

Abstract Submitted  
for the DAMOP06 Meeting of  
The American Physical Society

**Error in trapped-ion quantum gates due to spontaneous photon scattering**<sup>1</sup> R. OZERI, C. LANGER, J.D. JOST, R.B. BLAKESTAD, J. BRITTON, J. CHIAVERINI<sup>2</sup>, D. HUME, W.M. ITANO, E. KNILL, D. LEIBFRIED, R. REICHLER, S. SEIDELIN, J.H. WESENBERG, D.J. WINELAND, NIST, Time and Frequency Division, Boulder, CO 80305 — Quantum bits that are encoded into hyperfine states of trapped ions are a promising system for Quantum Information Processing (QIP). Quantum gates performed on trapped ions use laser induced stimulated Raman transitions. The spontaneous scattering of photons therefore sets a fundamental limit to the gate fidelity. Here we present a calculation that explores these limits. Errors are shown to arise from two sources. The first is due to spin relaxation (spontaneous Raman photon-scattering events) and the second due to the momentum-recoil that is imparted to the trapped ions in the scattering process. It is shown that the gate error due to spontaneous photon scattering can be reduced to very small values with the use of high laser power. It is further shown that error levels required for fault-tolerant QIP are within reach of experimentally realistic laser parameters.

<sup>1</sup>Supported by DTO & NIST.

<sup>2</sup>Current address: LANL

Roe Ozeri

Date submitted: 02 Feb 2006

Electronic form version 1.4