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Control of hybrid quantum registers in diamond TIM HUGO TAMINIAU, TOENO VAN DER SAR, MACHIEL S. BLOK, GIJS DE LANGE, HANNES BERNIEN, WOLFGANG PFAFF, LUCIO ROBLEDO, RONALD HANSON, Kavli Institute of Nanoscience Delft, Delft University of Technology, PO Box 5046, 2600 GA Delft, The Netherlands — Nitrogen Vacancy (NV) centers in diamond provide a robust quantum register consisting of the NV electron spin, the nuclear spin of the associated nitrogen atom and nearby nuclear spins of carbon impurities (^{13}C). The constituents of this hybrid system each have different properties that make them ideal for different roles. For example, the electron spin is readily polarized and read-out optically using spin-dependent fluorescence, whereas long coherence times make the nuclear spins ideal quantum memories. However, because all these systems evolve and decohere on very different time scales, it is challenging to control the register and to protect it from decoherence due to the surrounding environment at the same time. Here we discuss our recent progress in initializing, controlling and reading out all the spins in such few-qubit NV quantum registers. To this end, we combine dynamical decoupling of the electron spin with control of all the nuclear spins, and explore different initialization schemes. These few qubit registers might then be used to implement quantum search algorithms and error correction protocols.

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