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NEWS | NOVEMBER 10 2022

Looking for dark matter with diamonds FREE

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Scilight 2022, 461115 (2022)
https://doi.org/10.1063/10.0015153

AIP Publishing

Scilight

10 November 2022

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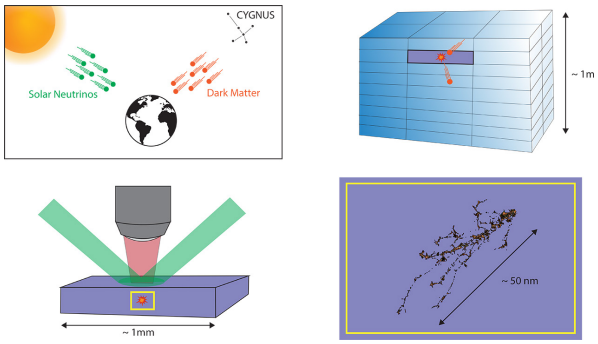
Current methods for quantum-sensing can be adapted to search for dark matter.



One of the most pressing puzzles in modern physics is the nature of dark matter, which remains undetectable with current methods. Numerous theories have predicted that weakly interacting massive particles (WIMPs) are good candidates for dark matter. Ebadi et al. describe a new approach to search for WIMPs using diamond-based quantum sensors.

The quantum sensor method would use high-resolution mapping of damage tracks in diamond to discriminate the incoming directions of WIMPs and neutrinos — thereby overcoming a key limitation for current techniques.

“In upcoming generations of experiments, traditional methods of searching for WIMPs will be sensitive to neutrino backgrounds. Further improvements in dark matter sensitivity will be hampered by such backgrounds,” author Reza Ebadi said.

The authors discuss current developments in directional dark matter detection in diamond, which is both a leading platform for emerging quantum technologies and a promising component of next-generation semiconductor electronics. In previously published research, the authors demonstrated the sensitivity needed for directional detection using widefield strain imaging via quantum defect spectroscopy, and nanoscale strain mapping by scanning X-ray diffraction microscopy. Based on these results, they believe the quantum diamond approach has promise for directional discrimination of WIMP dark matter from neutrino backgrounds.

The team hopes their review will encourage interdisciplinary efforts towards improving WIMP detection.

“Advancing the underlying technologies required for such a detector in the next few years is key to having a full-scale detector ready to take over when traditional searches reach their limits in the following decade,” said Ebadi.

Source: “Directional detection of dark matter using solid-state quantum sensing,” by Reza Ebadi, Mason C. Marshall, David F. Phillips, Johannes Cremer, Tao Zhou, Michael Titze, Pauli Kehayias, Maziar Saleh Ziabari, Nazar Delegan, Surjeet Rajendran, Alexander O. Sushkov, F. Joseph Heremans, Edward S. Bielejec, Martin V. Holt, and Ronald L. Walsworth, *AVS Quantum Science* (2022). The article can be accessed at https://doi.org/10.1116/5.0117301.

This paper is part of the Dark matter detection with quantum materials and devices Collection, learn more here.

AIP Scilight. 2022, 461115-1; https://doi.org/10.1063/10.0015153