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Calibration of a Liquid Xenon Detector for the Search for Dark Matter with the LUX-ZEPLIN (LZ) Experiment at Sanford Lab

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The 2nd generation direct detection dark matter experiment LZ will perform the most sensitive direct search for weakly-interacting massive particles (WIMPs). LZ is located at 4850 feet underground at the Sanford Underground Research Facility (SURF) in Lead, South Dakota. LZ is employing a two-phase xenon detector with an active mass of 7 tonnes. WIMPs could interact in the cryogenic liquid xenon of the detector's core by scattering off xenon nuclei into a xenon nucleus, which would then recoil and produce scintillation light and electric charge. The ratio of the directly detected scintillation light S1 and the delayed charge detection S2 is characteristic for such a nuclear recoil (NR) and differs significantly from an electron recoil (ER) produced by undesired backgrounds. However, the precise knowledge of the energy dependent ratio S1/S2, for which the electron recoil dominated regime transitions into the nuclear recoil dominated regime, is key.
Calibrations with neutrons produced in DD-generators, or from AmLi, Cf-252, and Y/Be radioactive sources, are performed and analyzed to map out the NR signal region for the WIMP search. Gamma-ray sources are utilized to map out the ER region characteristic for backgrounds. In addition, a second important calibration, to be performed on a daily basis, is the determination of the lifetime of signal electrons against absorption on impurities within the liquid xenon. This is achieved through the use of internally distributed gamma-ray sources. In this talk both types of calibration will be presented, and where appropriate, compared to full detector simulations.

Primary author: SHARMA TIMALSINA, Madan (SD school of mines)

Co-author: REICHENBACHER, Juergen (South Dakota School of Mines and Technology)

Presenter: SHARMA TIMALSINA, Madan (SD school of mines)

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