Rheology of soft jammed particles: role of attractive interactions

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Abstract:

In nature, soft disordered solids occur in different forms (eg. gels, emulsions, colloids, foams, grains etc) across a wide range of packing fractions, which is made possible by the tuning of particle interactions. The flow properties of these soft materials have been harnessed for various applications in our daily lives. Thus, understanding the role of particle interactions and the corresponding mechanisms which lead to observed rheological behaviour is an important recurrent theme.

Using numerical simulations, we study the rheological response of an athermal assembly of soft particles with tunable attractive interactions, in the vicinity of jamming. At small attractions, a fragile solid develops and a finite yield stress is measured. Moreover, the measured flow curves have unstable regimes, which lead to persistent shearbanding. These features are rationalized by establishing a link between the rheology and the number of contacts per particle, which also provides a minimal model to describe the measured flow curves.