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Light Dark Matter Searches with Carbon Nanotubes

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Directional detection of Dark Matter particles in the MeV mass range could be accomplished by studying electron recoils in large arrays of parallel carbon nanotubes. In a scattering process with a lattice electron, a DM particle might transfer sufficient energy to eject it from the nanotube surface. An external electric field is added to drive the electron towards the open ends of the array, where it is eventually detected. The anisotropic response of this detection scheme, as a function of the orientation of the target with respect to the DM wind, is calculated, and it is concluded that no direct measurement of the electron ejection angle is needed to explore significant regions of the light DM exclusion plot. A standard compact photomultiplier, in which the photocathode element is substituted with a dense array of parallel carbon nanotubes, could serve as the basic detection unit. For DM particles in the GeV mass range, ion channeling phenomena in carbon nanotubes can be exploited.

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