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Fully non-linear multi-species Fokker-Planck-Landau collisions for gyrokinetic particle-in-cell simulations of fusion plasma[1] ROBERT HAGER, Princeton Plasma Physics Laboratory, E.S. YOON, Rennselaer Polytechnic Institute, S. KU, Princeton Plasma Physics Laboratory, E.F. D'AZEVEDO, P. H. WORLEY, Oak Ridge National Laboratory, C.S. CHANG, Princeton Plasma Physics Laboratory — We describe the implementation, and application of a time-dependent, fully nonlinear multi-species Fokker-Planck-Landau collision operator based on the single-species work of Yoon and Chang [Phys. Plasmas 21, 032503 (2014)] in the full-function gyrokinetic particle-in-cell codes XGC1 [Ku et al., Nucl. Fusion 49, 115021 (2009)] and XGCa. XGC simulations include the pedestal and scrape-off layer, where significant deviations of the particle distribution function from a Maxwellian can occur. Thus, in order to describe collisional effects on neoclassical and turbulence physics accurately, the use of a non-linear collision operator is a necessity. Our collision operator is based on a finite volume method using the velocity-space distribution functions sampled from the marker particles. Since the same fine configuration space mesh is used for collisions and the Poisson solver, the workload due to collisions can be comparable to or larger than the workload due to particle motion. We demonstrate that computing time spent on collisions can be kept affordable by applying advanced parallelization strategies while conserving mass, momentum, and energy to reasonable accuracy. We also show results of production scale XGCa simulations in the H-mode pedestal and compare to conventional theory.

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