Rheology of dense granular suspensions
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Suspensions are composed of mixtures of particles and fluid and are ubiquitous in many natural phenomena (e.g. sediment transport in rivers and oceans, landslides, debris and lava flows) and in industrial processes (e.g. food and cosmetic, pulp and paper, materials for civil and petroleum engineering). This talk addresses the rheology of concentrated suspensions of non-colloidal particles. While hydrodynamic interactions or lubrication forces are essential in the dilute regime, they become of lesser importance when the concentration is increased and direct particle contacts prevail, particularly close to the maximum volume fraction where the suspension ceases to flow. Dense suspensions can be seen as a fluid with effective rheological properties but also as a two-phase system wherein the fluid and particles can experience relative motion. They can be described with constitutive laws in which the control parameter is the normal stress imposed to the particle phase rather than the volume fraction. This alternative description inspired by the frictional approach of dry granular media is particularly suited to yield examination of the rheology close to the jamming transition. Finally, beyond the classical problem of dense suspensions of hard spheres in a Newtonian fluid, there are entirely novel avenues of study concerning more complex mixtures of particles and fluid.