INTERNSHIP PROPOSAL

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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: CIFRE

Creating a crease - collective instabilities in fibrous systems

Mechanical instabilities such as fractures, earthquakes, imploding shells… are sometimes spectacular and always fascinating. In this project we will study the creasing instability.

In a baby's arm - fig. a, we know that creasing results from the balance between volumetric deformation (which is nearly forbidden: the material is incompressible) and shear deformation (which is easy: the material is soft).

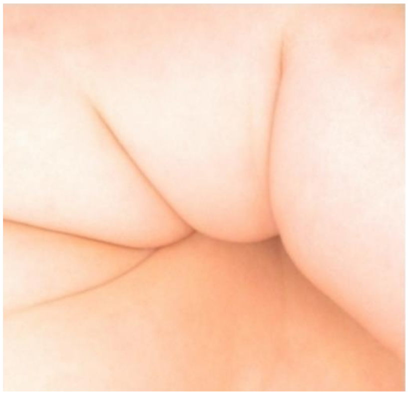
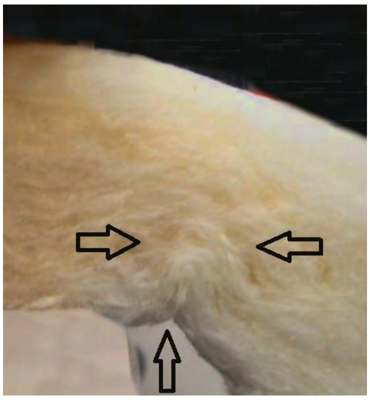
a)  b) 

Figure : creases formed by instability - a) soft incompressible material (baby's arm – after Hohlfeld 2011); b) anisotropic fibrous system.

Intriguingly, other systems also undergo an apparently similar form of creasing, but they are highly compressible: oriented fibre assemblies, aka glass wools - fig. b.

To understand creasing in these systems, we need to characterise and model the collective response of oriented fibres. We will start at an intermediate lengthscale, measuring fibre packets (e. g. traction) in relation to the underlying fiber structure (in situ confocal imaging). We will also quantify the interaction between packets at the mesoscale (by image correlation). The results will be compared to predictions at various levels of modelling from simple scaling arguments to continuum scale descriptions through full multiscale numerical schemes, in collaboration with C. Picu (Rensselaer Polytechnic Institute, USA).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO