Abstract Submitted
for the DPP05 Meeting of
The American Physical Society

Nonlinear Finite Larmor Radius Drift Kinetic Equation H. VERNON WONG, University of Texas — A novel and efficient method is described for deriving the nonlinear drift kinetic equation. Electric drifts can be of the order of particle thermal velocities. A maximal ordering is invoked: the smallness parameter $\epsilon < 1$ is proportional to m/e, subject to the proviso that $E_\parallel \sim \epsilon$. The drift kinetic equation is derived up to second order in ϵ. With the parallel speed $v_\parallel$, magnetic moment μ, and position vector $\mathbf{r}$ as phase space variables, the equation is derived in a form such that the phase space volume following the particle phase space trajectories is manifestly preserved. The moments of the drift kinetic equation reproduce the corresponding moments of the Vlasov equation to order ϵ^2. The mean perpendicular velocity, momentum flow tensor, and pressure tensor are expressed in terms of the electromagnetic fields and the velocity moments of the drift kinetic distribution function G. A consistent set of fluid-kinetic equations is formulated, with the fluid-like perpendicular plasma motion described by the perpendicular component of the plasma momentum equation. The drift equation is used to describe the parallel plasma dynamics, and G is required to evaluate the velocity moments necessary to close the set of equations. These equations provide a basis for the development of hybrid simulation codes.

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Date submitted: 21 Jul 2005 Electronic form version 1.4