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Exact Series Solutions for the Quantum Modes of Atomic Waveguides WILLIAM GOLDING, Army Research Laboratory — Miniature magnetic waveguides for atoms are used in many atom chip designs. For very cold atoms the quantum modes of these guides are important. The simplest field configuration usually assumed for a straight atom chip guide is a transverse magnetic quadrupole combined with a uniform longitudinal bias field often called a Ioffe field. The Ioffe field is used both to prevent the possibility of Majorana transitions and to make an approximate quantum solution of the guide problem easier to obtain. However, the introduction of the Ioffe field has other effects that may reduce the performance of atom guides in practice. Among these effects are reduction of waveguide mode spacing and the introduction of Landau-Zener transitions due to Ioffe field gradients or variations. In addition, uniform Ioffe fields can be difficult to incorporate into general atomic guides that need to follow unconstrained curved paths. A series technique has been developed for exact calculations of both the eigenvalues and the quantum modes of these guides for arbitrary Ioffe fields.

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