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A measurement of the mean electronic excitation energy of liquid xenon

Liquid xenon is widely deployed as target in particle detectors for rare event searches. The measurement of the occurring scintillation light and ionisation charge caused by a particle interaction allows for the determination of the associated recoil energy. A precise reconstruction of the deposited energy requires calibrations of the energy scale of the detector by means of radioactive sources. However, a microscopic calibration, i.e. the translation from the number of excitation quanta into deposited energy, also necessitates good knowledge of the energy required to produce single scintillation photons or ionisation electrons in liquid xenon. The sum of these excitation quanta is directly proportional to the deposited energy in the target. The proportionality constant is the mean excitation energy and is commonly known as W-value. We present a measurement of this work function with electronic recoil interactions in a small dual-phase xenon time projection chamber. Our result is based on calibrations at O(1–10 keV) with internal 37-Ar and 83m-Kr sources and single electron events. We obtain a value of W = 11.5 -0.3 +0.2 (syst.) eV, with negligible statistical uncertainty, which is lower than previously measured at these energies. If further confirmed, our result will be relevant for modelling the absolute response of liquid xenon detectors to particle interactions.

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