Coupled-Channel Computation of Direct Neutron Capture on Non-Spherical Nuclei

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Models of direct neutron capture of neutrons have so far accounted for the effects of non-spherical nuclei either in the incoming wave functions (via non-spherical optical model potentials), or in the final bound states (via non-spherical real potential wells), but not in both. Since it is known that spherical optical potentials do not give a good reproduction of low energy neutron-scattering observables of deformed nuclei, we have performed calculations in which the initial and final states are both treated in a self-consistent, non-spherical-nucleus picture. We have done this in the coupled-channels model of nuclear reactions implemented in the FRESCO code [1] by using the same deformation-length for the couplings to the rotational-band states in the incoming and the final state configurations. We compute direct capture using this method for even-mass calcium isotopes \(^{40,42,44,46,48}\text{Ca}\) to study the effect across the two closed neutron shells, for neutron-rich even-mass tin isotopes relevant to models of astrophysical nucleosynthesis, and for \(^{56}\text{Fe}\) that is an important structural material used in nuclear applications.


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Theory of Reactions for Unstable iSotopes

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