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Off-line Tests and Performance of ORISS with an Improved RFQ Ion Cooler/Buncher

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ORISS (Oak Ridge Isomer/Isobar Spectrometer/Separator) is a Time-of-Flight (ToF) based high resolution and high transmission instrument. Designed for decay spectroscopy experiments, the performance goals are a mass resolving power (FWHM) of 400,000 and a transmission of 50%. As a separator, it will provide isobarically pure samples of any rare isotope and of many isomers. As a spectrometer, it will measure masses in many cases where low production rates and/or contaminations limit the use of a Penning trap. The UNIRIB universities and staff continue to explore ways to utilize ORISS at NSCL and TRIUMF. At NSCL, ORISS would accept beams from the stopping gas cell located behind the A1900 fragment separator or the He Jet system and be used for mass measurements and decay spectroscopy experiments.
Presently, ORISS is tested offline at the former HRIBF facility. The Radio-Frequency ion cooler/buncher, which serves as an ion injector, and the multi-reflection section, where the mass dispersion occurs, were tested separately. The cooler/buncher converts the incoming ion beam of typically 125 eV and 60 mm mrad emittance into bunches, which are then injected into the multi-reflection section for mass analysis. In the past year, significant improvements were made to the cooler/buncher, such as increased mechanical precision, higher RF amplitudes and frequencies, and a modified internal pressure distribution of the He buffer gas. As a result, a transmission of the cooler/buncher of > 50% has been achieved, and is being further optimized. At the exit of the cooler/buncher, a ToF spectrum is registered, and ToF peaks with a FWHM of 9 ns for mass A = 133 have been recorded and are being optimized.
The overall ORISS system performance is expected to meet our design goals. The ion optics of the multi-reflection section was tested previously and is well understood. From the results presented here, we predict a total ORISS transmission of comparable size (> 50%) and a mass resolving power of > 200,000. During ion injection and multi-reflection, no ion losses except through collisions with residual gas atoms are expected, which we estimate to be small. The ToF-peak broadening as a function of the number of laps is well understood from our ion optical model and previous measurements, and allows us to predict very high mass resolving power.
Measurements of transmission, mass resolving power, beam acceptance, throughput and space charge effects will be presented.

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