

Design of a New Recoil Separator for Measurements of Radiative Capture Reactions in Astrophysics

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Proton- and alpha-capture reactions on unstable proton-rich nuclei play crucial roles in the energy generation and element synthesis occurring in nova explosions and X-ray bursts. Measurements of the cross sections of such reactions have begun in recent years using radioactive beams incident on hydrogen or helium gas targets, and directly detecting the recoils at the focal plane of an electromagnetic separator system located along the beam axis. For such a separator system to be effective, it must ideally have high acceptance, high mass resolution, high transmission of a given charge state, and excellent rejection of unreacted scattered beam particles that are $\geq 10^{10}$ times intense than the capture reaction recoils. A new device for such measurements, the **Separator for Capture Reactions [SECAR]**, is being designed for use at the **Facility for Rare Isotope Beams (FRIB)**. FRIB is the next generation radioactive beam facility in the U.S., to be built at Michigan State University [1], that will produce intense beams of hundreds of unstable nuclei that are involved in explosive nucleosynthesis processes. Aspects of a preliminary conceptual design of SECAR, based on the St. George recoil separator being constructed at Notre Dame [2], will be presented, along with plans for the first set of measurements.

[1] <http://frib.msu.edu>

[2] M. Couder *et al.*, Nucl. Inst. Meth. A **587**, 35 (2008).

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