MAR09-2008-001701

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Multiphoton Coherent Manipulation in Large Spin Qubits[1]

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Manipulation of quantum information allows certain algorithms to be performed at unparalleled speeds. Photons are an ideal choice to manipulate qubits as they interact with quantum systems in predictable ways. They are a versatile tool for manipulating, reading/coupling qubits and for encoding/transferring quantum information over long distances. Spin-based qubits have well known behavior under photon driving and can be potentially operated up to room temperature. When diluted enough to avoid uncontrolled spin-spin interactions, a variety of spin qubits show long coherence times, *e.g.* the nitrogen vacancies in pure diamonds (1,2), nitrogen atoms trapped in a C60 cage (3), Ho3+ and Cr5+ ions (4,5) and molecular magnets (6,7). We have used large spin Mn2+ ions (S=5/2) to realize a six level system that can be operated by means of single as well as multi-photon coherent Rabi oscillations (8). This spin system has a very small anisotropy whose effect can be tuned *in-situ* to turn the system into a multi-level harmonic system. This offer new ways of manipulating, reading and resetting a spin qubit. Decoherence effects are strongly reduced by the quasi-isotropic electron interaction with the crystal field and with the 55Mn nuclear spins.

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[1]Supported by the NSF Cooperative Agreement Grant DMR-0654118, the NSF grants DMR-0645408, DMR-0506946, the FSU and the NHMFL (IHRP-5059), DARPA (HR0011-07-1-0031) and the Sloan Foundation.