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Diamond spin qubits for quantum technologies

Abstract: Synthetic diamond has recently emerged as a candidate material for a range of quantum-based applications including: secure quantum communication, quantum information processing and quantum sensing. In such applications, the synthetic diamond acts as a host for impurities or defects, acting like a solid-state atom trap. The quantum states of these impurities, such as the Nitrogen-Vacancy (NV) and Silicon-Vacancy (SiV) defects, can be individually manipulated and made to interact, and photons of light emitted from these impurities can be used to read out. Notably, synthetic diamond (along with silicon carbide) offers advantages over competitive materials as the quantum properties of NV centres it hosts can be manipulated and probed at room temperature.

In this presentation we will show how single colour centres can be created with a few nanometres accuracy and coherent dipole-dipole coupling was employed to generate their entanglement. Single NV centres created close to the diamond surface can be employed as nanoscale sensors of electric and magnetic fields. We will discuss further development of the field of quantum information processing and quantum sensing. Its success critically depends on the ability to improve positioning accuracy, creation yield and readout of individual NV centres.

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