Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Shear viscosity measurements in a 2D Yukawa liquid[1]
VOLODYMYR NOSENKO, JOHN GOREE, The University of Iowa — Shear viscosity was measured for a 2D strongly-coupled Yukawa liquid. First, we formed a dilute monolayer suspension of microspheres in a partially-ionized rarefied gas, i.e., a dusty plasma. In the absence of manipulation, the suspension forms a 2D triangular lattice. We used a new in-situ method of applying a shear stress using the scattering forces applied by counter-propagating laser beams. The lattice melted and a shear flow formed. Using digital video microscopy for direct imaging and particle tracking, the microscopic dynamics of the shear flow are observed. Averaging the velocities of individual microspheres, a velocity flow profile was calculated. Using the Navier-Stokes equation with an additional frictional term to account for gas drag, we fit the velocity profile. The fit yielded the value of the shear viscosity. The kinematic viscosity of our particle suspension is of order 1 $\mathrm{mm}^2\mathrm{s}^{-1}$, which is comparable to that for liquid water. We believe this is the first report of a rheological measurement in a 2D dusty plasma. This talk is based on V. Nosenko and J. Goree, PRL 93, 155004 (2004).

[1]Work supported by NASA and DOE.

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Date submitted: 01 Dec 2004 Electronic form version 1.4