Experimentally exploring surrogate transfer reactions to determine (n,γ) reaction rates

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The rapid neutron capture process is understood to be responsible for the creation of about half of the elements heavier than iron. Astrophysical models of nuclear abundances are dependent on (n,γ) cross sections and branching ratios. Experimental nuclear physics measurements of (n,γ) rates are necessary to reduce uncertainties in these values. However, most of the isotopes of interest along the r-process path are unstable and are too short lived to create a solid target for direct measurements of neutron capture cross sections. A proposed method of constraining compound (n,γ) cross sections is to use the surrogate reaction method with a light ion transfer reaction such as (d,pγ). Recently, the (d,pγ) reaction in normal kinematics was validated as a surrogate for the (n,γ) reaction [1]. To measure (d,pγ) with radioactive ion beams (RIBS) the Gammasphere ORRUBA (Oak Ridge Rutgers University Barrel Array) Dual Detectors for Experimental Structure Studies (GODDESS) was developed. This talk will present an overview of GODDESS and preliminary results.

[1] A. Rakiewicz, J.A. Cizewski, J.E. Escher, G. Potel, J.T. Burke, R.J. Casperson, M. McCleskey, R.A.E. Austin, S. Burcher, R.O. Hughes, B. Manning, S.D. Pain, W.A. Peters, S. Rice, T.J. Ross, N.D. Scielzo, C. Shand, and K. Smith. Towards neutron capture on exotic nuclei: Demonstrating $(d, p\gamma)$ as a surrogate reaction for (n, γ). *Physical Review Letter*, 122, 2019.