



Contribution ID: 134

Type: not specified

Phonon-mediated High-voltage Detector with Background Rejection for Low-mass Dark Matter and Reactor Coherent Neutrino Scattering Experiments

Thursday, March 18, 2021 12:00 PM (20 minutes)

SuperCDMS Z-sensitive Ionization and Phonon(ZIP, iZIP) detectors have shown great success in discriminating electron recoils and nuclear recoils, while the High Voltage (HV) detectors have reached very low (~ 100 eV_{nr}) energy thresholds by sacrificing that discrimination. This talk focuses on a novel phonon-mediated two-stage silicon detector that will retain both an excellent threshold performance of the HV detector and maintain the iZIP-style background discrimination. The basic idea is to separate the measurement of primary phonons and charge estimate using Luke phonons in two different regions of a monolithic crystal. We have successfully demonstrated the discrimination ability of the first Si-based prototype detector for electron and nuclear recoil events. This new detector technology has the potential to significantly enhance the sensitivity to dark matter and coherent neutrino scattering experiments beyond the capabilities of current technologies which have limited discrimination at low energies.

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Session Classification: Low background / Low threshold detectors

Track Classification: Low background / Low threshold detectors