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Quantum measurement and control of rapidly rotating single qubits in diamond ALEXANDER WOOD, EMMANUEL LILETTE, YAAKOV FEIN, School of Physics, University of Melbourne, LIAM MCGUINNESS, Institute for Quantum optics, Ulm University, Germany, DAVID SIMPSON, ALASTAIR STACEY, JEAN-PHILLIPE TETIENNE, LLOYD HOLLENBERG, School of Physics, University of Melbourne and CQC2T, University of Melbourne, ROBERT SCHOLTEN, ANDY MARTIN, School of Physics, University of Melbourne — Internal state rotations are a ubiquitous feature of quantum mechanics, but the effects of physical rotation on a qubit are less widely understood. Rotation induces interesting physics, such as geometric phase accumulation in a rotating qubit, as well as concomitant challenges. The nitrogen-vacancy (NV) center in diamond is a highly versatile quantum sensor, capable of probing magnetic fields, electric fields, crystal strain and temperature in real-world sensing environments. The NV is a propitious candidate for observing the effects of physical rotation on a single qubit, for example as a nanoscale gyroscope. In this work we demonstrate optical addressing and quantum state manipulation of single NV centers within a diamond mechanically rotated with a period comparable to the spin dephasing time T_2. Our results demonstrate measurements of single qubits rotating with high angular velocities, and establish the experimental techniques required to control and extract quantum information from rapidly moving NV centers.

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