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Using Defect Creation for Directional Sensitivity and Dark Matter Signal Discrimination in Phonon-Mediated Detectors[1] FEDJA KADRIBASIC, Texas AM University — We examine two potential applications of defect formation for dark matter detectors - directionality and nuclear-electron recoil discrimination. Numerical simulations of classical interatomic potentials, alongside more precise density functional theory simulations and experiments, predict an angular dependence in the defect formation energy threshold that varies by around 20 eV from minimum to maximum. Additionally, they predict a nonisotropic, nonlinear energy loss in semiconductor detector materials that never produces phonons due to the nonzero energy required to form defects. Next-generation dark matter and coherent neutrino nuclear scattering, such as SuperCDMS and MINER, are poised to reach the resolutions necessary to detect these effects. Once these detectors are calibrated at these low recoil energies, we argue that the anisotropy in defect formation in single-electron resolution semiconductor detectors allows for very effective directional sensitivity to dark matter signals for masses below 1 GeV/c^2. Additionally, defect creation from nuclear recoil interactions distorts the expected spectra in such a way that, statistically, one can discriminate nuclear recoils from electron recoils with only phonon measurements, especially in the mass range below 10 GeV/c^2.

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