On-line mass measurement using multi-reflection time-of-flight mass spectrograph (MRTOF-MS) at KISS

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We report the first online measurement using a newly developed multi-reflection time-of-flight mass spectrograph (MRTOF-MS), which recently achieved a mass resolving power of, ∼120,000 in an offline test. The detailed structure of the MRTOF-MS can be found in a previous report.[1] As a calibrant for the $A \sim 200$ mass region, ^{85}Rb ions were chosen because the ^{198}Pt ions extracted from the gas cell cooler buncher (GCCB), were found more likely doubly charged.[2] The Rb ions existing in the ^{133}Cs ion source were filtered out by using the rear linear Paul trap mass filter and transported with significant intensity. During the online experiment using a ^{198}Pt target of 12.5 mg/cm^2 and ^{136}Xe beam of 10.75 MeV/nucleon, different target-like isotopes were produced in a multi-nucleon transfer reaction at KISS,[3] and among them, ^{194}Os ions were used to study the hyperfine structure.[4] At KISS, by adjusting the laser frequency, specific ions are selectively ionized by irradiating the ionization lasers in two steps and transported

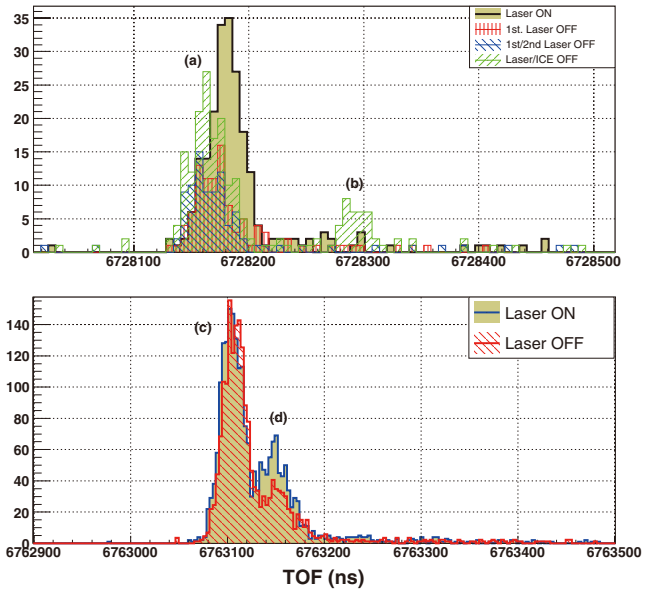

Fig. 1. Measured TOF spectra : ^{193}Os run (Upper) and ^{194}Os run (Lower). See the text for details.

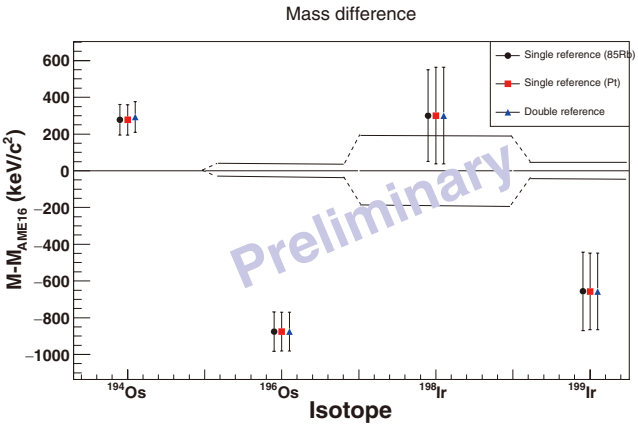

Fig. 2. Mass deviation from the AME2016 mass value. The solid line denotes the uncertainties from the AME2016.

with almost 100% purity. However, in most of the measurements, huge contaminants were observed, which seemed irrelevant to the ionization laser. As an example, Fig. 1 demonstrates the contaminants observed in the ^{193,194}Os runs, in which (a) and (c) are ^{193}Pt and ^{194}Pt ions, respectively, that survived from the elastic events emitted from the production target. The other contaminant near ^{194}Pt (d) is more likely a mixture of A = 194 isotopes (Ir, Au, and Hg). The contaminant (b), 6.5 micro-amu heavier than ^{193}Os, is not identified yet but sufficiently removed by the ion collection electrode (ICE). Fig. 2 demonstrates the accuracy and precision of each measurement of ^{194}Os ($T_{1/2}$ = 6 y), ^{196}Os ($T_{1/2}$ = 30 m), ^{198}Ir ($T_{1/2}$ = 8 s), and ^{199}Ir ($T_{1/2}$ = 6 s). Three different methods implemented to derive their masses, i.e., the single referencing method[5] using ^{85}Rb ions or Pt ions and the double referencing method,[6] were compared there. It should be noted that the large discrepancy of ^{194}Os is more likely due to the contaminant included in the ^{194}Os position, as previously described. The mass of ^{198}Ir has been directly measured for the first time, but it still needs more careful analysis.

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