Abstract Submitted
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Atom Waveguides for Atom Chips WILLIAM GOLDING, Army Research Laboratory — Studies of the quantum behavior of magnetic atoms guided by two-dimensional quadrupole magnetic fields will be presented. The basic model is a particle with spin one-half that is guided by a quadrupole field of infinite longitudinal extent. The Schrödinger equation for this spin one-half system is reduced to a pair of coupled second-order differential equations for the radial wavefunctions. These equations are uncoupled resulting in fourth-order differential equations that can be solved using Frobenius series techniques near the regular singular point that occurs at the origin. The four solutions to these equations represent four types of transverse waveguide mode. However, two solutions are not finite at the origin and are rejected as unphysical in this problem. The two finite solutions that remain provide a complete understanding of the guide mode structure close to the guide center. To complete the solutions and to obtain the transverse eigenvalues of the guide one can use numeric techniques along with asymptotic solutions to establish boundary conditions at large radii. In general, the solutions defined in this way are not pure bound states but have both a bound and an unbound character. However, by both exploiting a degeneracy at zero longitudinal field and transforming to a spin basis in which the quantization axis is defined to be everywhere parallel to the local field, states that are either purely bound or unbound can be constructed.

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