Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Hybrid Gyrokinetic / Gyrofluid Simulation of ITG Turbulence
NOAH MANDELL[1], WILLIAM DORLAND, University of Maryland-College Park
— One of the main sources of disagreement between gyrofluid and gyrokinetic models is the inability of gyrofluid models to accurately describe zonal flows. These nonlinearly-driven sheared poloidal $\mathbf{E} \times \mathbf{B}$ flows have been shown to play a key role in determining the turbulence saturation level. While attempts have been made to improve gyrofluid modeling of zonal flows, we show here that improved zonal flow closures are insufficient. We introduce a new hybrid algorithm that simulates the zonal flow modes with a fully gyrokinetic model, while simulating the remaining modes with the newly developed GPU gyrofluid code GryfX. GryfX contains a new model of nonlinear FLR phase mixing by zonal flows, which in addition to accurate zonal flow modeling brings the heat flux predictions of the hybrid code into agreement with the gyrokinetic code GS2. The combination of GPU acceleration and the reduction of hundreds of velocity space grid points to six gyrofluid moments gives GryfX a roughly 7,000 times performance advantage over GS2. Further, due to supercomputer configurations that contain nodes with multiple CPUs per GPU, the hybrid fluid/kinetic code has minimal additional computation time cost and maintains a significant performance advantage over GS2.

[1]Present address: Princeton University

Noah Mandell
University of Maryland-College Park

Date submitted: 11 Jul 2014 Electronic form version 1.4