Search for Neutrinoless Double-Beta Decay

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Abstract

Are neutrinos their own antiparticles? Search for an extremely rare and yet unobserved nuclear transition—neutrinoless double-beta decay ($0\nu\beta\beta$) decay if observed would prove neutrinos and antineutrinos are the same—Majorana neutrino. $0\nu\beta\beta$ decay violates lepton number conservation and could explain the origin of matter-antimatter asymmetry in the Universe. Neutrino oscillation proves neutrinos are massive, but the absolute neutrino masses are yet unknown. $0\nu\beta\beta$ decay would provide a model-dependent measurement of the absolute neutrino mass. The experimental search for $0\nu\beta\beta$ decay signal is extremely challenging since it requires a quasi-background-free experiment. The KamLAND-Zen experiment sets the most stringent lower limit on the half-life of $0\nu\beta\beta$ decay: $T^{0\nu}_{1/2} > 3.8 \times 10^{26}$ years, and corresponding upper limits on the absolute neutrino mass are in the range 28–122 meV. The new experiment LEGEND-200 started collecting data. Next-generation ton-scale experiments—LEGEND-1000, nEXO, SNO+, CUPID, KamLAND2-Zen etc are planned. In this talk, I will provide an introductory aspects of neutrinoless double-beta decay and an overview of different planned experiments, with a particular emphasis on the LEGEND-1000.

About the Speaker: Ibrahim Mirza is a sixth-year PhD physics candidate at The University of Tennessee, Knoxville, United States. He works in experimental particle physics, and involved in the search for neutrinoless double-beta decay at LEGEND-1000 experiment. Ibrahim conducts his research at Oak Ridge National Laboratory. His work involves vacuum technology, developing low-radioactivity materials, cleanroom, 3D printing, simulations and data analysis.