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Radon removal system for the LZ Dark Matter experiment

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Content

There is plenty of indirect evidence from astrophysical observations that Dark Matter exists, and that it constitutes 80\% of the matter in the Universe. However, Dark Matter has not yet been observed directly. The Weakly Interacting Massive Particle (WIMP) is currently the most attractive candidate for the cold Dark Matter. Since WIMPs only interact through gravitational and weak forces, they are extremely difficult to detect. The LUX-Zeplin (LZ) experiment is the most advanced next-generation direct detection experiment to search for Dark Matter in the Universe with a dual-phase liquid xenon (LXe) detector with a total target mass of 7 ton. LXe dual phase detectors proved to be very sensitive probes to search for Dark Matter based on previous experimental results. To be located at the Sanford Underground Research Facility (SURF) in South Dakota, LZ is planning to reach the ultimate sensitivity of 3×10^{-48} cm^2 in three years of operation for a WIMP mass of 50 GeV. To reach such a low detection limit, LZ implements various low background techniques to significantly reduce radioactive background. Radon is potentially the strongest background source that continuously emanates from detector parts and may contribute into the Dark Matter region-of-interest window. Its daughter nucleus, ^{214}Pb, has 6% beta branching fraction to the ground state of ^{214}Bi. The sources of radon include signal cables, feedthrough cables, stainless steel conduits, and dust. An R\&D radon removal system was built to evaluate the most efficient mechanisms to significantly reduce radon traces in the LZ detector. The ultimate goal is to reduce radon levels by more than 90%. The method, apparatus, and detailed experimental results will be presented.

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