Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Quantification of Sub-Grid-Scale Terms in Plasma Turbulence[1]
TING RAO, Columbia University, RAVI SAMTANEY, DAVID KEYES, King Abdullah University of Science and Technology — The notions of DNS and LES are well established in hydrodynamic turbulence. We apply similar ideas to plasma turbulence whose governing equation (i.e., the Vlasov or Fokker-Planck equation) is higher dimensional (generally 6D). Analogously to the Navier-Stokes LES equations, we filter and derive sub-grid-scale terms for the Vlasov equation. It is known in gyrokinetic plasma turbulence that nonlinear interactions in velocity space lead small scales generation of the distribution function up to the collisional scales (see Schekochihin et al., Plasma Phys. Control. Fusion 2008). Because the gyrokinetic description still requires a 5D phase space description, and hence is computationally expensive, our first approach is to quantify the SGS terms in the context of drift kinetic equations in 4D phase space under the electrostatic approximation using high resolutions of up to a billion grid cells. We examine the phenomenology of the SGS terms by a careful quantification using high-order DNS of drift kinetic turbulence. The eventual goal is to develop SGS models for use in under-resolved or LES of plasma turbulence.

[1]TR is supported by the Center for Plasma Edge Simulations, under a US-DOE grant. RS and DK are supported by KAUST. Simulations were undertaken on the Shaheen IBM Blue-Gene P at the KAUST Supercomputing Laboratory at KAUST.

Ravi Samtaney
PPPL/ KAUST

Date submitted: 06 Aug 2010 Electronic form version 1.4