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Ionization yield for nuclear recoils in silicon at TUNL and Université de Montréal

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SuperCDMS (Super Cryogenic Dark Matter Search) is an experiment for the direct detection of dark matter that uses cryogenic silicon and germanium detectors which can measure energy depositions as low as a few eV. The ionization yield for nuclear recoils is the ratio of the number of electron-hole pairs produced by a nuclear recoil over the number of electron-hole pairs produced by an electronic recoil of the same energy. The IMPACT experiment (Ionization Measurement with Phonons At Cryogenic Temperatures) uses a silicon SuperCDMS HVeV detector to measure the ionization yield of nuclear recoils in silicon below the recoil energies reached by previous calibrations. In order to do so, we used a 55.7 keV neutron beam on our detector at TUNL as well as 29 liquid scintillator detectors placed at various angles to the beam to detect the scattered neutrons. By comparing the energy deposited in our HVeV detector to the expected energy from the scattering angle at different voltages, we can measure the ionization yield for nuclear recoils in silicon for energies between 0.1 and 4 keV. No results currently exist for recoil energies < 0.7 keV. We plan on expanding the experiment at Université de Montréal with a 4.8 keV neutron beam and a borated liquid scintillator array.

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