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Analyzing Superheavy Element Nuclides with a Multi-Reflection Time-of-Flight Mass Spectrograph

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The atomic masses of superheavy elements is a valuable for calibrating and improving models of nuclear structure in the upper bound of nuclear existence. In many cases, as the difference in binding energy between ${}^{A}_{Z}\mathrm{X}$ and ${}^{A}_{Z-1}\mathrm{X}$ far exceeds the variance among reasonable models, a sufficiently precise mass determination could provide an orthogonal method for element identification. To these ends, our group has developed a large multi-reflection time-of-flight mass spectrograph (MRTOF), coupled to a helium gas ion stopper located downstream from the gas-filled recoil ion separator GARIS-II at RIKEN.

Our MRTOF features an ion detector that provides an ion impact signal for ToF determination, along with a pair of embedded silicon PiN diodes to detect subsequent alpha- and beta-decays. When combined with the MRTOF's mass resolving of $m/\Delta m{\sim}7.5{\times}10^{5}$ the decay-correlated ToF-MS this detector allows us to perform gives us the ability to absolutely exclude spurious ToF signal sources such as cosmic rays and stable molecular ions. The technique also allows for simultaneous determination of mass and half-life. In cases where an isomeric state emits an alpha-particle with sufficiently different energy from that of the ground state, we could use the technique to resolve even very low-lying isomers; this also allows the use of the MRTOF to determine the state ordering, which in many cases among SHE is not clear.

We will present the status of and recent results from our system, and discuss plans for extending and improving the technique in the near future.

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