RIBF190: Exploring collectivity beyond ^{78}Ni

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Recently, it has been indicated that the doubly magic ^{78}Ni has competing low-lying spherical and prolate-deformed states.[1] In its north-east quadrant, measurements of $E(2_1^+)$ and $E(4_1^+)$ of the $N = 52, 54$ Zn isotopes show deformation of ground-states becomes prominent beyond $N = 50$.[2] Shell model[3,4] and interacting boson model calculations[5] that reproduce the available spectroscopic information of $N > 50$ Se and Ge isotopes predict them as transitioning from their $N = 50$ sphericity to collective structures. In the case of the Ge isotopes this takes the form of soft and rigid triaxiality, while the Se isotopes start to exhibit prolate-oblate shape coexistence. Initial spectroscopy seems to agree with the models that predict these interesting features.[6,7] In addition to the quadrupole degrees of freedom, octupole collectivity may be expected to be enhanced in the neutron-rich Ge/Se region due to their proximity to the "doubly octupole magic" numbers, $N = 56$ and $Z = 34$

An experiment was performed over 4 days with three BigRIPS settings to extract the reduced transition probabilities of low-lying states in ^{84,86}Ge and ^{86,88,90}Se in order to clarify the quadrupole and octupole collectivity of the region. Exotic nuclei were produced from the in-flight fission of a ^{238}U beam which was accelerated to 345 MeV/nucleon. Following fission, the isotopes of interest were selected in the first stage of BigRIPS using the $B\rho$-ΔE-$B\rho$ technique and identified with the second stage using their $B\rho$, ΔE, and time-of-flight (TOF) values. The BigRIPS particle-identification plots for the three settings of the experiment are shown in Fig. 1. Secondary targets of Be (3.8-mm-thick) and Bi (1.1 mm-thick) were situated at the F8 focal plane to induce nuclear and Coulomb excitations, respectively. Gamma rays emitted from excited states were detected with the HiCARI array[8] which surrounded F8. The trajectory of incoming and outgoing ions with respect to the target was measured with PPACs. Following the reaction targets, ions were transported through the ZeroDegree spectrometer where they were identified, again using their $B\rho$, ΔE, and TOF values. Finally, the ions were stopped in a gas cell and their masses recorded using a MR-TOF setup.

While off-line data analysis is yet to begin, the on-line γ-ray spectra show clearly that the main objectives of the experiment are attainable. In addition to the Coulomb excitation to the 2_1^+ states being observed in all objective nuclei, some nuclei show 2_2^+ excitations on the heavy target.

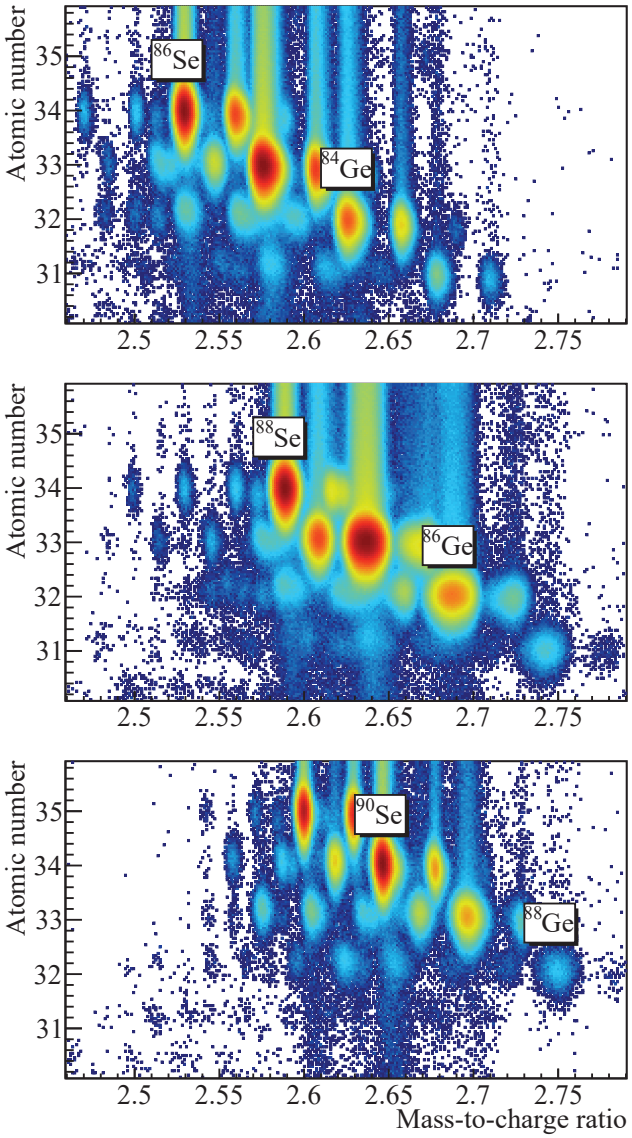

Fig. 1. On-line particle identification plots for the three BigRIPS settings employed during the experiment. Labels refer to the identified ions below them.

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References

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