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Purification of large volume of liquid argon for LEGEND-200

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The LEGEND-200 experiment is under construction at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy. Its main goal is a background-free search for neutrinoless double beta decay of Ge-76. Up to 200 kg of bare high purity germanium (HPGe) detectors with ^{76}Ge enrichment beyond 86% will be deployed in liquid argon (LAr). The LAr will serve as a cooling medium for the detectors as well as a passive and active shield. The LAr active veto instrumentation will be composed of light guiding optical fibers connected to silicon photomultipliers for detecting scintillation light of argon. It has been already shown in the GERDA experiment that the LAr veto was a very powerful tool for background rejection.

The scintillation properties of LAr (attenuation length, triplet lifetime) are worsened by the presence in the liquid (at a ppm level) of electronegative impurities such as oxygen, water and nitrogen from quenching and absorption processes. Consequently, the efficiency of the LAr veto will be significantly impacted. In order to achieve the best possible performance of the LAr detector LAr will be purified during initial filling of the LEGEND-200 cryostat.

The design, construction and performance of the system capable of purifying 65m³ of liquid argon to sub-ppm level will be presented. The quality of the purified liquid is monitored in real-time by measuring the triplet lifetime and simultaneous direct measurements of the concentrations of impurities such as water, oxygen, and nitrogen with a sensitivity of 0.1 ppm. If needed, the system may also be used later to purify LAr in the cryostat in the loop mode. A dedicated cryogenic pump has been installed on the bottom of the LEGEND-200 cryostat to circulate LAr between the purification system and the cryostat.

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