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Effect of angular momentum selectivity of the beta-Oslo method

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Accurate predictive models of neutron capture cross sections are key to understanding cosmogenic nucleosynthesis, fundamental nuclear physics, and nuclear stockpile security. For several decades, the "Oslo Method" has been used to determine gamma-ray strength functions and nuclear level densities, important input parameters to such models. This method has traditionally been limited to the study of nuclei close to stability that can be created in charged-particle collisions with stable targets. More recently, the "beta-Oslo Method" was developed, a new application of the Oslo Method to nuclei formed by beta decay, allowing strength function and level density measurements in more neutron-rich nuclei. However, the range of angular momenta of nuclear states populated by beta decay, within $1\hbar$ of the ground state of the decaying nucleus, are much more limited than by charged particle reactions and in the natural distribution available.

To investigate the effect on the Oslo Method of this angular momentum selectivity, artificial nuclear level schemes for a range of neutron-rich strontium isotopes were generated by the Monte Carlo code DICEBOX. Gamma ray cascades were simulated from distributions of states with angular momentum that can be populated by beta decay, assumed to be measured with 100% lossless efficiency, and analyzed with the Oslo Method. The strength functions and nuclear level densities extracted were then compared to both the known models used to generate the DICEBOX cascades and those parameters extracted from a broader initial angular momentum distribution. Furthermore, the sensitivity of the method to certain subject user-defined inputs, such as the determination of unknown normalization parameters and gamma-ray matrix resolution, was noted.

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