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Upgrading the Shield of the GIOVE High-purity Germanium Detector

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The GIOVE (Germanium Inner-Outer Veto) detector is a highly sensitive germanium spectrometer used to screen materials for trace amounts of radioactivity. Material screening is an important aspect of the construction rare-event experiments such as GERDA and XENON, which require extremely low background levels. GIOVE is located at the Max Planck Institute for Nuclear and Particle Physics in Heidelberg, Germany, housed in the lower level laboratory at a depth of 15 m water equivalent. The extensive shield and unique passive-active veto system allows the detector to achieve sub-mBq sensitivities despite its shallow depth. A variety of new shield configurations and materials were investigated to further improve the sensitivity of the detector. Monte Carlo simulations demonstrate that substantial reductions in the neutron and gamma-ray spectrum at the diode may be possible by either rearranging the existing shield layers or making use of new materials tungsten and boron carbide. The results indicate that new materials and construction techniques may allow GIOVE to achieve higher sensitivity levels and suggest potential improvements to current material screening methods available to rare-event experiments.

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