Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Intensity-modulated polarizabilities and magic trapping of alkali-metal and divalent atoms in infrared optical lattices[1] TURKER TOPCU, ANDREI DEREVIANKO, University of Nevada, Reno — Long range interactions between neutral Rydberg atoms has emerged as a potential means for implementing quantum logical gates. These experiments utilize hyperfine manifold of ground state atoms to act as a qubit basis, while exploiting the Rydberg blockade mechanism to mediate conditional quantum logic. The necessity for overcoming several sources of decoherence makes magic wavelength trapping in optical lattices an indispensable tool for gate experiments. The common wisdom is that atoms in Rydberg states see trapping potentials that are essentially that of a free electron, and can only be trapped at laser intensity minima. We show that although the polarizability of a Rydberg state is always negative, the optical potential can be both attractive or repulsive at long wavelengths (up to $\sim 10^4$ nm). This opens up the possibility of magic trapping Rydberg states with ground state atoms in optical lattices, thereby eliminating the necessity to turn off trapping fields during gate operations. Because the wavelengths are near the CO_2 laser band, the photon scattering and the ensuing motional heating is also reduced compared to conventional traps near low lying resonances, alleviating an important source of decoherence.

[1]This work was supported by the National Science Foundation (NSF) Grant No. PHY-1212482.

Turker Topcu
University of Nevada, Reno

Date submitted: 14 Feb 2014 Electronic form version 1.4