Double-quantum-coherence control in NV- centers in Diamond at small fields

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The Nitrogen-Vacancy (NV) color center in diamond is a model quantum system with long coherence time, and the ability to optically initialize and read-out single centers. This makes it attractive for applications in quantum information processing, magnetometry, and magnetic imaging. The ground state of this localized defect is a triplet of magnetic states ($m_s = 0,\ \pm 1$), where the $m_s = 0$ state is separated from the $m_s = \pm 1$ states at zero-field, and in the presence of a magnetic field, the $m_s = \pm 1$ states are further split due to the Zeeman interaction. Towards the goal of high-fidelity coherent control of the full qutrit space, we study the dynamics of double quantum coherence (DQC) ($m_s = +1 \leftrightarrow m_s = -1$) in the regime where the Rabi drive is comparable to the Zeeman energy. We generate the DQC with high purity, selecting only the signal from the electronic transitions conditioned on the ^{14}N nuclear spin being in the $m_n = 0$ state; we measure the coherence time of the DQC, and extend that coherence time using multiple-pulse sequences.