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Performance of HPGe Detector (BEGe Crystal)

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In this work we present the characterization of a BEGe (Broad Energy Germanium) type HPGe (High Purity Germanium) detector, with a Carbon Fiber entrance window (typically ~0.6 mm thick) and an active area of 6305 mm², operated at shallow depth in Abu Dhabi. The shielding is made of 6 inch lead [5 inch ordinary low-background lead; and 1 inch of low ²¹⁰Pb content] and a liner composed of 1.5 mm high purity copper and 1 mm low-background tin. For cooling, a hybrid cryostat [CANBERRA CryoCycle II] is used. The detector was calibrated using a NORM sample with known isotopes, and the efficiency curve was obtained using LabSOCS, a 1.6 keV FWHM (Full Width at Half Maximum) was obtained for the 662 keV peak of ¹³⁷Cs. A muon veto was applied at different gate times, reducing the background by 10% (for energies greater than 100 keV), as well as reducing the area of the 511 keV annihilation peak by 15%. Flushing the detector with nitrogen gas, to remove the radon progeny, further improved the background by ~2-3%. A thorough analysis for the shaping filter parameters, namely, the rise-time and the flattop, showed that the detector had its best resolution at rise-time equal to 4 μs at a flattop value of 1.1 μs, this was true for energies approximately below 1000 keV, with a more significant improvement for less than 511 keV peaks. The analysis was done using REXX code, for energies 30 keV to 2.5 MeV, with ten iterations for each measurement, using point sources, and then repeated with a NORM sample, and the results were in agreement for both.

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