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Cryogenic He gas catcher with an RF curtain structure for upgraded KISS facility

Tuesday, 9 May 2023 14:00 (30 minutes)

We have developed the KEK Isotope Separation System (KISS) [1] at RIKEN to study heavy element synthesis in the universe. KISS presently consists of an argon gas cell based laser ion source (atomic number selection) followed by isotope separation on-line (mass number selection). KISS has successfully provided pure low-energy beams of neutron-rich isotopes near $N = 126$ in the platinum region and near $N = 152$ in the uranium region produced by multi-nucleon transfer reactions, which were studied by their nuclear spectroscopy such as β-decay spectroscopy, mass measurements, and laser spectroscopy.

To extend the studies to more neutron-rich regions, we plan to upgrade the KISS facility to KISS-II [2] whereby we replace the present argon gas cell with a next-generation, large-volume, cryogenic helium gas catcher utilizing an advanced RF curtain structure. The RF curtain structure features a 4-phase RF traveling wave technique [3] which enables efficient transport of the desired radioactive ions under a strong plasma of He^{2+} and e^- induced by ionizing interactions with the primary and secondary beams. The helium gas catcher can offer faster, more efficient, and element-independent extraction of ions. Delivering such wide isobaric cocktail beams to the existing multi-reflection time-of-flight mass spectrograph (MRTOF-MS) will allow for high-efficacy mass measurements as the device can simultaneously analyze numerous ion species. For *e.g.* decay studies, the MRTOF-MS could be used to provide an isobarically (or even isomerically) pure beam as well. Therefore, the use of a helium gas catcher could provide at least one order of magnitude improvement in experimental efficacy over the existing argon gas cell.

In advance of the development of the large-volume He gas catcher, we have started to test the RF curtain structure installed in a small-volume cryogenic helium gas catcher at KISS. We could successfully extract radioactive ions from the gas catcher and identify them by using the MRTOF-MS. In this presentation, we will introduce the activities at KISS and the overview of KISS-II, and report the development of the small-volume cryogenic helium gas catcher.

[1] Y. Hirayama *et al.*, Nucl. Instr. and Meth. B 353 (2015) 4, B 412 (2017) 11.
[2] T. Aoki *et al.*, https://arxiv.org/abs/2209.12649v2.
[3] K.R. Lund *et al.*, Nucl. Instru. and Meth. B 463 (2020) 378.

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