Abstract Submitted
for the DPP07 Meeting of
The American Physical Society

Moment approach to the derivation of diffusive and general parallel closures[1] JEONG-YOUNG JI, ERIC D. HELD, Utah State University — In the moment expansion with the random velocity polynomials instead of the total velocity, the Coulomb collision operators are analytically calculated for any arbitrary order moment. For the electron-ion interaction, the leading terms in the small- mass ratio approximation are derived so that the momentum and energy are conserved. The general moment equations are also explicitly presented. For high collisionality, diffusive closures are derived with all nonlinear terms kept, and as a result, comparable terms to the Braginskii equations are additionally found. For arbitrary collisionality, parallel heat flux and viscous stress are also derived from the general parallel moment equations. The parallel closures can be computed by integrating the gradients of temperature and fluid velocity through kernel functions along a magnetic field line. The kernel functions are simple linear combinations of exponential functions. It is verified that the closure calculation converges with increasing number of moments and that lower collisionality requires more moments. As a practical example, the parallel heat flux is applied to simulate the temperature in SSPX. Finally, a numerical implementation that speeds up the closure calculation is also discussed.

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

Jeong-Young Ji
Utah State University

Date submitted: 20 Jul 2007