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The strength of the N = 82 shell closure has a major impact on the nucleosynthesis of elements with mass number ≈ 130 since it perturbs the neutron capture and β-decay rates for neutron-rich nuclei along the *r*-process path with Z in the neighborhood of 40, which are important in the reaction network calculations. This shell closure can be probed by studying the spectroscopy of neutron-rich nuclei near the *r*-process path with mass number ranging from ~ 100 – ~ 120, which have benefited from the past study of the prompt γ-ray emission of fission fragments. For example, the population of ground-state and K = 2 bands up to spin 22^+ and 19^+, respectively, for ^{112}Ru ($T_{1/2}$ = 1.75 s) was observed by using the ^{238}U(α,2n f) reaction with Gammasphere/CHICO [1]. In addition, the lifetimes for states with spin between 8^+ and 16^+ in ^{112}Ru were also measured using the spontaneous fission of ^{248}Cm [2] and ^{252}Cf [3] and, thus, the magnitude of quadrupole deformation is determined. However, one major quantity, the asymmetry of quadrupole deformation that includes the quadrupole moments of excited states, won't be obtained until the realization of Coulomb excitation of the reaccelerated ^{112}Ru radioactive beam at sub-barrier energy, which typically is ~ 4.0 – 4.5 MeV/nucleon. This quantity is essential to study the shape evolution in neutron-rich nuclei adjacent the *r*-process path, which is sensitive to the strength of the shell closure at N = 82.

To assess the resources needed to field a quantitative measurement to advance our knowledge on shape evolution, we have carried out a numerical simulation of the Coulomb excitation for ^{112}Ru at 460 MeV bombarding energy on a ^{208}Pb target of 1 mg/cm^2 using a semiclassical code, GOSIA [4] with GRETINA/CHICO2 [5] (shown in the figure below). With a beam intensity of 10^5 pps, a statistical uncertainty ~ 10% can be achieved in three days for the γ-ray yield of 1 mb production cross section. With this lower bound set, it is possible to reach a precision measurement for the transitional matrix elements up to spin 8^+ or 10^+ of the ground-state band and up to 6^+ of the K = 2 band as well as the quadrupole moments up to spin 6^+ of the ground-state band and up to 4^+ of K = 2 band. The shape degrees of freedom would be well characterized from these measured electromagnetic properties. The evolution of the shape degrees of freedom along the neutron-rich Ru isotopes with N up to 74 can be explored in the upgrade ReA facility with E/A > 4 MeV/nucleon. This study can be extended to N = 76 and beyond once the FRIB is online and the new instrument GRETA/CHICOx is available. CHICOx would be a modified version of CHICO2 and is in the planning stage to alter the exterior design to be fitted inside the cavity of GRETA. This unique instrument is useful for not only the current proposed Coulomb excitation work but also any experiment requiring the measurement of two-body kinematics, such as the quasi-elastic reaction, deep-inelastic reaction, or fission.

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