

**THROUGH THICK AND THIN –
IMAGING THE MICROSCOPIC STRUCTURE
OF NON-NEWTONIAN FLOW BEHAVIORS
IN COLLOIDAL SUSPENSIONS**

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4:00 P.M. NSH 118
(Refreshments at 3:30 P.M. NSH 202)

While a simple Newtonian fluid such as water flows with a constant viscosity, many structured fluids ranging from polymer melts to surfactant solutions exhibit fascinating non-Newtonian flow behaviors including shear thinning and shear thickening. One typical example is a colloidal suspension, where its viscosity can vary by orders of magnitude depending on how quickly it is sheared. Although this non-Newtonian behavior is believed to arise from the arrangement of suspended particles and their mutual interactions, microscopic particle dynamics in such suspensions are difficult to measure directly. Here, by combining fast confocal microscopy with simultaneous force measurements, we systematically investigate a suspension's structure as it transitions through regimes of different flow signatures. Our measurements of the microscopic single-particle dynamics unambiguously show that shear thinning results from the decreased relative contribution of entropic forces and that shear thickening arises from particle clustering induced by inter-particle hydrodynamic lubrication forces. Furthermore, we explore out-of-equilibrium structures of sheared colloidal suspensions and report a novel string phase, where particles link into log-rolling strings normal to the plane of shear. Our techniques illustrate an approach that complements current methods for determining the microscopic origins of non-Newtonian flow behavior in complex fluids.

Colloquium

All interested persons are cordially invited to attend.