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Illuminating i-Process Nucleosynthesis via Indirect Neutron-Capture Techniques

Neutron-capture cross sections play a vital role in our understanding of heavy element nucleosynthesis. In astrophysical processes such as the intermediate neutron-capture process, or i-process, element formation occurs in neutron-rich environments and involves short-lived isotopes for which capture cross sections cannot be measured directly. Instead reaction rates in these regions rely on Hauser Feshbach calculations that have uncertainties up to a few orders of magnitude. Illuminating this complex puzzle of nucleosynthesis requires innovations in theory, experimental techniques, and new observational data. In this presentation, I will discuss experimental techniques that have been developed over the last few years to constrain the statistical properties (nuclear level density, gamma-ray strength function) of short-lived nuclei which are used as inputs for Hauser Feshbach calculations. In particular, I will describe recent results from the β-Oslo method, the Surrogate Reaction method, and the Particle-Evaporation Technique, and how they can be applied across the nuclear chart at facilities such as the Facility for Rare Isotope Beams, CARIBU at Argonne National Laboratory, and TRIUMF to address i-process nucleosynthesis and beyond.

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