HAW14-2014-020068

Abstract for an Invited Paper
for the HAW14 Meeting of
the American Physical Society

Upgrades for GERDA Phase II

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The Germanium Detector Array (GERDA) experiment is searching for the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. It is a process that violates lepton number conservation and is predicted to occur in extensions of the standard model of particle physics. GERDA is located underground in the Gran Sasso National Laboratory (LNGS), Italy. An array of bare high-purity germanium detectors enriched in ^{76}Ge is operated in a cryostat with 64 m^3 of liquid argon supplemented by a 3 m thick shield of water. The experiment aims at exploring the $0\nu\beta\beta$ decay up to a half life of $2 \cdot 10^{26}$ yr in two phases: Phase I of the experiment has been concluded last year. No signal is observed and the so far best limit is derived for the half life of the $0\nu\beta\beta$ decay of ^{76}Ge, $T^{0\nu}_{1/2} \leq 2.1 \cdot 10^{25}$ yr (90% C.L.), after an exposure of 21.6kg·yr. The result refutes an earlier claim of discovery with high probability. The background index of $1 \cdot 10^{-2}$ cts/(keV·kg·yr) is lower by about one order of magnitude compared to previous experiments. At present the experiment is being upgraded to Phase II. The aim is to collect an exposure of 100kg·yr and further reduce the background by another order of magnitude to a level of $\leq 10^{-3}$ cts/(keV·kg·yr). The detector mass will be increased by ∼20 kg of new Broad Energy Germanium (BEGe) detectors from enriched ^{76}Ge, which exhibit superior pulse shape discrimination and hence background rejection power. Low mass detector holders, cold front-end electronics, contacting and cabling schemes are redesigned for ultra low mass and radiopurity. In addition, a retractable liquid argon veto will be installed to efficiently suppress background events that induce scintillation in the liquid argon. A hybrid solution of photomultiplier tubes and silicon photomultipliers coupled to scintillating fibres was chosen. This talk gives an account of the results and these challenging modifications to meet our design goals.

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