SEMINAR: Detecting and manipulating individual carbon vacancies in diamond with atomic antennas

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June 21, 2024
15:00 to 16:00
Seminar Room

A resonantly excited atomic optical dipole simultaneously generates a propagating (far-) and an evanescent (near-) electromagnetic field. The near-field component diverges in the limit of vanishing distance, indicating an optical antenna with potential for giant near-field intensity enhancement. In principle, any atomic optical dipole in a solid can serve as an optical antenna; however, most of them suffer from environment-induced decoherence that largely mitigates field enhancement. Here, we demonstrate that germanium vacancy centers in diamond - optically-coherent atom-like dipoles in a solid - are exemplary antennas. We measure up to million-fold optical intensity enhancement in the near-field of resonantly excited germanium vacancies. We utilize germanium vacancy antennas to detect and control the charge state of nearby carbon vacancies and generate measurable fluorescence from individual vacancies through Forster resonance energy transfer. Comparison with plasmonic nanospheres - a prototypical near-field enhancement medium -- shows that atomic antennas can generate orders-of-magnitude larger field intensity at nanometer lengthscales. Our study reveals the capacity of atomic antennas for efficient optical energy concentration in solids, with broad applications in spectroscopy, sensing, and quantum science.

Hosted by: Prof. Dr. Darrick Chang