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Direct Dark Matter Searches with LUX and LZ

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The Large Underground Xenon (LUX) experiment recently completed the data-taking phase of its search for direct evidence of dark matter. The detector is instrumented as a dual-phase liquid xenon (LXe) time projection chamber (TPC), providing energy measurement, position information in 3D, and single-scatter event identification.

LUX has obtained the world leading spin-independent exclusion limit over a wide range of WIMP (Weakly Interacting Massive Particle) masses, excluding cross sections above 0.11 zb for M(WIMP)=50 GeV/c2 (90% CL). For spin-dependent interactions, cross sections above 1.6E-41 cm2 and 5E-40 cm2 are also excluded for M(WIMP)=35 GeV/c2 (90% CL) for neutron and protons interactions respectively. Paramount for the LUX results was the extensive calibration of the detector electron and nuclear response. For the electron recoils, 83mKr and CH3T sources dissolved in the xenon were used to measure the electric field uniformity and the signal dependence with the position of interaction, both aspects critical to define the active volume of the detector. The nuclear response was calibrated in situ using a collimated beam of monoenergetic 2.45 MeV neutrons from a deuteron-based generator.

Besides detailing the 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 facilities used by LUX. The experiment aims to improve in 3 years of livetime (starting with commissioning in 2020) the WIMP-nucleon spin-independent sensitivity by a factor of 50.

Primary author: Dr LINDOTE, Alexandre (LIP)

Presenter: Dr LINDOTE, Alexandre (LIP)

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