

Constraints on a Spin-dependent Exotic Interaction between Electrons with Single Electron Spin Quantum Sensors

Recently, single NV center in diamond as a quantum sensor has been proposed and utilized to explore electron-nucleon monopole-dipole interaction, which sets a constraint for the electron-nucleon coupling, $g_s^N g_p^e$, with the force range 0.1–23 μm . (1) A new laboratory bound on the axial-vector mediated interaction between electron spins at micrometer scale is established with single nitrogen-vacancy centers in diamond. A single crystal of p-terphenyl doped pentacene-d14 under laser pumping provides the source of polarized electron spins. Based on the measurement of polarization signal via nitrogen-vacancy centers, we set a constraint for the exotic electron-electron coupling, $g_A^e g_A^e$, within the force range from 10 to 900 μm . The obtained upper bound of the coupling at 500 μm is $|(g_A^e g_A^e)/4\pi\hbar c| \leq 5.7 \times 10^{-19}$, which is one order of magnitude more stringent than previous experiment. Our result shows that the NV center can be a promising platform for searching for new particles predicted by theories beyond the standard model.

Reference:

- (1). Xing Rong, Mengqi Wang, Jianpei Geng, Xi Qin, Maosen Guo, Man Jiao, Yijin Xie, Pengfei Wang, Pu Huang, Fazhan Shi, Yi-Fu Cai, Chongwen Zou and Jiangfeng Du, Nature communications, 2018, s41467-018-03152-9
- (2). Xing Rong, Man Jiao, Jianpei Geng, Bo Zhang, Tianyu Xie, Fazhan Shi, Chang-Kui Duan, Yi-Fu Cai and Jiangfeng Du, arXiv, 2018,1804.07026

Primary authors: Prof. DU, Jiangfeng (University of Science and Technology of China); Prof. GENG, Jianpei (Hefei University of Technology); Ms JIAO, Man (University of Science and Technology of China); Prof. RONG, Xing (University of Science and Technology of China)

Presenter: Ms JIAO, Man (University of Science and Technology of China)

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model