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Progress Towards Directional Detection of Dark Matter in Diamond MASON MARSHALL, Departmentdeap of Electrical and Computer Engineering, University of Maryland, RAISA TRUBKO, Department of Physics, Harvard University, PAULI KEHAYIAS, Sandia National Labs, MATTHEW TURNER, Department of Physics, Harvard University, MARK KU, Department of Electrical and Computer Engineering, University of Maryland, DAVID PHILLIPS, Smithsonian Astrophysical Observatory, ALEX SUSHKOV, Department of Physics, Boston University, RONALD WALSWORTH, Department of Electrical and Computer Engineering, University of Maryland — We are developing a method for directional direct detection of weakly interacting massive particle (WIMP) dark matter via induced nuclear recoil in diamond. A WIMP collision initiates a cascade of nuclear recoils, leaving a 100nm track of crystal damage. The orientation of this asymmetric damage track allows us to determine the incoming particles direction, allowing discrimination between dark matter candidates and backgrounds such as solar neutrinos. Spectroscopy of quantum emitters such as nitrogen-vacancy (NV) centers can be used to localize and map these damage tracks. A diamond-based semiconductor detector incorporating NV centers would therefore allow directional WIMP detection at solid-state densities, enabling WIMP searches below the neutrino floor. Here, we present the proposed detection technique, as well as the development of micro- and nanoscale techniques for localization and mapping of damage tracks in a future detector.

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