Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

Estimation of One- and Two-Photon Rydberg Transition Rates in Helium Driven Directly by an Optical Frequency Comb D.E. PROCYK, E.E. EYLER, Department of Physics, University of Connecticut, R.J. JONES, K.D. MOLL, M.J. THORPE, J. YE, JILA, NIST, and University of Colorado — Direct frequency comb spectroscopy (DFCS) involves the resonant excitation of atoms or molecules directly with one or multiple components of an optical frequency comb, allowing high resolution spectroscopy and absolute frequency measurements across a wide spectral bandwidth. While DFCS has been proven with alkali atoms, extension of the technique to atomic helium will lead to precision measurements of this important atom. For helium atoms formed in a metastable helium MOT at milli-Kelvin temperatures we have estimated transition rates for excitation by a frequency comb, using a quantum defect model with scaled oscillator strengths. In the triplet system, Rydberg $n^3D \leftarrow 2^3S$ and $n^3S \leftarrow 2^3S$ transitions can be excited by resonant or near-resonant two-photon excitation via the intermediate 3^3P state. The rates are highly favorable, $> 10^6$ s^{-1} per atom even for $n \approx 40$. The 1^1S ground state could also be studied by "dumping" metastable atoms from the MOT using an additional laser. Although the two-photon $2^1S \leftarrow 1^1S$ transition presently looks unfeasible, rates for one-photon $n^1P \leftarrow 1^1S$ transitions driven by a far-UV comb are reasonable.

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Date submitted: 23 Feb 2006 Electronic form version 1.4