Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

A rheological signature of frictional interactions in shear thickening suspensions JOHN ROYER, NIST , DANIEL BLAIR, Georgetown University, STEVEN HUDSON, NIST — We elucidate the relative contributions from hydrodynamic lubrication and frictional contact forces to colloidal shear thickening by measuring both the viscosity η and first normal stress difference N_1 in suspensions of silica spheres over a wide range of volume fractions. The first normal stress difference reveals a transition not apparent in the viscosity alone, from $N_1 < 0$ at moderate volume fractions $\phi \leq 0.52$ to $N_1 > 0$ at larger values of ϕ. While the $N_1 < 0$ behavior is consistent with hydrodynamic models, the $N_1 > 0$ behavior (dilation) is instead a characteristic of frictional 'granular' suspensions. Fitting our viscosity profiles $\eta(\sigma, \phi)$ to a model for friction-driven shear thickening, we capture the shear thickening for $\phi \geq 0.52$ but must adjust the adjust the maximum fraction of frictional contacts to fit at lower volume fractions. Our results bring together two contrasting theories for shear thickening; they show that friction drives shear thickening in concentrated colloidal suspensions, but also highlight the need to include hydrodynamic effects to fully describe the rheology at moderate concentrations.

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Date submitted: 03 Nov 2015 Electronic form version 1.4