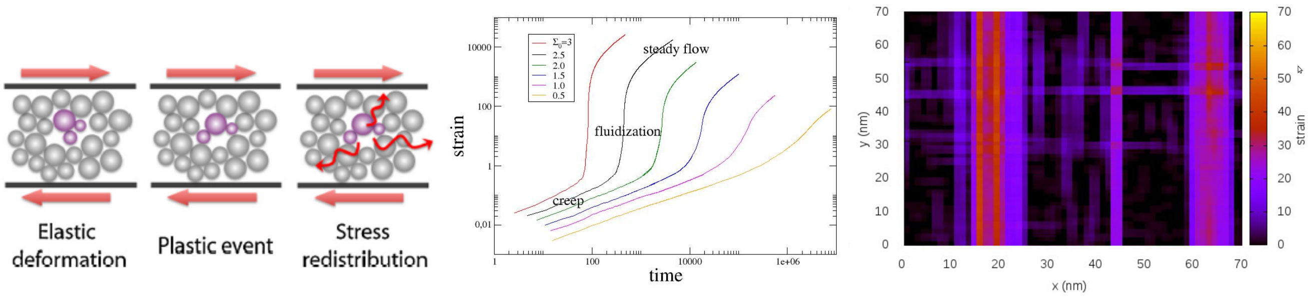
M2 Research internship

Creep and fluidization in thermal glassy systems

Many «glassy» systems (**polymers, gels, complex fluids**) share the same phenomenology [1]: under an applied external stress, they first creep very slowly following a power law behavior $\gamma \sim t^p$ with a creep exponent p generally smaller than 1: this is the **Andrade creep** regime which is also known in 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. Andrade creep in metals is interpreted in terms of the gliding motion of dislocations. In contrast, for glassy systems, there is still no satisfying framework to explain these phenomena.

The goal of the internship is to study the competition between fluidization and thermal diffusion on the basis of a **mesoscopic model.** The idea is to study the mechanical response of a disordered system characterized by a broad distribution of energy barriers [2], which may be lowered under the effect of a deformation. We want to understand how thermal diffusion may help in overcoming the energy barriers and eventually favor the formation of long-lived shear bands. Depending on the student taste, one could also focus on fluidization in biologically active media.



(Left) Basic ingredients for a mesoscopic model of (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 student will use a simple Monte Carlo code that is already written. A taste for **statistical physics** and 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 be of of interest for the experimentalists working in the ILM Institute.

[1] Bonn, Paredes et al, *Yield stress materials in soft condensed matter*, Review of Modern Physics (2017).

[2] Merabia and Detcheverry, *Thermally activated creep and fluidization in flowing disordered materials*, EPL (2016).

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

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28/09/2017