Recent Research Using the HRIBF Recoil Mass Spectrometer *

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The HRIBF Recoil Mass Spectrometer (RMS) [1] at Oak Ridge National Laboratory is comprised of a momentum separator for primary beam rejection and an E-M-E "Rochester-type" mass spectrometer for product identification. The RMS has a large energy ($\pm 10\%$) acceptance and can transmit products with mass-to-charge ratios differing from the central ion by up to $\pm 5\%$ while providing a mass resolution ($M/\Delta M$) on the order of 400. By combining the RMS with several types of detectors operating in coincidence, experiments focusing on nuclei produced with sub-microbarn cross-sections are possible.

Proton radioactivity has been shown to provide information on the parent state's wave function through comparisons of half-life and energy data with relatively simple WKB calculations. A recent experiment has identified proton fine structure (decay branches to more than one state) in ^{146}Tm resulting in the population of neutron states in the daughter. This branching arises from the mixing of the neutron single-particle wave functions in the parent nucleus. Relative excitation energies of the daughter neutron states may be identified.

The rapid proton capture process is one way in which nature is able to produce proton-rich, mid-mass isotopes. Found to occur in supernovae and X-ray bursts, the balance between proton capture and beta decay rates govern the path and the range of the process. Should the half-life of an isotope below a proton-unbound isotope be long, then the process stalls and heavier elements cannot be produced in large quantities. Zirconium-80 lies along this path and is a potential waiting point in the process. We report on our measurements of the half-life of ^{80}Zr and its effects on the A=80 abundances [2].

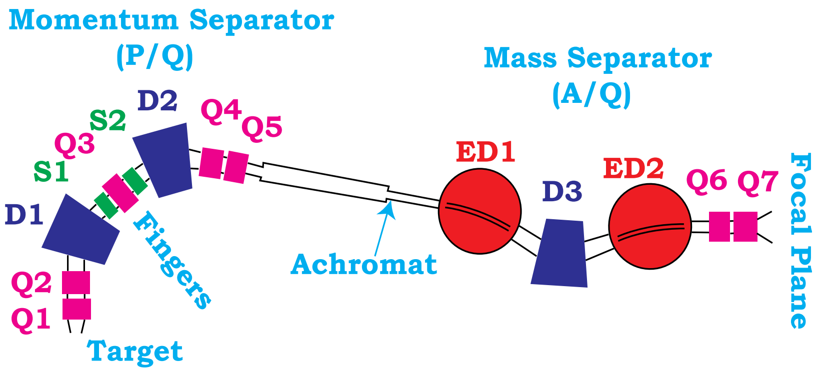

FIG. 1. A schematic drawing of the HRIBF Recoil Mass Spectrometer.

[1] C. J. Gross *et al.*, Nuclear Instrum. and Methods, Sect. A, in press. (available at http://www.phy.ornl.gov/hribf/research/equipment/rms/rms_nim.pdf).
[2] J. J. Ressler *et al.*, Phys. Rev. Lett. **84**, 2104 (2000).

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