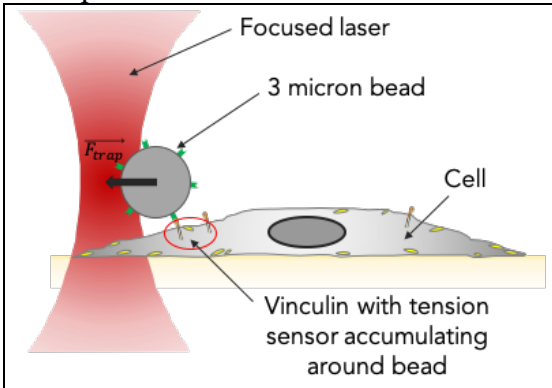
Proposal for a Master 2 internship to be continued as a PhD thesis

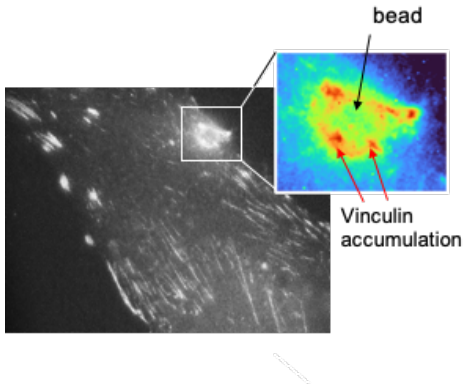
Laboratoire Charles Fabry - BIOPHOTONICS group

Biomechanics of cell adhesion using optical tweezers and fluorescence microscopy

Living cells are subject to many mechanical forces that regulate their behavior, and their disruption leads to numerous pathologies such as the formation of glial scars following neuronal damage, the formation of atherosclerotic plaques or tumor growth. Light is used both to act mechanically on living cells, via a bead attached to the membrane and manipulated by optical tweezers, and to monitor changes in the conformation of vinculin, the protein involved in cell adhesion to the bead, using fluorescence. The fluorescence signal known as FRET (for Förster Resonance Energy Transfer), results from a transfer of excitation between two fluorophores inserted between the ends of the vinculin protein.



Principle of the experiment



Fluorescence of a cell with an adherent bead

An original set up combining FRET measurement and optical tweezer (Camille Dubois et al, JBO 2023) is operational at Institut d'Optique and applied to 3µm beads attached to fibroblast cells, labelled with fluorescent proteins. During C. Dubois's thesis, we have shown that vinculin recruitment and tension occur at focal adhesions under force. Following those very interesting results, several paths of study opened up: observing the effect of force at different time scales, both over many minutes as the actin cytosqueletton reorganizes and under rapid force oscillations to mimick blood flow, labelling the other proteins involved in adhesions such as actin and fibronectin, testing cell mutants with modified mechanical properties. The intern will benefit from the expertise in optics at Institut d'Optique as well as the biology environment and imaging facilities at I2BC, since the two teams collaborate on this project. He or she will acquire wide-ranging skills in the experiment, cell culture and transfection, optical microscopy and image analysis. Previous knowledge in all these areas is not required, but you will need to be keen to get started.

Preference will be given to students who are willing to continue with a PhD on the same subject. This phD will include short stays (1 to 3 months) at Rutgers University (USA), which is our partner on this project, as well as collaboration with Marcelina Cardoso Dos Santos at I2BC (Paris-Saclay). The funding envisaged for the thesis is a grant from the doctoral school (EOBE).

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Duration: 4 to 6 months, can be started part time in january and full time in march.