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Classical and Quantum Mechanical Motion in Magnetic Fields K. COLE NEWTON, JOEL FRANKLIN, Reed College — We study the motion of a particle in a particular magnetic field configuration both classically and quantum mechanically. For flux-free radially symmetric magnetic fields defined on circular regions, we establish that particle escape speeds depend, classically, on a gauge-fixed magnetic vector potential, and demonstrate some trajectories associated with this special type of magnetic field. Then we show that some of the geometric features of the classical trajectory (perpendicular exit from the field region, trapped and escape behavior) are reproduced quantum mechanically using a numerical method that extends the norm-preserving Crank-Nicolson method to problems involving magnetic fields. While there are similarities between the classical trajectory and the position expectation value of the quantum mechanical solution, there are also differences, and we demonstrate some of these.

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