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Update on the LUX/LZ experiments

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The Large Underground Xenon (LUX) experiment operated at the Sanford Underground Research Facility from 2013 to 2016. The detector was instrumented as a dual-phase xenon time projection chamber (TPC), providing energy measurement, position information in 3D, and single-scatter event identification. After decommissioning the instrument, the collaboration continues to exhaustively exploit the existing calibration and WIMP-search data aiming for a better understanding of the Liquid Xenon (LXe) physics and also to perform searches of dark matter candidates beyond the standard WIMP paradigm.

For WIMPs, a profile likelihood analysis using a total exposure of $129\,\text{kg.yr}$ (runs $3+4$) set a 90% CL upper limit on the spin-independent (SI) cross section of $1.1\times10^{-46}\,\text{cm}^2$ at $M_{WIMP}=50\,\text{GeV.c}^{-2}$. For spin-dependent (SD) interactions, cross sections above $\sigma_n^{SD}=1.6\times10^{-41}\,\text{cm}^{-2}$ ($\sigma_p^{SD}=5\times10^{-40}\,\text{cm}^2$) are also excluded at $M_{WIMP}=35\,\text{GeV.c}^{-2}$ (90% CL).

For axion and axion-like particles, a double-sided profile likelihood analysis using an exposure of $38.4\,\text{kg.yr}$ (run 3 only) excluded g_{Ae} larger than 3.5×10^{-12} (90% CL) for solar axions. This limit on the coupling corresponds to an upper limit on the axion mass of $0.12\,\text{eV.c}^{-2}$ or $36.6\,\text{eV.c}^{-2}$, depending on the theoretical model assumed. For galactic axion-like particles, values of g_{Ae} larger than 4.2×10^{-13} are excluded for particle masses in the range $1-16\,\text{keV.c}^{-2}$. These are the most stringent constraints to date for these interactions.

Besides detailing the calibrations and analysis leading to the LUX results, we will also present the LUX-ZEPLIN (LZ) detector, a LXe dark matter detector featuring more than 5 tons of target material in the fiducial region (from a total of 10 tons of xenon). It will be installed at the same facility used by LUX. With a projected exposure of 1000 days (commissioning starts in 2020), LZ aims to exclude the WIMP-neutron (-proton) SD cross-sections down to $2.7\times10^{-43}\,\text{cm}^2$ ($8.1\times10^{-42}\,\text{cm}^2$) for a $40\,\text{GeV.c}^{-2}$ WIMP. For the WIMP-nucleon SI interactions, a best sensitivity of $1.6\times10^{-48}\,\text{cm}^2$ (90% CL, $M_{WIMP}=40\,\text{GeV.c}^{-2}$) is expected. This represents a factor of 10 improvement when compared to the expected sensitivities of currently running LXe dark matter experiments.

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