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Optimal Control of Large Spin Systems[1] SETH MERKEL, University of New Mexico, SOUMA CHAUDHURY, University of Arizona, ANDREW SILBERFARB, California Institute of Technology, TOBIAS HERR, University of Arizona, IVAN DEUTSCH, University of New Mexico, POUL JESSEN, University of Arizona — A quantum system is said to be controllable if the accessible Hamiltonians (as a Lie algebra) generate all unitary operators on Hilbert space. Optimal quantum state control seeks a time-dependent sequence of Hamiltonians that maximize the fidelity with an arbitrary target state given a fixed initial state. We consider optimal control of the spin of a cesium atom restricted to its F=3 ground state hyperfine manifold, with a Hilbert space of dimension 2F+1=7. Control is implemented through time varying magnetic fields in two orthogonal directions along with a quadratic AC-Stark shift created by an off-resonant laser probe. The optimization is performed under several constraints, most importantly a temporal limitation determined by dephasing due to photon scattering and parameter inhomogeneity. The fidelity of state preparation is verified through both a full density matrix simulation and reconstruction from experimental data.

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Seth Merkel
University of New Mexico

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