Quantum Physics

Coherence and control of quantum registers based on electronic spin in a nuclear spin bath

P. Cappellaro, L. Jiang, J. S. Hodges, M. D. Lukin

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We consider a protocol for the control of few-qubit registers comprising one electronic spin embedded in a nuclear spin bath. We show how to isolate a few proximal nuclear spins from the rest of the environment and use them as building blocks for a potentially scalable quantum information processor. We describe how coherent control techniques based on magnetic resonance methods can be adapted to these electronic-nuclear solid state spin systems, to provide not only efficient, high fidelity manipulation of the registers, but also decoupling from the spin bath. As an example, we analyze feasible performances and practical limitations in a realistic setting associated with nitrogen-vacancy centers in diamond.

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