Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

Continuum solution of the drift kinetic equation in NIMROD[1]
ERIC HELD, JEONG-YOUNG JI, MUKTA SHARMA, Utah State University, NIMROD TEAM — Efforts to incorporate the nonlocal transport of heat and momentum along magnetic field lines in simulations of high-temperature plasmas have focused on integral (nonlocal) forms for the parallel heat flow and stress closures. Although such closures can be rigourously derived, their efficient computation in plasma fluid codes remains a formidable numerical challenge. In this work, we describe a complementary approach to computing closures that uses a continuum solution to the plasma kinetic equation. The closures constructed from these solutions are coupled to the evolving fluid moment equations of the NIMROD code. In addition to capturing the parallel free-streaming and accurate collisional effects of the integral closures, the continuum solution also includes time-dependence, particle trapping and acceleration physics. In this approach, we solve for the coefficients of an expansion in Legendre polynomials on a grid in speed, $s = v/v_T$, throughout the computational domain. Examples of heat and momentum transport in the vicinity of magnetic islands are discussed including comparisons between the integral and continuum closures in the steady state limit. We also compare the continuum and integral closures applied to the problem of sound wave damping as collisionality varies.

[1]Research supported by the U. S. DOE under grants nos. DE-FG02-04ER54746, DE-FC02-04ER54798 and DE-FC02-05ER54812.

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Date submitted: 18 Jul 2009 Electronic form version 1.4