A New Split-Weight Scheme for Finite-$\beta$ 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-$\beta$ 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, $\delta h$, 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 $\phi$ and $A ||$ are the perturbed potentials, the new scheme makes use of $\hat{b} \cdot \nabla (F_0 + \delta g) = 0$, where $\hat{b} = \hat{b}_0 + \delta B / B_0$, and further separates the plasma response as $F = (1 + \psi)F_0 + \delta g + \delta h$, where $\delta g = \int dx || \kappa \cdot (\nabla A || \times \hat{b}_0)$ and $\kappa$ is the zeroth order spatial inhomogeneity. The new $\delta h$ is again followed in time. The results for finite-$\beta$ 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).