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Enhanced Electric Field Sensing with Nitrogen-Vacancy Ensembles BRYCE KOBRIN, MAXWELL BLOCK, ANDREY JARMOLA, University of California, Berkeley, NATANIEL FIGUEROA, Helmholtz Institute, Johannes-Gutenberg University, Mainz, Germany, VICTOR ACOSTA, University of New Mexico, Albuquerque, NM, SATCHER HSIEH, CHONG ZU, University of California, Berkeley, JOAQUIN MINGUZZI, Institute for Quantum Electronics, ETH, Zurich, JERONIMO MAZE, Ponticia Universidad Catolica de Chile, Santiago, Chile, DMITRY BUDKER, Helmholtz Institute, Johannes-Gutenberg University, Mainz, Germany, NORMAN YAO, University of California, Berkeley — Nitrogen-vacancy (NV) centers in diamond have shown promise as inherently localized electric field sensors, capable of detecting individual charges with nanometer resolution. Here, we demonstrate that a detailed understanding of the internal electric field environment in NV ensembles enables enhanced sensitivity in the detection of external electric fields. We follow this logic along two complementary paths. First, using excitation tuned near the NVs zero-phonon line, we perform optically detected magnetic resonance (ODMR) spectroscopy at low temperatures in order to precisely measure the NV centers excited state susceptibility to electric fields. In doing so, we show that a characteristically observed contrast inversion arises from an interplay between spin-selective optical pumping and the NV centers local charge distribution. Second, motivated by this understanding, we propose and analyze a novel scheme for optically enhanced electric field sensing using NV ensembles; we estimate that our approach should enable an improvement in DC sensitivity by two orders of magnitude.

Bryce Kobrin
University of California, Berkeley

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