Abstract Submitted
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Properties of Multiscale Finite-Beta Gyrokinetic Plasmas W.W. LEE, E.A. STARTSEV, R.A. KOLESNIKOV, Princeton Plasma Physics Laboratory — The numerical issues arise from the finite-β gyrokinetic Maxwell equation of the form, $[\nabla_\perp^2 - \beta m_i/m_e - \beta](\partial\psi\ \partial t) = -\beta(\hat{\mathbf{b}}_0\cdot\nabla)\int v_\parallel^3(\delta g_i - \delta g_e)dv_\parallel + (\hat{\mathbf{b}}_0\cdot\nabla)\int v_\parallel(\delta g_i - \delta g_e)dv_\parallel + \beta\nabla\psi\times\hat{\mathbf{b}}_0\cdot[(m_i/m_e)(\kappa_n+\kappa_{Te}) - (\kappa_n+\kappa_{Ti})/\tau]$ will be discussed. The equation is the result of a new simulation scheme which separates out the fast particle response due to quasi-static bending of magnetic field lines by letting $\delta g = F - (1+\psi)F_0 - \int dx_\parallel \kappa\cdot\delta\mathbf{B}$, so that a new full density and/or temperature gradient, which is set up by the fast particles, is transverse to the direction of the full field, background plus perturbation, where $\hat{\mathbf{b}} = \hat{\mathbf{b}}_0 + \delta\mathbf{B}/B_0$, $\delta\mathbf{B} = \nabla A_\parallel \times \hat{\mathbf{b}}_0$, $\psi = \phi + \int(\partial A_\parallel/\partial t)dx_\parallel/c$, ϕ and $A_\parallel$ are the perturbed potentials, and κ represents the zeroth-order inhomogeneities. For $\beta m_i/m_e (\equiv \rho_s^2/\delta_e^2) \gg 1$, it is found that, we need to use a computational grid based on the electron skin depth δ_e, which can be an order smaller than ρ_s, the length of interest, in agreement with the analytical perturbative methods in solving this type of singular equations. The adequacy of the above equation for the perturbations of the order of $k \sim \kappa$,[1] where k is the perturbed wavenumber, will also be presented along with their conservation properties. The issue of transition from δf to *total-F* in finite-β PIC simulations in general geometry, based on the particle weights, will also be discussed. [1]W. W. Lee and R. Kolesnikov, Phys. Plasmas **16**, 04506 (2009).

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