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Characterization of instrumental background in a (p,γ) reaction, studied at the iThemba LABS Tandetron facility

Understanding background radiation is essential for precision studies in any facility. This work investigates background contributions observed during radiative capture measurements at the low-energy nuclear astrophysics beamline (H-line) of the iThemba LABS Tandetron facility. The H-line is dedicated to studying the statistical properties of proton-rich isotopes via proton or alpha induced reactions, providing key observables such as photon strength functions and level densities which are critical inputs for nucleosynthesis reaction calculations.

To achieve high-precision measurements, experiments utilize a high-resolution gamma-ray detection system comprising High-Purity Germanium (HPGe) and Cerium-doped Lanthanum Bromide ($LaBr_3$:Ce) detectors, along with the 3 MV Tandetron accelerator.A key challenge in these measurements is distinguishing true reaction signals from background contributions, which may arise from beam interactions with beam-line elements or contaminants on the target.

Findings indicate that suboptimal beam tuning can result in unintended interactions with beam-line components, while beam spreading after the target leads to further interactions. This comprehensive background characterization allows for refinements in experimental methodology, ensuring improved accuracy in PSF studies.

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