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Towards Quantum Sensing for Directional Dark Matter Detection Using Nitrogen Vacancy Centers in Diamond

Tuesday 20 May 2025 09:15 (45 minutes)

WIMP dark matter detection is increasingly constrained by the "neutrino fog," where solar neutrino backgrounds mask potential signals. To address this challenge, we are developing a diamond-based detector that leverages nitrogen-vacancy (NV) centers for directional event discrimination. WIMP or solar neutrino interactions induce nuclear recoils that create permanent 10–100 nm damage tracks in diamond, which can be imaged using quantum sensing techniques. Since our last report at MDvDM, we have (1) detected artificial damage tracks from ~1 MeV single-ion impacts, (2) developed a light-sheet quantum diamond microscope for high-precision, high-volume strain and fluorescence imaging, and (3) conducted molecular dynamics simulations of damage track formation. Lastly, we will also present ongoing work towards three-dimensional super-resolution imaging of these tracks using NV-based quantum sensing.

Do you plan to give the talk in person?

No

Primary author: ANG, Daniel (University of Maryland)

Co-authors: GILPIN, Andrew (University of Maryland); TANG, Jiashen (University of Maryland); CAMP, Mason (University of Maryland); SHEN, Maximilian (University of Maryland); Prof. WALSWORTH, Ronald (University of Maryland)

Presenter: ANG, Daniel (University of Maryland)