Abstract Submitted
for the SES06 Meeting of
The American Physical Society

The Quantum, Semiclassical & Classical Monodromy of Hydrogenic Atomic States in Perpendicular and Near Perpendicular External Electric and Magnetic Fields CHRIS SCHLEIF, JOHN DELOS, William & Mary — We construct a classical integrable approximation for Hydrogen in perpendicular and nearly perpendicular external electric and magnetic fields and show that for a certain range of field strength ratios and angles, classical action variables can only be consistently defined locally on connected integrable regions of phase space. This effect, called classical Monodromy, is a result of the global organizational structure of the invariant manifolds in the phase space of this approximate system. EBKM quantization of classical actions is then used to construct a lattice of semiclassical eigenstates. For n manifolds containing a sufficient number of eigenstates, the semiclassical spectrum contains a lattice defect whenever the underlying classical system has classical Monodromy. Finally we use standard quantum perturbation theory to produce a quantum spectrum for Hydrogenic states in external fields. We find that for system parameters where the classical Monodromy is present, a lattice defect appears in the spectrum of quantum eigenstates. We find that our classical system accurately predicts all features of this Quantum Monodromy including excellent agreement between the classical bifurcation of a doubly pinched torus into 2 singly pinched tori, and a Quantum bifurcation of the lattice defect from a single [1 2 ; 0 1] defect into two distinctive [1 1 ; 0 1] defects.

Chris Schleif
William & Mary

Date submitted: 21 Aug 2006 Electronic form version 1.4