

M1 or M2 Internship opportunity :

DEFORMATION OF PACKED SOFT PARTICLES IN A MICROFLUIDIC DEVICE

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An internship opportunity is available in the [Physical microfluidics and Bioengineering](#) lab at Ecole Polytechnique. In our lab we are studying the biological response of cells to mechanical forces and we are developing new microfluidic approaches to deform or apply stresses to cells, cell aggregates, or tissue from patients [1]. We are now interested in improving our understanding of the stress propagation within the microfluidic device in order to extend its bioengineering capabilities.

The objective in this internship is to understand the deformation of a packed layer of soft hydrogel particles when they are subjected to global deformations. In particular the project will consist of fabricating gel beads in the range of $100\ \mu\text{m}$ and placing them in a deformable microfluidic device. Then by imposing a global deformation of the device we will look at the mobility of the beads and forces generated between them and inside them (see Fig. 1). The project will involve microfabrication, through the use of 3D printers, as well as microscopy and quantitative image analysis. We will also potentially use more advanced microfabrication methods if needed, as well as possibly combing the forcing with biological samples.

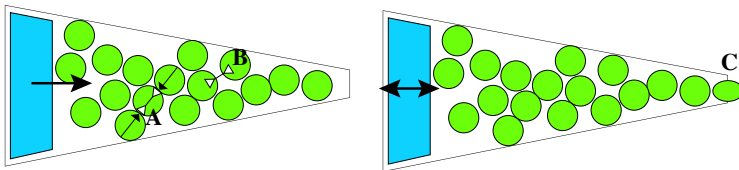


FIGURE 1 – Soft beads can be packed into a deformable microchannel. How do the beads move when the channel is deformed? What are the forces that are generated inside individual beads (**A**), between adjacent beads (**B**)? When the forcing is oscillatory, how many beads are ejected from the channel (**C**)?

The candidate : The ideal candidate should be interested in soft matter physics and microfluidics, as well as applications for bioengineering. A background in physics, engineering, or related background is appreciated. *The project could potentially be followed by a PhD, for the right candidate.*

The lab : The project will take place at LadHyX, Ecole Polytechnique, where our research is focused on developing microfluidics tools and understanding the underlying physics (see e.g. Ref. [2, 3]). Our group is made up of engineers, physicists, and biologists, working on the Polytechnique campus in Palaiseau and the Institut Pasteur, in Paris. The student will interact with different members of the team.

To apply or for further information : Applicants are invited to send a CV and transcript of courses taken, as well as the names of two referees, to Charles Baroud (charles.baroud@polytechnique.edu).

References

- [1] Jain, S., Belkadi, H., Michaut, Sart, Gros, Genet, and Baroud, C.N. “Using a micro-device with a deformable ceiling to probe stiffness heterogeneities within 3D cell aggregates”. *BioRxiv*, (2023).
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- [3] Taccoen, N., Lequeux, F., Gunes, D. Z., & Baroud, C. N. “Probing the mechanical strength of an armored bubble and its implication to particle-stabilized foams”. *Physical Review X*, 6(1), 011010 (2016).