Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Integral parallel closures of electrons for arbitrary collisionality JEONG-YOUNG JI, ERIC HELD, Utah State University, HOGUN JHANG, National Fusion Research Institute — In developing electron parallel closures for density, temperature, and flow velocity equations, we have analytically solved 1600 parallel moment equations for arbitrary collisionality. This is a generalization of our previous work on the heat flow responding to a temperature gradient[1] and viscosity to a flow velocity gradient.[2] Heat flow, viscosity, and friction force closures are expressed as integrals of the temperature gradient, the difference between electron and ion flow velocities, and the flow velocity gradient weighted by kernel functions. The kernel functions are sums of exponentially decaying functions, which are obtained by solving the eigensystem of the matrix of free streaming and collision terms. Our integral (nonlocal) closures agree well with the existing closures in the collisional and collisionless limits. Furthermore we have obtained fitted kernel formulas for arbitrary collisionality from the moment solution and asymptotic behaviour in the high and low collision limits. The formulas can be used conveniently without solving the higher order moment equations in closing electron fluid equations.

[1]J.-Y. Ji, E. D. Held, C. R. Sovinec, Phys. Plasmas **15**, 022312 (2009).
[2]J.-Y. Ji and E. D. Held, J. Fusion Energy **28**, 170 (2009).

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Date submitted: 12 Jul 2013 Electronic form version 1.4