Abstract Submitted
for the DPP07 Meeting of
The American Physical Society

Heating and Angular Momentum Transport in Hot Accretion Flows[1] PRATEEK SHARMA, ELIOT QUATAERT, University of California, Berkeley, GREGORY W. HAMMETT, JAMES M. STONE, Princeton University — The magnetorotational instability (MRI), an instability of magnetized differentially rotating plasmas, has been studied extensively with MHD. However, MHD is not a good description when the plasma mean free path is larger than the scales of interest. Sgr A*, the accretion flow around the supermassive black hole in the center of our Galaxy, is the prime example of a collisionless accretion flow. We use the kinetic MHD formalism (valid if Larmor radius $\ll$ length scales), closed with parallel heat fluxes, for local simulations of the collisionless MRI. Kinetic MHD differs from MHD in that the pressure is anisotropic with respect to the magnetic field lines. Pressure anisotropy ($p_\perp > p_\parallel$) results because of adiabatic invariance ($\mu \propto p_\perp/B$ = constant) as magnetic field is amplified by the MRI. Pressure anisotropy cannot become arbitrarily large; we use models of pressure isotropization by different microinstabilities so that $\Delta p/p \leq S/\beta^\alpha$. Anisotropic viscous stress, due to momentum transport by parallel free streaming particles, is comparable to the Maxwell stress. Moreover, electrons can be significantly heated due to anisotropic viscous stress. Large electron heating results in a significant radiative efficiency, ruling out the models which ascribe the low luminosity of Sgr A* to only a low efficiency; a supression of net mass accretion rate is required for the low luminosity.

[1]supported in part by a Sloan Fellowship, David and Lucile Packard Foundation, NASA grants NNG05GO22H and NNH06AD01I, and DOE grants DE-FC02-06ER41453, DE-AC02-76CH03073, and DE-FG52-06NA26217.

Prateek Sharma
University of California, Berkeley

Date submitted: 17 Jul 2007 Electronic form version 1.4