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Understanding eV-threshold calorimeters for SuperCDMS and other dark matter searches

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A wide variety of experiments to directly search for dark matter/atom scattering are being pursued. To search for low-mass dark matter, detectors are exploiting recent advances in calorimeter technology and are pushing the physical limits of ionization calorimetry with single photon or electron detection. SuperCDMS SNOLAB and other upcoming experiments will be using these technologies to provide substantial increases in sub-GeV/c² dark matter sensitivity.

At the limit of single photon or electron sensitivity, calorimeter sensitivity should no longer be a simple linear function of the number of quanta observed. A more complete understanding of how the energy and momentum from a dark matter-nucleus collision partitions between electron excitation, phonon generation, defect formation is required.

A calibration is being undertaken beginning this summer at the University of Montreal, using SuperCDMS style sensors on a silicon chip, to characterize low-energy nuclear recoils. Recoils from both the elastic scattering of low-energy neutrons and nuclear Thomson scattering of MeV-energy photons will be measured. Details of and new effects that may be seen by this experiment, such as directional dependent sensitivities, will be discussed.

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