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Advancing Neutrinoless Double-Beta Decay in LEGEND

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The observation of neutrinoless double-beta decay ($0\nu\beta\beta$) would confirm the Majorana nature of neutrinos, violate lepton number conservation, and offer deep insights into the origin of neutrino mass and the matter-antimatter asymmetry of the universe. The LEGEND (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) program builds upon the success of its predecessors, the MAJORANA DEMONSTRATOR and GERDA, combining their strengths to achieve unprecedented sensitivity using enriched High-Purity Germanium (HPGe) detectors. LEGEND-200 is currently operational, while the design of the tonne-scale LEGEND-1000 is underway.

In this contribution, I will present the current status of the LEGEND experiment, with a focus on recent progress in background suppression—a critical challenge for $0\nu\beta\beta$ searches. In particular, I will highlight the role of machine learning techniques in improving background rejection, capitalizing on the detailed knowledge of signal formation in HPGe detectors. These techniques include novel, interpretable algorithms designed to meet the stringent low-background and high-transparency requirements of the experiment.

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Session Classification: Experiments - 0nuBB