The fluidization dynamics of a "simple" yield stress fluid

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Yield stress materials are viscoelastic solids at rest but behave as viscous liquids when stressed above their yield stress. In soft jammed systems, yielding can be seen as an instance of an unjamming transition driven by the shear stress. The question of whether this shear-induced fluidization displays universal features, in a way similar to jamming driven by temperature or by volume fraction, has triggered much research effort in the recent years. Experimentally, difficulties arise from the need to measure deformations and flows close to yielding at vanishingly small shear rates with sufficient spatial and temporal resolutions.

In this talk, I will focus on the fluidization dynamics of a "simple" yield stress material, namely a carbopol microgel, that presents negligible aging and thixotropy. Through long experiments combining standard rheology and local velocimetry under imposed strain or stress, I will show that the material first undergoes a transient regime characterized by shear banding, before reaching a homogeneous flow regime.
The duration of the shear-banding regime decreases as power-laws of the applied shear rate and of the applied viscous stress.These power-laws nicely combine to recover the Herschel-Bulkley law characteristic of the steady-state rheology of our microgel.
To further discuss this scaling behaviour, I will propose an analogy with critical phenomena in which the yield point appears as a critical point of an underlying out-of-equilibrium phase transition.