Magneto-optical properties of Fourier-limited Tin-Vacancy centers in diamond

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Scalable quantum information processing requires spectrally stable interfaces between fiber-coupled photons and solid-state qubits. For remote entangling, bright and indistinguishable photons are necessary and thus high demands on the optical transitions of the spin-photon interfaces are compulsory. Group-IV color centers in diamond offer by symmetry a first-order insensitivity to charge noise, making them promising candidates for scalable integration. By an optimized spectroscopy method, we identify charge-state and spectrally stable Tin-Vacancy (SnV) centers with Fourier-limited optical linewidths using resonant excitation. We implement a 3D vector magnet in a confocal microscope setup to analyze the magneto-optical properties of the SnV electron spin at cryogenic temperatures. We determine long spin relaxation times as predicted by the larger spin-orbit splitting of the SnV center compared to other Group-IV defects. By rotating the magnetic field with respect to the symmetry axis, we determine the angle dependent splitting of the electron spin ground and excited states. This allows a full fit to the electron spin Hamiltonian and determination of the orbital quenching factors as previously derived in DFT calculations [1].
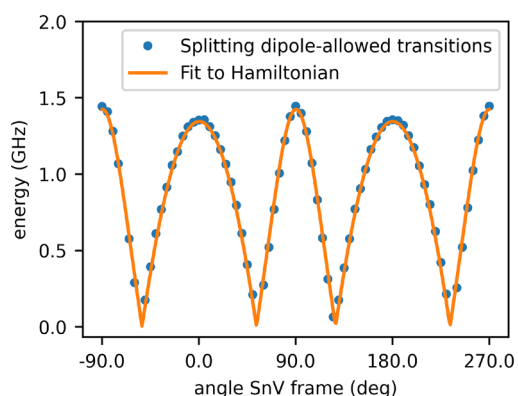
References
[1]   Thiering & Gali, Phys. Rev. X, 8 (2018), 021063
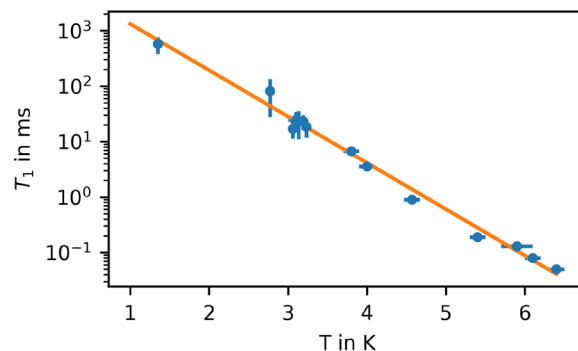
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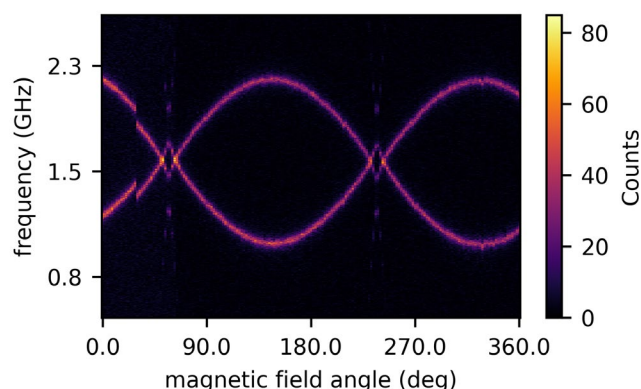
Figure 1: Fourier-limited PLE spectrum of a Tin-Vacancy center under magnetic field rotation.

Figure 2: Full fit of the dipole-allowed transitions to the electron spin Hamiltonian in the local defect frame.

Figure 3: Electron spin lifetime under varying temperatures exceeding 0.5s at 1.3K.