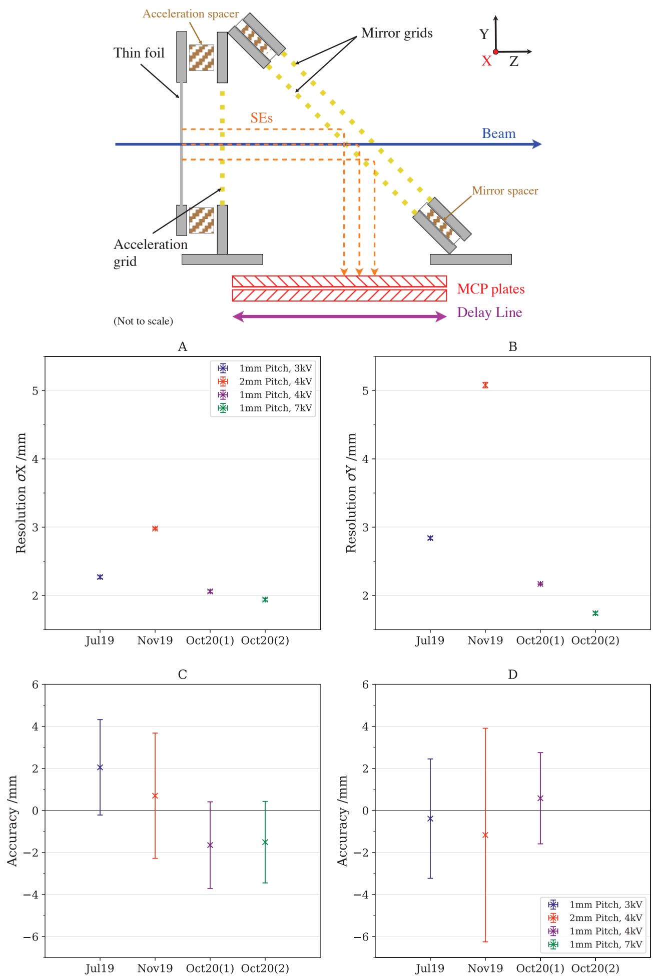

Fig. 1. (top) Schematic side-view of the position-sensitive detector. (bottom) Detector resolution (A&B) and accuracy (C&D) in the horizontal X and vertical Y position from four HIMAC experiments. The accuracy is defined as deviation from expected position. For Oct20(2), the accuracy is not plotted for the Y because a different method was used to optimize the voltage and accuracy could not be estimated.

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