LEGEND-1000 and the Nature of Neutrinos

The neutrino is the second most abundant particle in the universe, and we have learned a great deal about neutrinos over the past decades. Yet many compelling questions remain. Perhaps most significant, we don't yet know whether the neutrino and antineutrino are distinct particles; that is, whether the nature of the neutrino is Dirac or Majorana. If it is the latter, the neutrino could be responsible for the matter-antimatter asymmetry of the cosmos. And it would mean that a lepton-number-violating process, neutrinoless double beta decay (0νββ), should occur. Observation of 0νββ decay is the only feasible means of demonstrating the Majorana nature of neutrinos.

LEGEND-1000 is a planned ton-scale experiment to search for the 0νββ decay of Ge-76 with a discovery sensitivity of $T_{1/2} = 10^{28}$ years. It will use 1000 kg of high-purity germanium detectors that are isotopically enriched in Ge-76, operated in liquid argon, and located at the deep underground laboratory LNGS in Italy.

This talk will present the motivation for the search for 0νββ decay, summarize the operating principles and technical design of LEGEND-1000, and present the project planning and timeline.