Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Simulating large, anisotropic density fluctuations in colloidal gels under shear JAMES SWAN, ZSIGMOND VARGA, Massachusetts Inst of Tech-MIT — The steady shear of weak colloidal gels results in vorticity aligned density fluctuations. These have been measured in neutron scattering and flow dichroism experiments and observed with microscopy coupled to rheometer tools of varying geometry. The origins of this instability remain a mystery, and discrete element simulations of colloidal gels have to date, failed to reproduce the phenomena. We use new Brownian Dynamics simulations to show that this instability is fluid mechanical in origin, and results from long-ranged hydrodynamic interactions among particles in the gel. Squeeze flows between vorticity aligned flocs prevent mutual collisions and realignment, thus promoting stability of large-scale anisotropic density fluctuations. The nonlinear rheology in sheared colloidal gels and measures of their structural anisotropy determined from simulations agree well with a wide variety of experiments. Finally, we demonstrate collapse of this data across different shear rates, strengths of interaction, and volume fractions using a single force scale, the most probable rupture force for the inter-colloid bonds.

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Date submitted: 11 Nov 2016 Electronic form version 1.4