Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

Incorporating time-dependent parallel kinetics in NIMROD[1]
ERIC HELD, JEONG-YOUNG JI, JOHN JAMES, MICHAEL ADDAE-KAGYAH, MUKTA SHARMA, Utah State University, NIMROD TEAM, SCIDAC CEMM AND PSI-CENTER COLLABORATION — Incorporating the physics of rapid parallel particle motion in plasma fluid codes requires a kinetic treatment that admits arbitrary mode, collision and parallel transit frequencies. In this work, we present numerical solutions of the time-dependent, Chapman-Enskog-like drift kinetic equation (CEL-DKE) that emphasize the dominant parallel motion, and subsequent closure of the plasma fluid equations evolved by the NIMROD code. This solution proceeds first via an expansion of the kinetic distortion in a pitch-angle basis. The diagonalization of the parallel free-streaming/time-derivative operator proceeds via an expansion in the eigenbasis of the free-streaming matrix. A massively parallel computational approach then solves each equation in this decoupled system of PDE's on separate groups of processors. This approach ensures scalability to thousands of processors. The remaining speed dependence is handled by solving the separated PDEs on a grid of Guass-Laguerre nodes which renders integration over the speed weighting of the desired $\vec{q}$ and $\Pi_{\|}$ closure moments exact. Application of these time-dependent closures in simulations of NTMs and ELMs is discussed.

[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: 22 Jul 2006 Electronic form version 1.4