Diamond based quantum computers and simulators

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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. We will also present experimental realisation of room temperature quantum simulator based on C^{13} nuclear spins arrays.