Quantum Control of Atomic Spin System

G. Xu, D.J. Heinzen (*the University of Texas at Austin*)

Arbitrary control of atomic system is of interest for two reasons. First, it is a simple system in which to explore concepts of quantum control. A spin system has a finite numbers of states and can be manipulated by a well controlled radio-frequency magnetic field. Second, the control can produce useful states for precision measurements and quantum optics applications. As an example, we report both a theoretical and an experimental study of the control on Cs 6S<sub 1/2> F=4 manifold. The 9 Zeeman levels of this system are subject to a weak static magnetic field and a non-resonant laser field. The Zeeman splitting and the AC Stark shift arrange the 9 levels in an anharmonic ladder. An additional time-dependent magnetic field then induces motions of the spin are not simply rotations. Calculations based on the optimal control theory [1] suggest that arbitrary control of the system is possible. Preliminary experimental evidence of the coherent control will be shown.

[1] S. Shi, H. Rabitz, J. Chem. Phys. 92, 364 (1990)