Self-organization and rheology of dense non-Brownian suspensions - a geometric approach

While the rheology of non-Brownian suspensions in the dilute regime is well-understood, their behavior in the dense limit remains mystifying. As the packing fraction of particles is increased, particle motion becomes more collective, leading to growing correlation lengths and the eventual divergence of the viscosity as the material approaches the jamming critical point. There is no accepted microscopic description of this phenomenon. In my talk I will present a simple model of dense flow, the Affine Solvent Model (ASM). Within the ASM framework, a formal analogy can be made between the rheology of the flow and the elasticity of simple networks. This analogy leads to a new conceptual framework to relate microscopic structure to rheology. It enables us to define and compute numerically normal modes and a density of states. I will show how the self-organization of the particles under steady flow is manifested in the spectral analysis of the underlying geometry of flow configurations, and relate the mechanical response of hard particles under shear to elastic networks that rigidify under tension.

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