INTERNSHIP PROPOSAL

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Development of acoustic force spectroscopy techniques for cell mechanics

Duration of the internship: 4-6 months

Description of the host team:

This project is developed in collaboration between the LAI and the LMA. The LAI develop and apply advanced force spectroscopy techniques to unravel the physics behind biological systems, from single molecules to membranes and living cells. We are notably using acoustic force spectroscopy, an emerging technology that needs to be developed to match our own applications. The "Waves and Imaging" team at the LMA is specialized in the development on non-invasive ultrasound techniques for the characterization and diagnostic imaging of biological tissues (bone, tumor, blood).

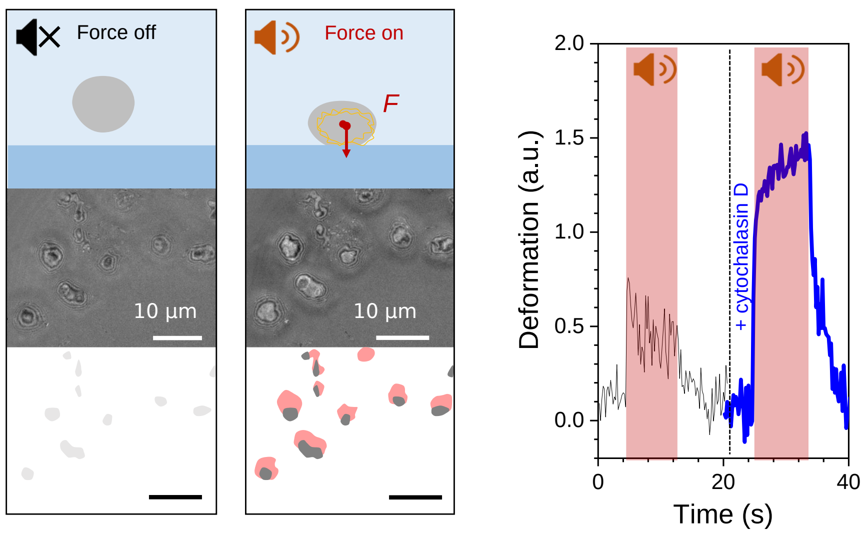
Description of the environment:

We are developping experimental approaches and applying physical concepts to achieve a quantitative understanding of cellular mechanics from a fundamental point of view but with an eye on applying our approches to the biomedical field.
Our interdisciplinary and international groups integrate members coming from physics, engineering, and biology backgrounds.

Description of the project:

Acoustic force spectroscopy (AFS) is an emerging technique that use acoustic forces in a microfluidic channel containing suspended cells to probe several cells in parallel (contrary to other methods that provide limited statistics on single cells) [1]. The commercial setup is not fully matching our needs (lack of calibration, manipulation of cell clusters). The aim of the project is to better characterize the current setup (precise characterization of the acoustic field within the microfluidic channel using hydrophones) and to develop a new acoustic chamber. Alternative configurations (like single acoustic tweezers [2]) could be considered for the development of this new setup that should enable to manipulate bigger elements, such as cell clusters. This would enable to unveil their rheology (Young modulus, adhesion, yield-stress) and predict their behavior in complex hydrodynamic environments.

Figure: Measurements principle. When an acoustic force is applied, cells are pressed against the surface and its contact area increases (in red). The increase of the deformation when cytochalasin D is added (cytoskeleton perturbator) shows the sensitiviy of the technique.



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References: Sitters et al. Nature Methods, 2015.
Lim et al. Microsystems & Nanoengineering, 2020.

Disciplines involved: physics (acoustic, mechanics), engineering

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Expected profile: We are looking for a student with background in physics or engineering and an interest in technological development. Experience in acoustic will be appreciated. The internship could be potentially followed by a PhD thesis.

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