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Particle Spectrometers for FRIB

A.M. AMTHOR, Bucknell University

FRIB promises to dramatically expand the variety of nuclear systems available for direct experimental study by providing rates of many rare isotopes orders of magnitude higher than those currently available. A new generation of experimental systems, including new particle spectrometers will be critical to our ability to take full advantage of the scientific opportunities offered by FRIB. The High-Rigidity Spectrometer (HRS) will allow for experiments with the most neutron-rich and short-lived isotopes produced by in-flight fragmentation at FRIB. The bending capability of the HRS (8 Tm) matches to the rigidity for which rare isotopes are produced at the highest intensity in the FRIB fragment separator. The experimental program will be focused on nuclear structure and astrophysics, and allow for the use of other cutting-edge detection systems for gamma, neutron, and charged-particle detection. Stopped and reaccelerated beam studies will be an important compliment to in-flight techniques at FRIB, providing world-unique, high quality, intense rare isotope beams at low energies up to and beyond the Coulomb barrier—with the completion of ReA12—and serving many of the science goals of the broader facility, from nuclear structure and astrophysics to applications. Two specialized recoil spectrometers are being developed for studies with reaccelerated beams. SECAR, the Separator for Capture Reactions, will be built following ReA3, coupled to a windowless gas jet target, JENSA, and will focus on radiative capture reactions for astrophysics, particularly those needed to improve our understanding of novae and X-ray bursts. A recoil separator following ReA12 is proposed to address a variety of physics cases based on fusion-evaporation, Coulomb excitation, transfer, and deep-inelastic reactions by providing a large angular, momentum and charge state acceptance; a high mass resolving power; and the flexibility to couple to a variety of auxiliary detector systems. Two designs have been proposed to meet these needs, ISLA, the Isochronous Separator with Large Acceptance, and an electromagnetic M/Q separator SUPERB, the Separator for the Unique Products of Experiments with Radioactive Beams.