Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

How does inertia affect the steady-shear rheology of disordered solids? JOERG ROTTLER, University of British Columbia, JEAN-LOUIS BARRAT, ALEXANDRE NICOLAS, LiPhy, Universit Grenoble-Alpes CNRS — We study the finite-shear-rate rheology of disordered solids with molecular dynamics simulations in two dimensions. By systematically varying the damping strength ζ, we identify two well defined flow regimes, separated by a thin crossover region. In the overdamped regime, the athermal rheology is governed by the competition between elastic forces and viscous forces, whose ratio gives the Weissenberg number Wi $\propto \zeta\dot{\gamma}$; the macroscopic stress Σ follows the frequently encountered Herschel-Bulkley law $\Sigma = \Sigma_0 + k\sqrt{\mathrm{Wi}}$, with yield stress $\Sigma_0 > 0$. In the underdamped (inertial) regime, dramatic changes in the rheology are observed for low damping: the flow curve becomes nonmonotonic. This change is not caused by longer-lived correlations in the particle dynamics at lower damping; instead, for weak dissipation, the sample heats up considerably and proportional to the driving. By thermostatting more or less underdamped systems, we are able to link quantitatively the rheology to the kinetic temperature T_k, while the damping strength enters only indirectly by setting T_k.

Joerg Rottler
University of British Columbia

Date submitted: 01 Nov 2015 Electronic form version 1.4