Quantum measurement and orientation tracking of NV spin qubits in a living cell

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The nitrogen-vacancy (NV) defect centre in diamond represents an ideal single spin quantum system for use in biology. It possesses a broad absorption band from 512-560 nm, sustained fluorescence from 630-750 nm, is chemically inert and bio-compatible. These defect centres have been used as highly stable fluorescence beacons to track the position and diffusion of diamond nano-crystals in vitro [1,2] and in vivo [3]. Recent experimental demonstrations [4] of nanomagnetometry using these single spin systems create opportunities for new applications in biology [5]. In this talk, we explore the viability of diamond-based nanobiomagnetometry applications and report recent results on the full suite of quantum control and measurement protocols on NV-nanodiamonds in a living HeLa cell, and demonstrate the enhancements that the quantum properties enable for orientation tracking in the intra-cellular context [6].