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Self-Correcting Dynamic Decoupling Pulse Sequences ALEXEI M. TYRYSHKIN, STEPHEN A. LYON, Princeton University, WENXIAN ZHANG, VIATCHESLAV V. DOBROVITSKI, Ames Laboratory — Dynamic decoupling (DD) techniques employ a series of strong refocusing pulses to combat decoherence in quantum systems. However, each DD pulse is imperfect and thus introduces a small instrumental error; the error can accumulate rapidly upon applying many DD pulses, and this error can destroy the quantum state. We have examined several DD pulse sequences, including CPMG, XZXZ, XYXY and their concatenated variants, using electron spin resonance (ESR) of donors electron spins in silicon. While all these DD sequences performed comparably in cancelling the phase noise arising from magnetic field fluctuations, only one sequence (XYXY) demonstrated the ability to protect an arbitrary coherent state, including X, Y, and Z states in the rotating frame. The other sequences (CPMG and XZXZ) were able to store only one state (Y) while destroying other states (X and Z). The superior performance of XYXY arises from its internal ability to correct for pulse amplitude errors, the dominant error in these ESR experiments.

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