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Four-Dimensional Continuum Gyrokinetic Code: Neoclassical Simulation of Fusion Edge Plasmas[1] X.Q. XU, A. XIONG, B.I. COHEN, R.H. COHEN, M.R. DORR, J.A. HITTINGER, G.D. KERBEL, W.M. NEVINS, T.D. ROGNLIEN, LLNL — We are developing a continuum gyrokinetic code, TEMPEST, to simulate edge plasmas. Our code represents velocity space via a grid in equilibrium energy and magnetic moment variables, and configuration space via poloidal magnetic flux and poloidal angle. The geometry is that of a fully diverted tokamak (single or double null) and so includes boundary conditions for both closed magnetic flux surfaces and open field lines. The 4-dimensional code includes kinetic electrons and ions, and electrostatic field-solver options, and simulates neoclassical transport. The present implementation is a Method of Lines approach where spatial finite-differences (higher order upwinding) and implicit time advancement are used. We present results of initial verification and validation studies: transition from collisional to collisionless limits of parallel end-loss in the scrape-off layer, self-consistent electric field, and the effect of the real X-point geometry and edge plasma conditions on the standard neoclassical theory, including a comparison of our 4D code with other kinetic neoclassical codes and experiments.

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X.Q. Xu
llnl

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