Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Monodromy and the Structure of the Spectrum of the Hydrogen Atom in Near Perpendicular Electric and Magnetic Fields CHRISTOPHER SCHLEIF, JOHN DELOS, The College of William and Mary — We study the hydrogen atom in weak perpendicular and near-perpendicular electric and magnetic fields using quantum and classical perturbation theory. Classical perturbation theory provides an integrable approximation to trajectories, providing three approximate constants of the motion. Quantization of actions produces a lattice of semiclassical expectation values which is in good agreement with direct quantum calculations. For certain ranges of electric and magnetic field strengths and orientations the lattice contains defects connected with a subtle phenomenon of classical mechanics called monodromy. If a classical system has monodromy then there is a classical action variable which is an intrinsically multivalued function of the constants of the motion. Monodromy had been predicted to be present for perpendicular fields by Sadovskií and Cushman. We show that the presence of monodromy persists in near-perpendicular fields, and that the associated lattice defects undergo a series of bifurcations. We have used classical mechanics to map out the range of lattice structure in all weak near-perpendicular field configurations from the Stark to Zeeman limits. We show that there are six different families of spectra, five of which display the effects of monodromy.

Christopher Schleif
The College of William and Mary

Date submitted: 02 Feb 2007 Electronic form version 1.4