Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 21/09/2017

Responsable du stage / *internship supervisor*:

Nom / *name*:	Débarre	Prénom/ *first name* :	Delphine
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Nom du Laboratoire / *laboratory name*: Laboratoire Interdisciplinaire de Physique (LIPhy)

Code d'identification : UMR5588 Organisme : CNRS/Univ. Grenoble Alpes

Site Internet / *web site*: http://www-liphy.ujf-grenoble.fr/

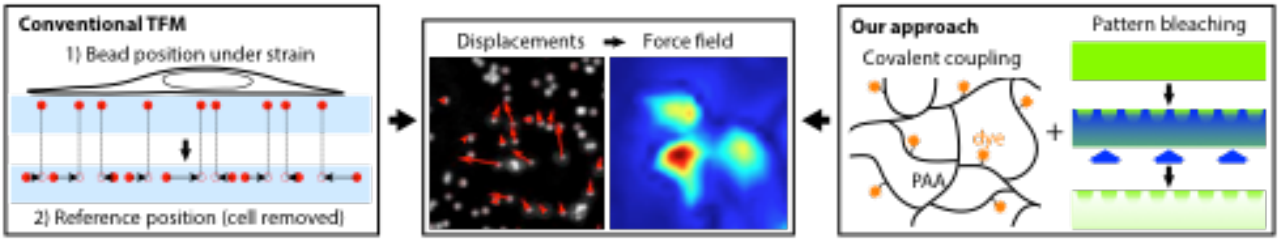
Adresse / *address:* 140, rue de la Physique, 38000 Grenoble

Lieu du stage / *internship place*: LIPhy

Titre du stage / *internship title*: **High-resolution traction force microscopy**

Mechanical forces exerted by and upon biological samples have recently emerged as a critical aspect of cell fate, morphogenesis and tumor growth. In this context, **the development of methods to measure forces exerted by cells has drawn considerable interest, in particular traction force microscopy** (TFM). TFM has been successfully used with eukaryotic cells, which spread over several hundreds of μm^2 and exert local forces in the 1-100 nN range. In contrast, studies reporting force quantification for bacteria are extremely scarce due to the small cell size (a few µm) and low forces (~100pN) generated.

The aim of this project is thus to develop high-resolution traction force microscopy and to apply it to study forces exerted by individual bacteria.



State-of-the-art high-resolution TFM techniques provide ~1µm resolution. Here, we propose to use **optical patterning of homogenous fluorescent gels** to achieve sub-µm, high sensitivity TFM: instead of randomly distributed beads, we propose to use a gel containing covalently coupled dyes that cannot diffuse through the network. Prior to cell seeding, the fluorescence is modulated by bleaching with patterned illumination to provide a diffraction-limited regular pattern whose deformation can be subsequently imaged (see Fig.). This approach provides a mechanically homogenous substrate and optimal, regular sampling of the deformation field that simplifies force field computation and improves the resulting spatial resolution (~500nm).

Practical implementation will tackle the following issues:

- **Optimizing the patterning process** by testing various motives, sizes and dyes.
- **Benchmarking the force field measurements against readily existing methods**.
- **Mapping forces exerted by individual bacteria adhering on soft substrates**. Our team already has experience in TFM on bacteria, and this development will be integrated in a wider project dealing with the impact of mechanical constraint on bacterial contamination of surfaces.

For whom? This project includes microscopy, simple chemistry, image analysis and microbiology and we are thus looking for candidates eager to work in an interdisciplinary environment.

Where? The Laboratory for Interdisciplinary Physics in Grenoble brings together optics, biophysics, soft matter physics, physico-chemistry and biology in a international environment.

With whom? Delphine Débarre (microscopy, data analysis), Sigolène Lecuyer (microbiology, mecanobiology), Lionel Bureau (physico-chemistry).

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **Ecole Doctorale/ANR**

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	**x**