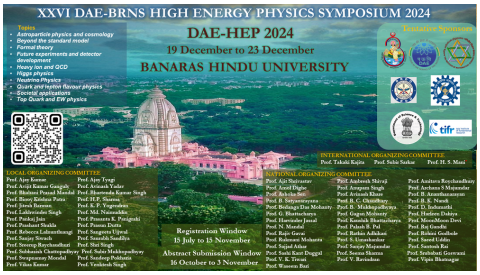

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Measurement of Cosmic Muon-Induced Low-Energy Gamma Background Spectroscopy with a HPGe Detector for CEvNS Experiment in India

In rare-event physics experiments, such as searches for elusive interaction like the coherent elastic neutrino-nucleus scattering, comprehensive background understanding and effective mitigation are absolutely necessary. The background levels within the region of interest (ROI) significantly impact measurement sensitivity, where the signal from neutrino-induced nuclear recoils is expected to appear as an excess above the background. In CEvNS experiments, the primary background comes from radioactive gamma radiation, with additional irreducible contributions from secondary gamma rays and neutrons generated by cosmic muon interactions with the shielding surrounding the detector. Therefore, the implementation of advanced and highly effective background suppression techniques is imperative for optimizing the sensitivity of experiment and ensuring its success.

This work presents a detailed characterization of a high-purity germanium (HPGe) gamma spectrometer, focusing on its detector response to various gamma and neutron radioactive sources. We also evaluate the rate of cosmic muon-induced secondary low energy backgrounds upto 10 keVee , utilizing HPGe surrounded by 10 cm lead and 2 cm copper shielding. We observed that the integration of an active muon-veto system, comprising plastic scintillator paddles coupled with photomultiplier tubes and utilizing an average muon veto window of 150 μs, enables us to effectively discriminate these backgrounds, thereby improving the detector's sensitivity to rare event detections.
Additionally, Monte-Carlo simulations using Geant4 are employed to benchmark experimental results and optimize detector response.

Field of contribution

Experiment

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