

## Master 2 internship proposal

### Physique et Mécanique des Milieux Hétérogènes

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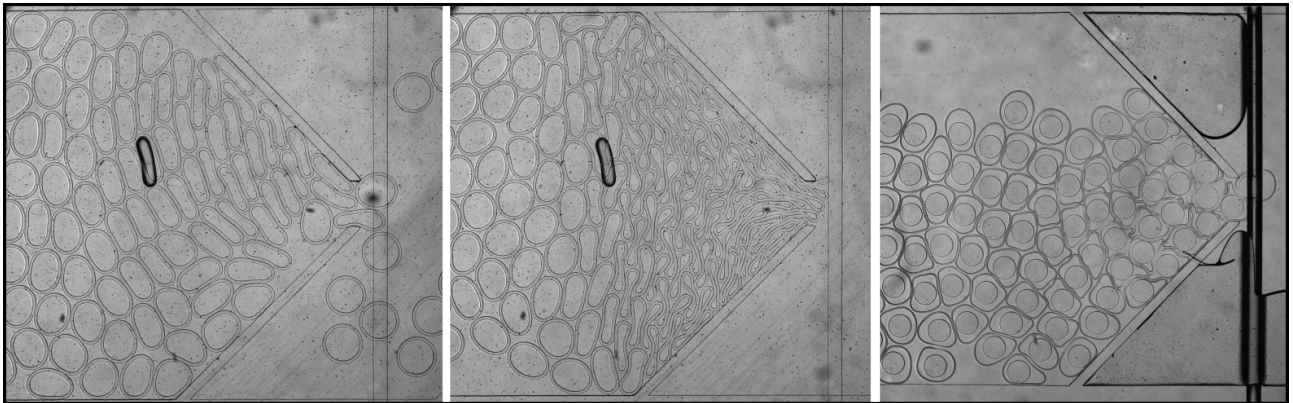
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**Internship location:** ESPCI, PMMH (Jussieu), 75005 Paris

### Flows of suspensions of deformable particles

Flows of dry and wet granular suspensions have long been studied, from the regular discharge of sand in hourglasses or silos to the clogging of particles under confinement. While most of experimental studies have used rigid particles, particles in practical applications often exhibit deformable features. In particular, the flow of red blood cells in the human body is known to be dramatically affected by diseases such as malaria, which increase cell stiffness and impair passage through narrow capillaries. Here, we have designed a model 2D microfluidic system to print particles of controlled shape, size and deformability [1]. By using stop-flow lithography, we are able to generate suspensions of 2D particles into a microfluidic channel and to study various flow geometries. With such system, we have studied microfluidic hopper flows of hard monodisperse disk-shaped particles, that exhibit similar behavior than the well-established laws in dry granular flows [1]. By designing ring particles, we perform experiments with packing composed of particles of controlled deformability to provide novel experimental measurements on the role played by deformability on clogging (Figure 1).



**Figure 1:** 2D particles composed of disks and rings of controlled thickness deform under flows within a microfluidic system. Composites composed of disks within flexible rings can also be printed. Credits: Simon Perrin-Roussel (PMMH).

#### References:

[1] L. Kool, J. Tampier, **P. Bourrianne** and **A. Lindner**, Hopper flows of dense suspensions: a 2D microfluidic model system. *Flow* (2025).

The applicant should have interests in fluid/solid mechanics and soft matter.  
Possibility to pursue in PhD on the topic.