Microscopic theory of non-Brownian suspension flows close to the Jamming point

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ABSTRACT

While the rheology of athermal suspensions in the dilute regime is well-understood, their behavior in the dense limit remains unclear. As the packing fraction of particles is increased, particle motion becomes more collective, leading to a growing length scale and scaling properties in the rheology close to the jamming transition where flow stops. In my talk I will present a microscopic theory for the rheology of dense non-Brownian suspensions. The theory provides predictions for the scaling laws connecting macroscopic observables such as the pressure and viscosity with microscopic observables such as the coordination. The non-trivial critical exponent characterizing the scaling laws will be shown to stem from the existence of two different force scales between particles in contact close to the jamming point. The first force scale is proportional to the macroscopic pressure, while the second force scale is shown to be determined by the force between colliding particles. The microscopic theory will be then derived from the proper balance between these force scales which is necessary to reach a statistically stationary flow.