

Gyrokinetic Simulation of ASDEX-Upgrade SOL with Implicit Moments-Conserving BGK Collision Operator

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It is important to understand heat and particle transport in the scrape-off layer (SOL) of tokamaks to better understand power handling options in the divertor. Experiments on ASDEX-Upgrade (AUG) have reported a significant enhancement of perpendicular transport as the effective collisionality increases in this region, due to a transition between the sheath-limited and the inertial filamentary regimes. Using the Gkeyll code, we have performed full- f gyrokinetic simulations in this parameter regime of the SOL with magnetic geometry from a numerical equilibrium taken from AUG. In the high effective collisionality regime, an explicit time integration scheme gives overly restrictive time steps. Therefore, we have implemented an implicit BGK collision operator, combined with Gkeyll's traditional explicit time integrator for the collisionless advection, to significantly increase the size of the time steps in these gyrokinetic simulations and permit new simulations in this parameter regime of the AUG SOL. To ensure conservation of density, momentum, and energy, we utilize a novel iterative scheme to correct the discretized approximation to the equilibrium Maxwellian distribution to which the BGK collision operator relaxes. We have further generalized the BGK infrastructure, both the implicit scheme and the correction routine, to handle cross species collisions. We will show both axisymmetric simulations of the AUG SOL and statistical studies of some preliminary 3D nonlinear turbulence simulations.

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