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Leading-Order Nonlinear Effects on Single-Particle Orbits in Periodic Focusing Solenoidal Fields[1] M. ALPERT, Harvard University, R.C. DAVIDSON, Princeton Plasma Physics Laboratory — Periodic focusing accelerators are used in many contexts including high energy density physics and heavy ion fusion. Therefore, it is important to understand the dynamics of charged particles in applied focusing fields. Theoretical treatments of the beam dynamics in focusing fields describe a thin beam in comparison to the axial lattice period of the focusing field. Such a case allows for a linear approximation of the applied transverse focusing force over the characteristic dimensions of the beam. In this work we analyze single-particle orbits in a periodic focusing solenoidal field including the effects of leading-order nonlinearities in the transverse focusing field. Using a quadratic approximation to the solenoidal fields, the equations of motion for a charged particle are derived. The nonlinearities introduced by the quadratic term are analyzed including questions of stability and the existence of matched-beam solutions. The addition of the quadratic term to the analysis of the beam dynamics may be useful in describing a thicker beam.

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