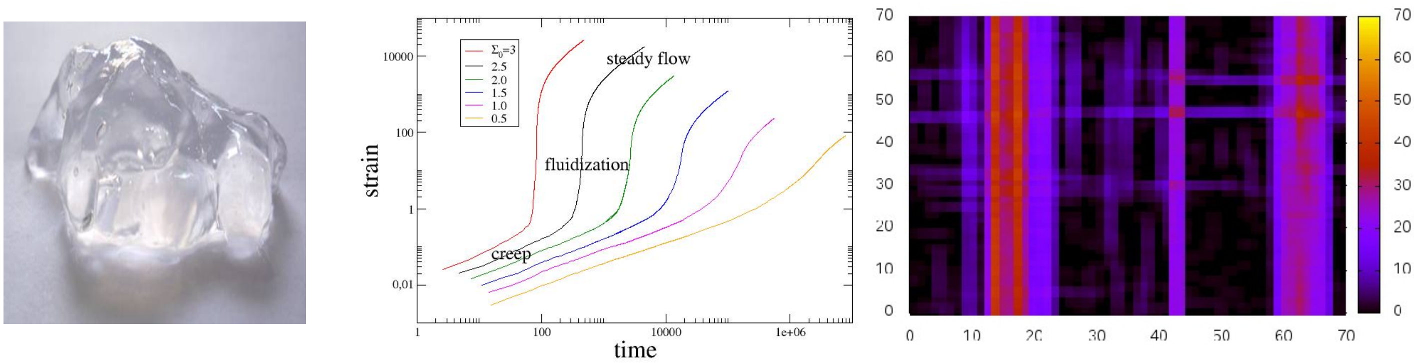
M2 Research internship

Creep and fluidization in soft glassy systems

Many «soft glassy» systems **(foams, emulsions, gels)** share the same phenomenology [1]: under an applied external stress, they first creep very slowly following a power law behavior $\gamma \sim t^p$ where p is the creep exponent, which is generally smaller than 1: this is the **Andrade creep** regime which is also shared by metals. Subsequently, after a time which decreases with the applied external stress, the soft glass starts to flow, and this **fluidization** phenomenon is accompanied by the formation of transient shear bands. Eventually, a steady state regime is reached with a constant strain rate. In case of metals, Andrade creep is interpreted in terms of the gliding motion of dislocations. On the contrary, for glassy systems there is still no satisfying framework to explain these phenomena.

The goal of the internship is to study creep and fluidization on the basis of a **kinetic model.** The idea is to study the mechanical response of a disordered system characterized by a broad distribution of energy barriers [2]. These barriers may be lowered under the effect of a local deformation. Using this model, the student will study the mean deformation of the system as a function of the applied stress, and will characterize spatial heterogeneities in strain fields.



(Left) Example of soft glassy fluid; carbopol gel (Middle) Strain as a function of time for various applied stresses, increasing from bottom to top. (Right) Local strains in the system.

In practice, the work will consist in using a simple Monte Carlo code that is already written. A taste for numerical work is necessary and coding skills would be a plus. The results will be interpreted using Fokker-Planck equations on toy models, and they will of of interest for the experimentalists working in the ILM Institute.

[1] Bonn, Paredes et al, Yield stress materials in soft condensed matter, arxiv:1502.05281.

[2] Merabia and Detcheverry, Creep and fluidization in thermal amorphous solids, submitted.

Opening toward a PhD : yes (funding with «bourse ministère»)

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