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An empirical, parameter–free, model independent method to correlate and predict neutron capture cross sections of relevance to astrophysics and other applications

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Abstract

Neutron capture cross sections in the keV range are critical for understanding nucleosynthesis in several important astrophysical environments. Certain key cross sections are also of relevance to reactor performance and design and for nuclear forensics. For decades, considerable effort has gone into measuring these cross sections where possible and modeling them where not. Nevertheless, further measurements are often difficult or impossible, and theoretical estimates of unknown cross sections (usually using various statistical models combined with specific structural and reaction input) are often quite uncertain (up to factors of 3 or more), especially when they involve extrapolation to unknown cases. These limitations contribute to ambiguities in understanding various nucleosynthetic processes and delineating the sites where they occur. It is therefore of considerable importance to develop an improved method to correlate known cross sections and to predict new ones with higher accuracy and confidence. This talk will present such a method, newly developed, that is simple, robust, parameter–free, model independent, and based on readily available empirical information. It can provide estimates of unknown cross sections often with accuracies of 20-30%, and often converts the estimation process from the normal one of extrapolation to one of interpolation.