**Master's degree in Biology – Chemistry-Biology Department**

# Master 2 internship project
# Year 2025-2026


**Laboratory/Institute:** Laboratoire Interdisciplinaire de Physique
**Director:** Bahram Houchmandzadeh
**Team:** MicroTiss **Head of the team:** Giovanni Cappello
**Scientist in charge of the project:** Giovanni Cappello **HDR: yes** X **no** ☐
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**Program of the Master's degree in Biology:**

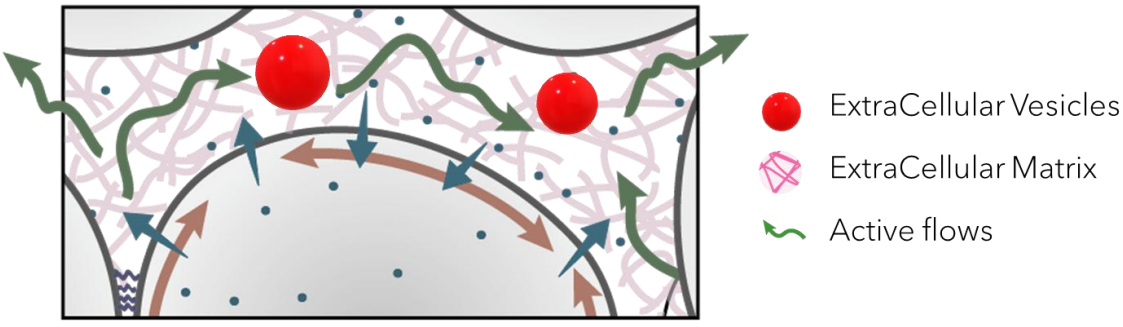
☐ Microbiology, Infectious Diseases and Immunology ☐ Biochemistry & Structure
X Physiology, Epigenetics, Differentiation, Cancer ☐ Neurosciences and Neurobiology

**Title of the project**: Active pumping of Extracellular Vesicles through Extracellular Matrix


Objectives: design an in vitro experimental model that replicates the interactions between cells, the ECM, and interstitial fluid. The objective is to demonstrate that cell contractility actively drives the transport of extracellular vesicles via pulsatile deformation of the surrounding matrix.

Abstract: In biological tissues, cell–cell communication often relies on the emission and reception of biochemical agents, which travel over considerable distances, especially when encapsulated within extracellular vesicles. Remarkably, these vesicles (typically around 100 nanometers) are able to traverse the fibrous extracellular matrix (ECM), even though its pore size is often much smaller (~ 10 nanometers), and the vesicles themselves are almost non-deformable. We hypothesize that cellular contractility facilitates the transport of extracellular vesicles through the ECM. This may occur either by generating traction forces that deform the matrix structure or by inducing interstitial fluid flows that aid in vesicle movement.

Methods: The student will begin by developing a microfluidic device to track vesicle motion through a reconstituted ECM under externally applied flow. Subsequently, contractile cells will be incorporated into the system to test the hypothesis that active cellular forces enhance vesicle mobility through a dense matrix environment.


Relevant publications of the team:


*Extracellular matrix in multicellular aggregates acts as a pressure sensor controlling cell proliferation and motility*, M. Dolega et al., Elife 10, e63258

*Cell-like pressure sensors reveal increase of mechanical stress towards the core of multicellular-spheroids under compression*. M. Dolega et al. Nature Communications 8 (2017) 14056


Requested domains of expertise: the ideal student will have a background in either physics or biology and a strong interest in working at the interface between these two fields.