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A study of the ionization efficiency for nuclear recoils in pure crystals

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We present a study of the ionization efficiency in pure materials based on an extension of Lindhard's original theory, in which the energy given to atomic motion by nuclear recoils is calculated taking into account a nonzero constant binding energy. We construct a modified integral equation that incorporates this effect consistently and find a numerical solution to this equation that leads to a "quenching factor" (QF) which is in good agreement with the available experimental measurements for Si and Ge. The calculated QF for nuclear recoils features a cutoff at an energy equal to twice the assumed binding energy. We argue that the model is a good approximation for Ge even for energies close to the true cutoff, while for Si is valid up to recoil energies greater than ~500 eV. In this talk, we will also describe recent studies aimed at further extending the calculation of the QF for Si to even lower energies, relevant for current and future direct dark matter searches and the detection of coherent elastic scattering of neutrinos off nuclei.

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