Contribution ID: **207** Type: **Contributed talk**

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

Tuesday 25 July 2017 13:45 (15 minutes)

Dark matter direct detection experiments rely heavily 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 treatment inherently assumes that interaction type and energy do not affect detector response to electron recoil scatters. The PICO bubble chambers have recently discovered that this assumption breaks down under certain conditions in a way that critically impacts detector performance. We have constructed a xenon time projection chamber at Fermilab to directly compare electron capture decays from Xe-127 against tritium beta decays, to determine if second-order differences will contribute to the profile likelihood analysis used by the LZ and XENON collaborations.

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Session Classification: Dark Matter

Track Classification: Dark Matter