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Constraining neutron capture rates for the intermediate neutron capture process

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The intermediate “i” process was proposed as a plausible scenario to explain some of the unusual abundance patterns observed in metal- poor stars (Denissenkov et al, ApJ Letters 2017). The most important nuclear physics properties entering i-process calculations are the neutron-capture cross sections and they are almost exclusively not known experimentally. In this talk we demonstrate results (Spyrou et al., PRL, 2024) from an experiment using RIBs from CARIBU, Argonne National Laboratory, allowing to experimentally constraint the ^{139}Ba(n,□)^{140}Ba reaction rate using the newly developed “Shape” method (Muecher et al., PRC 107, L011602, 2023). Our results remove the dominant source of uncertainty for the production of lanthanum, a key indicator of i-process conditions. Our results show that the observed elemental abundances in metal-poor stars are consistent with an i-process scenario at neutron densities of 10^{13} □/□□^{3}.
We will also discuss future plans for direct measurements of neutron capture rates at the University of Cologne, targeting i-process relevant nuclei near stability.

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