Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

Single-atom and multi-atom Excitation to Rydberg states RUI HAN, Centre for Quantum Thechnologies, Singapore, HUI KHOON NG, Centre for Quantum Technologies, Singapore and DSO, National Laboritories, applied physics lab, Singapore, B.G. ENGLERT, Centre for Quantum Technologies, National University of Singapore, Singapore — We study two-photon Raman transitions between states |0> and |1> via an intermediate state |e> that is far detuned so that it does not get significantly populated. This problem is often solved by adiabatic elimination in an interaction picture in which one then has an effective two-level Hamiltonian for states |1> and |0>. However, there is more than one interaction picture and results may depend on which one is chosen (see E. Brion et al, J. Phys. A: Math. Theor. 40 1033 (2007), for example). In this talk, we present a full treatment of the single-atom Raman transition without adiabatic elimination. This serves as a benchmark for the choice of the correct interaction picture to use for adiabatic elimination for other situations. One of the very useful examples is the collective Rydberg excitation in a multi-atom system, where we discuss the correction in adjusting the detuning to compensate for the light shift compare to a single-atom system.

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Date submitted: 27 Jan 2012 Electronic form version 1.4