DAMOP08-2008-000614

Abstract for an Invited Paper
for the DAMOP08 Meeting of
the American Physical Society

Stabilized 1762 nm Laser for Barium Ion Qubit Readout via Adiabatic Passage[1]

JOANNA SALACKA, University of Washington

Trapped ions are one of the most promising candidates for the implementation of quantum computation. We are trapping single ions of Ba^{137} to serve as our qubit, because the hyperfine structure of its ground state and its various visible-wavelength transitions make it favorable for quantum computation. The two hyperfine ground levels will serve as our |1> and |0> qubit states. The readout of the qubit will be accomplished by first selectively shelving the ion directly to the metastable 5D5/2 state using a 1762 nm narrow band fiber laser. Next, the cooling and repumping lasers are turned on and the fluorescence of the ion is measured. Since the 5D5/2 state is decoupled from the laser cooling transitions, the ion will remain dark when shelved. Thus if fluorescence is seen we know that the qubit was in the |0> state, and if no fluorescence is seen it was in the |1> state. The laser is actively stabilized to a temperature-controlled, high-finesse 1.76 um Zerodur optical cavity. The shelving to the 5D5/2 state is most efficiently achieved with adiabatic passage, which requires a smooth scan of the laser frequency across the transition resonance. To accomplish this, the laser frequency is modulated by an AOM driven by a smooth frequency sweep of adjustable amplitude and duration.

[1]In collaboration with Matthew Dietrich, Ryan Bowler, Gang Shu, Gary Howell, Adam Kleczewski, Nathan Kurz, Muir Kumph, Viki Mirgon, Joseph Pirtle, and Boris Blinov, University of Washington.