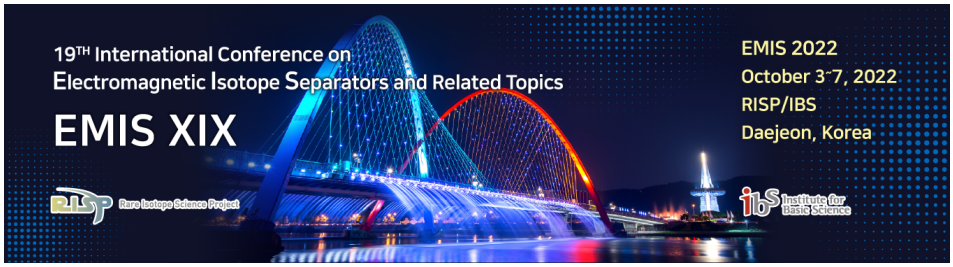

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Offline development for collinear laser spectroscopy at the SLOWRI facility

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Collinear laser spectroscopy is a powerful tool to study nuclear properties such as electromagnetic moments, spin, changes in charge radius, and shape in ground or isomeric states along isotopic chains. At the radioactive isotope (RI) beam factory of RIKEN, the in-flight fragmentation separator called Big-RIPS has supplied intense RI beams. A helium gas-catcher called SLOWRI has been developed at the downstream side to stop and cool the high-energy fragment beams. The SLOWRI facility supplies slow and low-emittance ion beams of most elements. It is an attractive platform where nuclei that are not accessible from ISOL based RI facilities can be studied. Particularly short-lived isotopes from refractory elements are accessible. Consequently, collinear laser spectroscopy on isotopic chains of refractory elements is under preparation at the SLOWRI facility.
Towards online measurement on RI beams, we have prepared an offline setup and performed test measurements using singly charged barium isotopes. In this proof of principle Ba ions were produced continuously by surface ionization, extracted at 10 keV, mass-separated, and collinear laser spectroscopy was performed. A homemade external cavity diode laser (ECLD) was used to excite a strong optical transition in the ion at 455 nm and spectra of stable isotopes (A=132-138) were observed. Then we measured spectra of singly charged zirconium ions as a proof of principle for refractory elements. Ions were produced by pulsed laser ablation. A commercial Ti:Sa laser with second harmonic generation using a LBO crystal was used to excite a strong transition in the Zr ion at 357 nm. We observed spectra of all stable isotopes (A = 90-92, 94, 96) by photon counting in coincidence with the pulsed ion beam for 50 us to reduce background counts. An additional development is to use ion bunches from a multi-reflection time-of-flight mass spectrometer (MR-TOF), where bunch lengths of 40 ns are achievable for further improvements of the signal to noise ratio in collinear laser spectroscopy –which is critical to extend collinear laser spectroscopy to isotopes produced at low intensity.

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