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Comparisons of Positivity Preserving Advection Algorithms for Edge Plasma Turbulence Simulations[1] G.W. HAMMETT, J.L. PETERSON, Princeton Plasma Physics Laboratory — The steep density and temperature gradients associated with the edge and scrape off layer regions of a fusion plasma complicate the numerical simulation of plasma turbulence. Spectral methods and Arakawa finite differencing have the interesting property of exactly preserving certain conservation properties of Hamiltonian systems and work well for simulating well-resolved, small amplitude fluctuations. However, such algorithms can exhibit Gibbs phenomena, small overshoots in the vicinity of large gradients. While these overshoots are unimportant for small amplitude turbulence in the core region of tokamaks, these algorithms can lead to regions of negative density or temperature in the tokamak edge. Several finite volume methods of solving multi-dimensional hyperbolic equations can be constructed to prevent such negative solutions, and can be useful for both gyrokinetic and gyrofluid continuum simulations. We explore here different algorithms for positivity-preservation and their effects on efficiency. When combined with Strong Stability Preserving time-integration techniques, unphysical negative solutions can simply and quickly be eliminated.

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