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Upgrade of the GERDA experiment

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The Germanium Detector Array (GERDA) experiment, located underground in the Gran Sasso National Laboratory of INFN, Italy, is searching for the neutrinoless double beta (0v2b) decay of Ge-76. It uses a new shielding concept by operating bare Ge diodes (enriched in Ge-76) in 64 mˆ3 of liquid argon supplemented by a 3m thick layer of water. The results of GERDA Phase I have been published recently [1]. Compared to previous Ge experiments, a background reduction of about one order of magnitude could be achieved yielding the so far best limit for 0v2b decay in Ge-76 and refuting a recent claim of discovery with high probability. The upgrade to GERDA Phase II is in progress; it strives for a further reduction of background by another order of magnitude towards a level of 10ˆ-3 cts/(keV kg yr), and for a tenfold increase in half-life sensitivity (˜10ˆ26 yr) at an exposure of about 100 kg yr. This paper will discuss the numerous challenges to be met for reaching these goals including the increase of target mass by 20 kg of new low background BEGe detectors from enriched Ge-76 material which exhibit superior pulse shape discrimination and hence background rejection power, the development of new detector mounts, cold front end electronic circuitry, cabling and contacting schemes of ultra low mass and radiopurity, as well as the implementation of a retractable hybrid liquid argon veto system consisting of photomultipliers and silicon photomultipliers coupled to fibers which efficiently rejects all backgrounds that induce scintillation light in the liquid argon.

[1] GERDA collaboration, Phys.Rev.Lett. 111 (2013) 122503

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