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Spin State-Dependent Relaxation Rates in Nitrogen-Vacancy Centers in Diamond[1] AEDAN GARDILL, MATTHEW C. CAMBRIA, YANFEI LI, SHIMON KOLKOWITZ, University of Wisconsin - Madison — Nitrogen-vacancy centers (NVs) in diamond are widely used for their easily accessible quantum properties in the solid-state at room temperature. Understanding the origins of decoherence in NVs is vital to extending their coherence times and unlocking their full potential. We present findings of spin-state dependent relaxation rates at room temperature for NVs deep in bulk diamond and for NVs in nanodiamonds. We measure the relaxation rate on both the qubit transition (between the ms = 0 state and one of the energy eigenstates composed of the ms = +/-1 states) and the qutrit transition (between the two eigenstates composed of the ms = +/-1 states). For deep, native NVs in ultrapure bulk diamond we find that spin-state dependent two-phonon processes result in a qutrit relaxation rate that is ˜2 times the qubit relaxation rate, providing an estimate of the strength of a previously unmeasured electric dipole-coupling term in the NV Hamiltonian. We also present measurements of fast relaxation on qutrit transitions in ˜40 nm nanodiamonds under ambient conditions. We observe a strong falloff of the qutrit relaxation rate with applied on-axis magnetic field, and conclude that surface electric field noise is a major source of decoherence for NVs in nanodiamonds.

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Aedan Robert Gardill
University of Wisconsin - Madison

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