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Estimating the γ-summing detector HECTOR efficiency using Geant4

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The High Efficiency Total Absorption Spectrometer (HECTOR) is a NaI(Tl) 4π summing detector designed to measure radiative capture cross sections relevant for astrophysical processes. In order to extract cross sections from experiments, the summing efficiency of the detector needs to be well understood. To determine efficiency, experimental yields are typically compared to Geant4 simulations if the level scheme and gamma-branching ratios are known. However, this technique proves to be particularly challenging for heavy nuclei for which the level schemes are not well known.
We present a statistical approach in which we determine the functional dependence of efficiency with the average number of segments fired in a given event ("multiplicity") and energy of the gamma rays through Geant4 simulated cascades. The cascades are randomly generated from a double Lorentizan GDR model. The Lorentizan parameters are extracted from the Reference Input Parameter Library (RIPL-3) for the compound nuclei of interest. As a benchmark of the methods, the strengths of the resonances in the 27Al(p,γ)28Si reaction will be presented.
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