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Double quantum spin relaxation limits to coherence of near-surface diamond nitrogen vacancy centers AMILA ARIYARATNE, BRYAN MYERS, ANIA JAYICH, Univ of California - Santa Barbara — The diamond nitrogen vacancy (NV) center is an emerging quantum technology, with applications in atomic-scale magnetic resonance imaging and quantum information. These applications require the NVs to be located within nanometers of the diamond surface; however, near-surface NVs undergo significantly higher decoherence than bulk NVs. For a two-level qubit, the coherence time T2 is limited by the spin relaxation time T1: T2$\leq$2T1. However, for shallow NVs, T2s only up to 0.1T1 have been reported. We identify an additional decoherence channel that must be accounted for to explain these prior results. The NV ground state is a 3-level system and hence a proper definition of T1 must consider all relaxation channels in the system, rather than just those between two qubit levels. We show that relaxation between the NV (+1,-1) levels lowers the effective T1 of the (0, +1) qubit, making the upper limit of T2$\leq$2T1 attainable. Further, we utilize all relaxation channels of the qutrit to spectroscopically probe surface-induced noise, discriminating between electric and magnetic field noise. Identifying origins of surface-induced noise has important implications across many qubit platforms.

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