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Experimental Measurement of Viscoelasticity in a 2D Dusty Plasma Using Modulated Shear Flows[1] JORGE BERUMEN CANTU, JOHN GOREE, Univ of Iowa — Viscoelasticity is a property of strongly coupled plasmas that describes their dissipative (viscous) and energy storing (elastic) properties. Dusty plasmas are well suited for experiments to measure this effect. The large particle size results in large charges and therefore strong coupling, and it allows the particles to be tracked easily using a video camera. We present results for an experiment performed to measure viscoelasticity using a dusty plasma produced in a modified Gaseous Electronics Conference (GEC) chamber with capacitively coupled RF power. Polymer microspheres are levitated and form a 2D cloud that conforms the strongly coupled component of the plasma. Laser heating is used to maintain a steady temperature in the suspension. Two additional laser beams are directed onto the cloud in a counter-propagating configuration to apply a shear on the dust cloud. The amplitudes of these two beams are sinusoidally modulated at frequencies ω to investigate the behavior of the particle cloud at different time scales. The microspheres are imaged from above by a high-speed camera. The particle positions and velocities are obtained from the videos and used as the inputs for calculating the time-dependent shear stress Pxy(t) and shear rate γ(t). Fourier analysis is performed, and results are reported as a frequency-dependent complex viscosity $\eta(\omega)$, defined as the ratio of Pxy(ω) over $\gamma(\omega)$.

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