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Neutron Capture Reactions for the Astrophysical r process

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The astrophysical r process is responsible for the synthesis of about half of the isotopes of the heavy elements. Although the general characteristics of the process have been known for a while, the astrophysical site where it takes place has not been unambiguously determined. Efforts to better understand this important process span across many fields, including astronomical observations of metal-poor stars, modeling of the possible scenarios, sensitivity studies, nuclear theory calculations and nuclear experiments. One of the nuclear inputs that have a large impact on the final abundance calculations is neutron-capture reaction rates. These reactions are practically unconstrained far from stability due to the difficulty in studying them with direct techniques. As a result, astrophysical calculations have to rely on theoretical models, which differ from each other by factors of 10-1000. Therefore, indirect experimental approaches are required, and this talk will present the development of a new technique to experimentally constrain these important (n,γ) reaction rates far from stability. The relevant experiments were done at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University using the γ-calorimeter SuN. New results in the mass region of A=70 and the impact on r-process calculations will be presented.

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