Advances in Gyrokinetic Particle Simulation Algorithms[1]

WILLIAM DORLAND, INGMAR BROEMSTRUP, University of Maryland — Most widely-used delta-f gyrokinetic particle-in-cell simulation algorithms have two important shortcomings compared to Eulerian algorithms: (1) inaccurate treatment of short wavelength perturbations due to low-order ring-averaging techniques, and (2) unphysical collision operators, and/or collision operators which fail to control the algebraic growth of the particle weights in time. These shortcomings make it difficult to carry out credible, long-time PIC simulations of ITG+ETG, or ITG+TEM, or ITG+microtearing modes. We present an efficient GK PIC algorithm which solves both problems. Linear and nonlinear examples are presented, demonstrating the failures of conventional GK PIC schemes and the success of the new algorithm. Oustanding parallelization of the new algorithm is demonstrated, with successful utilization of many thousands of cores simultaneously. Efforts to port this algorithm to many-core processors such as graphics processing units will also be described.

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