Quantum information technologies with solid-state spin-photon interfaces

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Abstract:

Single-photon emitters embedded within a solid-state host make natural candidates for quantum information processing nodes, as they combine: strong confinement of light for efficient light-matter coupling, readily controlled electronic spins for fast processing, and long-lived nuclear spins in the host material for memory. Semiconductor quantum dots in III-V materials and colour centers in diamond are among leading candidate platforms. In this talk, I will summarise my team's recent progress on both systems [1-4], and contextualise their future use for quantum communication and computing technologies as part of my research programme in Oxford.

[1] Jackson et al. (2021). Quantum sensing of a coherent single spin excitation in a nuclear ensemble. Nature Physics 17 (5)
[2] Gangloff et al. (2021). Witnessing quantum correlations in a nuclear ensemble via an electron spin qubit. Nature Physics 17 (11)
[3] Jackson et al. (2021). Optimal purification of a spin ensemble by quantum-algorithmic feedback. arXiv:2111.04624
[4] Debroux et al. (2021). Quantum control of the tin-vacancy spin qubit in diamond. Phys Rev X 11 (4)