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Purification of large volume of liquid argon for the LEGEND-200 experiment

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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 enrichment in Ge-76 beyond 86% will be deployed in liquid argon (LAr). The LAr will serve as cooling medium for the detectors as well as a passive and an active shield. For the latter the LAr instrumentation will be composed of light guiding fibers connected to silicon photomultipliers 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 and minimization. Details of the LAr veto system will be presented in a dedicated talk.

The scintillation properties of LAr (attenuation length, triplet life time) are worsened by presence (at a sub-ppm level) of electronegative impurities such as oxygen, water and nitrogen due to quenching and absorption processes. As a consequence, the efficiency of the LAr veto may be significantly influenced. In order to achieve best possible performance of the veto, LAr will be purified during initial filling of the LEGEND-200 cryostat. The design, construction and performance of a system capable to purify 65 m³ (91 tons) of liquid argon to sub-ppm level will be presented. The quality of the processed liquid is monitored in real time by measuring the triplet life time and simultaneous direct measurement of concentrations of impurities like water, oxygen and nitrogen down to 0.1 ppm. Scintillation properties of LAr filled into the cryostat are also determined in real time by a dedicated apparatus (LLAMA). For the LAr filled into the cryostat the measured triplet life time is in the range of 1.3 micro_s. If needed, the LAr purification system may be also used later to purify LAr filled in the cryostat in the loop mode. A dedicated cryogenic pump has been installed on its bottom. The pump is capable to circulate the LAr between the purification system and the cryostat.

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