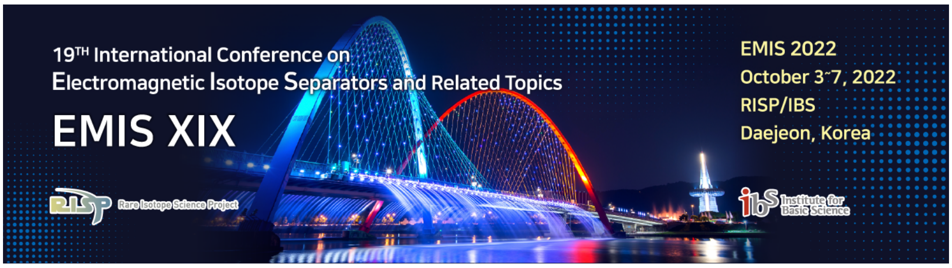

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Development of the new helium gas catcher and nuclear mass measurements with the new MRTOF-MS behind the ZeroDegree spectrometer at RIKEN BigRIPS

Thursday, 6 October 2022 10:00 (20 minutes)

A new helium gas catcher has been developed at the SLOWRI facility at RIKEN/RIBF aiming at the efficient conversion of the high-energy exotic RI beams from the BigRIPS separator to slow RI beams. The RI beams of relativistic energies are caught and thermalized in a cryogenic helium-gas filled chamber, and the thermalized ions are extracted by an RF ion guide system. The gas catcher has been combined with a multi-reflection time-of-flight mass spectrograph (MRTOF-MS), where atomic masses transported from the gas catcher can be measured with a precision of dm/m < 10^{-7} [1,2].

The gas catcher consists of a two-stage RF carpet (RFCs), where the 1st stage adopts the RF-DC method [3] while the 2nd stage employs the "ion-surfing"method [4]. Initial offline transport tests have been performed using ions from surface ionizers (like Cs and K) by measuring ion currents with Faraday cups. After the gas catcher was combined with the MRTOF-MS apparatus and mass-selective ion counting was enabled, we moved to offline tests using stable ions produced in the He gas by the alpha-ray radiation and radioactive fission products from a ^{248}Cm source. Using the two different ways of testing, a reasonable performance of the gas catcher for upcoming online experiments was confirmed.

The first online commissioning run was conducted in the end of 2020 downstream of the ZeroDegree spectrometer using parasitic beams from in-beam gamma-ray experiments by the HiCARI campaign. We successfully measured more than 70 atomic masses during the commissioning. A new optimization has been implemented in 2021, which resulted in mass spectra with a mass resolving power on the order of 106 within a total time-of-flight of only 12.5 ms. We further expand the scope of our operations including decay correlated mass spectroscopy and efficient background reduction by in-MRTOF mass selection.

The status of our gas catcher development, a further improvement, new mass measurement results, and the capabilities of our setup will be discussed in this contribution.

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[2] M. Rosenbusch et al., arXiv:2110.11507 (2021).
[3] M. Wada et al., Nucl. Instr. Methods Phys. Res. B **204**, 570 (2003).
[4] G. Bollen, Int. J. Mass Spectrom. **299**, 131 (2011).

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