Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Studying chaos, entanglement and decoherence in the quantum kicked top with cold atoms SHOHINI GHOSE, Wilfrid Laurier University, RENE STOCK, Institute for Quantum Information Science, University of Calgary, ROSHAN LAL, Indian Institute of Technology, ANDREW SILBERFARB, Aarhus Universitet — We propose and analyze an experiment to study the dynamics of the quantum kicked top using cold Cesium atoms interacting with laser and magnetic fields. This would be the first experimental realization of this well known chaotic system in a deeply quantum regime, and would allow detailed studies of the effects of chaos on entanglement and decoherence. These studies are of importance for understanding quantum-classical correspondence as well as for designing quantum information processing applications. We describe the process of state preparation in the system, and show how the nonlinear AC Stark shift together with a pulsed magnetic field can be used to realize the kicked top Hamiltonian. Signatures of chaos are evident in the entanglement between the electronic and nuclear spin, which can be monitored via Faraday rotation spectroscopy. We analyze and explain the predicted dynamics by decomposing the initial states into regular and chaotic Floquet eigenstates. Our accurate simulations show that dynamical signatures of chaos persist in the presence of decoherence due to photon scattering. Furthermore, chaos affects the decoherence rate itself due to the rapid mixing in phase space caused by chaotic dynamics, even in a deeply quantum regime.

Shohini Ghose
Wilfrid Laurier University

Date submitted: 02 Feb 2007 Electronic form version 1.4