Systematic isotopic chain investigations of γ-ray strength functions in the shell model

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γ-ray strength functions are one of the key nuclear physics inputs to constrain (n, γ) cross-sections for unstable nuclei relevant to different neutron-capture nucleosynthesis processes. This is of particular importance for the r process, where the process flow proceeds through neutron-rich nuclei far from stability. It has been shown that the presence of a low-energy enhancement, seen experimentally in many nuclei including neutron-rich ones [1, 2, 3, 4, 5] could impact the capture cross sections by orders of magnitude [6], which could in turn severely impact reaction network model predictions. We present a systematic study using large-scale shell model calculations of the low-energy $M1$ γ-ray strength function for many isotopic chains in the Nickel mass region. The low-energy enhancement is present in all cases studied, but its strength varies with mass number in systematic ways. We discuss possible explanations for the systematic behaviour, and the implications if this behaviour extends all across the nuclear chart.

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