Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The Einstein viscosity with fluid elasticity JONAS EINARSSON, MENGFEI YANG, ERIC S. G. SHAQFEH, Stanford University — We give the first correction to the suspension viscosity due to fluid elasticity for a dilute suspension of spheres in a viscoelastic medium. Our perturbation theory is valid to $O(\mathrm{Wi}^2)$ in the Weissenberg number $\mathrm{Wi} = \dot{\gamma}\lambda$, where $\dot{\gamma}$ is the typical magnitude of the suspension velocity gradient, and λ is the relaxation time of the viscoelastic fluid. For shear flow we find that the suspension shear-thickens due to elastic stretching in strain 'hot spots' near the particle, despite the fact that the stress inside the particles decreases relative to the Newtonian case. We thus argue that it is crucial to correctly model the extensional rheology of the suspending medium to predict the shear rheology of the suspension. For uniaxial extensional flow we correct existing results at $O(\mathrm{Wi})$, and find dramatic strain-rate thickening at $O(\mathrm{Wi}^2)$. We validate our theory with fully resolved numerical simulations.

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Date submitted: 31 Jul 2017 Electronic form version 1.4