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Calibrating Inner-Shell Electron Recoils in a Xenon Time Projection Chamber

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In the field of dark matter direct detection, the biggest challenge remains building detectors that sufficiently understand and control their radioactive backgrounds in order to distinguish individual dark matter interactions. Experiments rely on calibrations to understand each detector's response to predicted backgrounds. Certain backgrounds, such as neutrino-electron scatters, cannot be directly calibrated, and so beta- or gamma-decay sources are often used as a proxy. This research postulates that such a treatment is ignoring important second-order effects that distinguish between the standard calibration schemes and simulated background. We have constructed a xenon time projection chamber, a leading technology of the field, to compare a standard tritium beta-decay calibration against Xe-127 electron-captures that simulate neutrino scatters on inner-shell electrons in xenon.

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