Master 2 *Complex Systems*

INTERNSHIP PROPOSAL

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Modelling glass memories

Due to their out-of-equilibrium nature, glassy materials keep a memory of their thermal and mechanical past (see [1] for a recent result). These two effects are usually discussed independently : the glass structure depends on the rate of the thermal quench from the liquid phase to the glass phase ; the plastic behavior of an amorphous material depends on the mechanical loading it has experienced in the past (strain hardening). However more and more recent results suggest a strong coupling between thermal and mechanical effects [2,3].

Here we propose to develop a minimal model at mesoscopic scale allowing us to account for mechanical and thermal effects in the glassy dynamics. In the spirit of depinning models generally used to describe the motion of a triple contact line in wetting or a crack front in fracture, we plan to study the creep behavior of an amorphous material in a simple elastoplastic lattice model [4]. Such models are based on the coupling between a stochastic dynamics at local scale and long-range elastic interactions. They exhibit critical features (avalanches, finite size effects) but also reproduce other features more specific of amorphous plasticity (hardening, shear-banding). We will try to reproduce memory effects in the framework of these simplified models. We will start to study the effect of the glass preparation (quench, thermal annealing) on the plastic behavior under constant stress at finite temperature (creep). A particular focus will be given the localization behavior of the plastic strain.

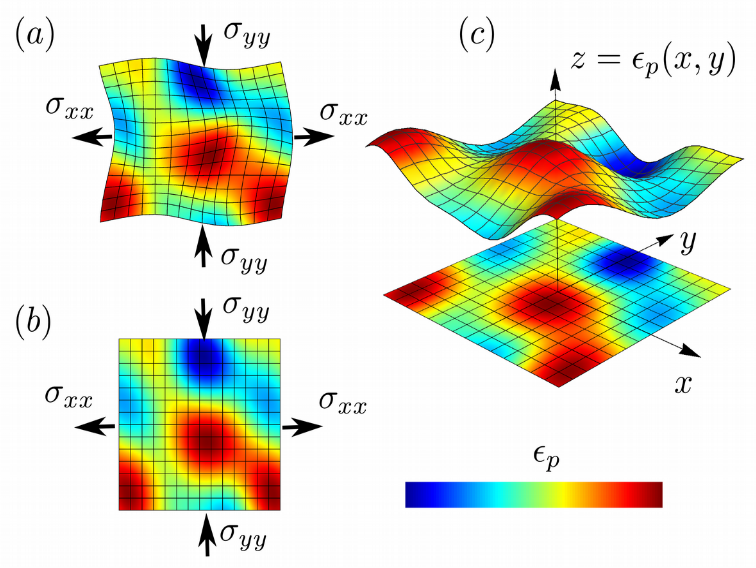

Fig. 1: Plastic deformation as the motion of an elastic manifold. (a) and (b) deformation of a mesh under shear loading. The color scale indicates the level of plastic strain. (c) the extra z-coordinate is used to represent the plastic strain.

References :

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