

Abstract Submitted
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A Quarter-Century Later: Nonlinear Gyrokinetics Under Attack¹ J.A. KROMMES, Princeton University — The nonlinear gyrokinetic equation (GKE) was first derived about a quarter-century ago. Subsequent technical developments have refined the GKE into a major tool for the description of both fusion and astrophysical plasmas. However, the GKE has suffered serious attacks on its veracity, two of which will be discussed: the possibilities that (i) the asymptotic expansion for the GK variables breaks down for torsional or stochastic magnetic fields²; (ii) conventional gyrokinetics is insufficiently accurate to determine the long-wavelength, axisymmetric part of the radial electric field.³ The relevant physical pictures and detailed mathematics will be described for both sides of each issue. For (i), local and global coordinate systems must be distinguished; for (ii), the use of Lagrangian field theory is advocated.

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²L. E. Sugiyama, Guiding center plasma models in three dimensions, *Phys. Plasmas* **15**, 092112 (2008); J. A. Krommes, Comments on “Guiding center plasma models...” [*Phys. Plasmas* **15**, 092112 (2008)], *Phys. Plasmas* (2009, submitted); L. E. Sugiyama, Response to Comments of J. A. Krommes, *Phys. Plasmas* (2009, submitted).

³F. I. Parra and P. J. Catto, Limitations of gyrokinetics on transport time scales, *Plasma Phys. Control. Fusion* **50**, 065014 (2008).

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