

Present status of the storage-ring mass spectrometer at RIBF

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Atomic masses are one of the most important quantities featuring various effects of nuclear structure, reaction dynamics as well as fundamental physics. Many mass spectrometers have been established in the worldwide facilities. However, masses of exotic nuclei are still a challenge today, and are needed to resolve the mystery of nucleosynthesis, namely, r-process.

Currently, the RI Beam Factory (RIBF) at RIKEN can provide the highest intensities of radioactive beams in the world. Taking the advantage of RIBF, we have recently developed a novel scheme to measure masses of exotic nuclei. The experimental principle is based on the storage-ring mass spectrometry under the isochronous ion-optical condition. We have built a dedicated storage ring, called Rare-RI Ring (R3), lattice structure of which is a weak-focusing cyclotron type to realize a precise isochronous setting [1]. A radioactive ion of interest produced from cyclotron beam is in-flight selected and is injected into the storage ring particle-by-particle at every injection. After a certain period of storage time, the ion is extracted and the total time-of-flight is precisely measured, which is proportional to the mass-to-charge ratio of the ion.

The technical developments of in-flight particle selection scheme and fast kicker magnet system for individual injection are essential to successful operations of the present method. A mass precision of a few hundreds of keV for uranium fission fragments has been achieved. Further improvements are ongoing now. In this contribution we will introduce the technical details and will show the results of commissioning and the latest measurements [2].

References

- [1] A. Ozawa, et al., Prog. Theo. Exp. Phys. 2012, 03C009 (2012).
- [2] H.F. Li, et al., Phys. Rev. Lett. 128, 152701 (2022).