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Anisotropy of quantized electronic excitations in semiconductors for directional dark matter searches

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We study the quantum effects that are associated with the nuclear recoil electronic excitations in semiconductor crystals. Our studies exhibit a rate modulation in very low threshold semiconductor detectors, for dark matter (DM) mass $< 1 \text{ GeV}/c^2$, that is correlated with the target nucleus recoil direction. This anisotropic quantum excitation threshold can be used to perform directional DM search for the range of DM mass that is out of reach for conventional gaseous detectors. We will also present the effect of defect creation in solid state phonon-mediated detectors with $\sim \text{eV}$ threshold on the expected DM or coherent elastic neutrino-nucleus scattering spectrum.

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