THE QUEST FOR MAJORANA NEUTRINOS WITH GERDA AND LEGEND

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Since neutrinos have no electric charges, they may be their own antiparticles, referred to as Majorana neutrinos, and thus violate lepton number conservation. Neutrinoless double beta decay would be a direct consequence, and the search for this decay mode is the most sensitive method to unravel the Majorana nature of neutrinos. By operating bare germanium diodes, enriched in Ge-76, in an active liquid argon shield, GERDA achieved an unprecedentedly low background index of 5.2 x10−4 counts/keV kg yr in the signal region and met the design goal to collect an exposure of 100 kg yr in a background-free regime. When combined with the result of Phase I, no signal is observed after 127.2 kg yr of total exposure. A limit on the half-life of 0vββ decay in Ge-76 is set at T1/2 > 1.8 x 1026yr at 90% C.L. [1], which coincides with the sensitivity assuming no signal. Majorana neutrino masses are therefore are constrained to m$\beta\beta$< 79–180meV at 90% C.L.. The new LEGEND Collaboration was founded in 2016 to develop a phased, Ge-76-based double-beta decay experimental program with discovery potential a half-life beyond 1028 years, using existing resources as appropriate to expedite physics results. Its first stage, LEGEND-200, is currently under preparation, re-purposing the GERDA experimental infrastructures at LNGS, Italy, and is scheduled to go into commissioning in 2021. In parallel, we are preparing the design for the ton-scale LEGEND-1000 stage of the experiment. In this talk, I will present the final results of GERDA and discuss the preparatory works and plans for LEGEND.

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[1] Final Results of GERDA on the Search for Neutrinoless Double-β Decay, https://journals.aps.org/prl/pdf/10.1103/PhysRevLett.125.252502