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Constraining the ^{139}Ba(n,γ)^{140}Ba reaction rate for the astrophysical i process

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In recent years the plethora of new astronomical observations has shown that the synthesis of heavy elements cannot be explained just by the three traditional processes (s, r, and p). For this reason, new processes have been proposed that are able to explain these new observations. The "intermediate" or i process is one such process and corresponds to neutron densities and time scales intermediate between the slow (s) and the rapid (r) neutron-capture processes. It involves nuclei that are roughly 5 neutrons away from the last stable isotope and as such the majority of their nuclear properties are experimentally known. The only missing piece of information from the nuclear physics side is the neutron-capture reaction rates. In a collaboration between Michigan State University (MSU), the University of Guelph, the University of Oslo, iThemba LABS and Lawrence Livermore National Lab we have an established experimental program that aims at constraining important neutron-capture reactions for the astrophysical i process. In this talk I will present the overall i-process program of the collaboration and focus on one particular reaction, the ^{139}Ba(n,γ)^{140}Ba reaction using the β-Oslo method. This reaction was identified by our collaborators at the University of Victoria as one of the most important reactions that impacts the production of lanthanum and cerium. The measurement of the relevant reaction took place at the CARIBU facility at Argonne National Lab. A ^{140}Cs beam was isolated and delivered to the center of the SuN detector onto the SuNTAN tape transport system. The β-Oslo method was used to extract the nuclear level density and the γ ray strength function which were used to constrain the neutron capture reaction rate on ^{139}Ba.

Field of work

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