

DEVELOPMENT OF RING-IMAGING CHERENKOV COUNTER FOR HEAVY IONS

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We are developing a new type velocity detector of the Ring-Imaging Cherenkov counter for heavy ions (HI-RICH). In order to determine the velocity of fast heavy ions, the time of flight (TOF) measurement is often used. However, the TOF measurement with high accuracy requires large spaces and costs to prepare a long beam line. On the other hand, the velocity of ions can be deduced by measuring the emitting angle of the Cherenkov radiation. With increasing the atomic number and beam energy of ions, heavy ions emit a larger number of Cherenkov photons. Therefore, HI-RICH is expected to be a new compact and low-cost velocity counter for fast heavy ions.

The test experiment has been carried out at NIRS-HIMAC. As shown in Fig. 1, HI-RICH consists of a radiator made of quartz (refractive index $n = 1.48$) with a thickness of 1.0 mm and three 8×8 multi-anode photomultiplier tubes PMTs (H7546A-203) placed perpendicular to the beam line. The PMTs are covered with band-pass filters with wavelength peaks of 360 nm. We detected several numbers of Cherenkov photons by using the PMTs in each event and determined the emitting angle and the velocity.

As shown in Fig. 2, we have achieved the detection efficiency of 90% and the relative velocity resolution $\Delta\beta(\sigma)/\beta$ of 0.0863(4)% for $^{132}\text{Xe}^{54+}$ with energy of 420 MeV/u ($\beta = 0.71$). It is equivalent to 4.3σ separation of the mass number A at $A = 132$, when the momentum is measured precisely enough to neglect its uncertainty.

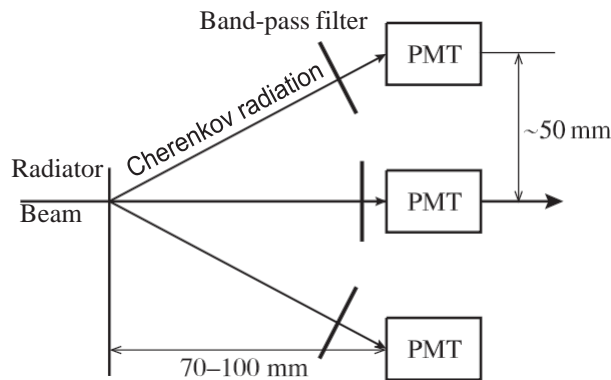


Fig. 1. Schematic view of the experimental setup for HI-RICH.

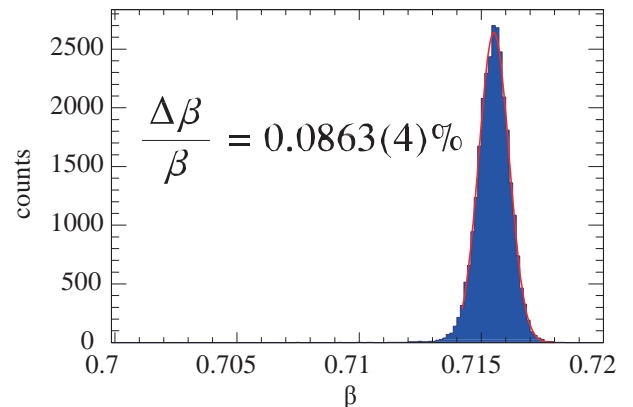


Fig. 2. Velocity β of $^{132}\text{Xe}^{54+}$ ions measured by HI-RICH.