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A New Split-Weight Scheme for Finite-β Gyrokinetic Plasmas

W.W. LEE, E.A. STARTSEV, W.X. WANG, Princeton Plasma Physics Laboratory, Princeton, NJ 08543 — The original split-weight scheme for finite-β simulations [1], which separates the perturbed particle distribution into an adiabatic part and a non-adiabatic part, is generalized to include spatial inhomogeneities. The new scheme requires an additional separation of the fast particle response associated with quasi-static bending of the magnetic field lines. While the original scheme follows the non-adiabatic response, δh, in time, where $\delta h = F - (1+\psi)F_0$, F is the distribution, F_0 is the background, $\psi \equiv \phi + \int(\partial A_{||}/\partial t)dx_{||}/c$ and ϕ and $A_{||}$ are the perturbed potentials, the new scheme makes use of $\hat{\mathbf{b}}\cdot\nabla(F_0+\delta g) = 0$, where $\hat{\mathbf{b}} = \hat{\mathbf{b}}_0 + \delta\mathbf{B}/B_0$, and further separates the plasma response as $F = (1+\psi)F_0 + \delta g + \delta h$, where $\delta g = \int dx_{||}\kappa\cdot(\nabla A_{||}\times\hat{\mathbf{b}}_0)$ and κ is the zeroth order spatial inhomogeneity. The new δh is again followed in time. The results for finite-β stabilization of drift waves and ion temperature gradient modes in slab geometry using the new scheme with a $\beta(\equiv c_s^2/v_A^2)$ as high as 10% and a grid size of the order of the electron skin depth, are in agreement with those discussed in Refs. [2] and [3]. This work is supported by the DoE OASCR Multi-Scale Gyrokinetics (MSG) Project. [1] W. W. Lee, J. Lewandowski, Z. Lin and T. S. Hahm, Phys. Plasmas **8**, 4435 (2001). [2] J. V. W. Reynders, Ph. D. Thesis, Princeton University (1992). [3] J. C. Cummings, Ph. D. Thesis, Princeton University (1995).

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