# Finite-$\beta$ Simulation of Microinstabilities

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**Abstract**

A new split-weight perturbative particle simulation scheme for finite-$\beta$ plasmas in the presence of background inhomogeneities is presented. The scheme is an improvement over the original split-weight scheme [W. W. Lee *et. al*, Phys. Plasmas **8**, 4435 (2001)], which splits the perturbed particle response into adiabatic and non-adaibatic parts. In the new scheme, by further separating out the non-adaibatic response of the particles associated with the quasi-static bending of the magnetic field lines in the presence of background inhomogeneities of the plasma, we are able to demonstrate the finite-$\beta$ stabilization of drift waves and ion temperature gradient modes using a simple gyrokinetic particle code based on realistic fusion plasma parameters. However, for $\beta m_i/m_e \gg 1$, it becomes necessary to use the electron skin depth as the grid size of the simulation to achieve accuracy in solving the resulting singularly perturbed equations. The proposed scheme is most suitable for studying shear-Alfvén physics in general geometry using straight field line coordinates for microturbulence and magnetic reconnection problems.