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Entanglement-enhanced sensing with electronic spins in diamond WON KYU CALVIN SUN, Massachusetts Inst of Tech-MIT, ALEXANDRE COOPER, California Institute of Technology, JEAN-CHRISTOPHE JASKULA , PAOLA CAPPELLARO, Massachusetts Inst of Tech-MIT — Entanglement-enhanced sensing promises sensitivities beyond the standard quantum limit (SQL), but requires robust control to prepare entangled states with high fidelity. Operationally, one must be able to initialize a quantum system to a state of low entropy (ideally a pure state) and perform an entangling gate while protecting the state against dissipation. These steps are usually challenging and imperfections might overshadow the advantage given by entanglement. In this work, we aim at measuring magnetic fields with sensitivity beyond the SQL with two electronic spins associated with a single nitrogen-vacancy center and a paramagnetic center in diamond. To achieve a state of low entropythat is, a state of high polarizationwe optimize the performance of a single polarization transfer block, and further show that imperfect repetitive transfers can increase the total polarization. Then to create the desired entangled state with high fidelity, we compare the performance of two entangling gates with varying dependence on decoherence channels and control errors. Our work not only demonstrates that entanglement-enhanced sensing in the solid-state is possible, but also introduces strategies to robustly achieve high-fidelity initialization and entanglement in larger quantum registers.

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