

# Université Claude Bernard Lyon 1- Hosting offer for a MSCA Post-doctoral fellowship candidate in *Oxygen driven Morphogenesis*

<b>Host Organisation</b>	<b>Université Claude Bernard Lyon 1</b>
<b>Department</b>	<b>Physics</b>
<b>Laboratory</b>	<b>Institute of Light and Matter (iLM)</b>
<b>Website (lab / research team)</b>	<a href="http://ilm.univ-lyon1.fr/biophysique/">http://ilm.univ-lyon1.fr/biophysique/</a>
<b>Supervisor Contact name</b>	<b>Pr. Jean-Paul RIEU</b>
<b>Supervisor Contact email</b>	Jean-paul.rieu@univ-lyon1.fr

## Host Organisation

The **Université Claude Bernard Lyon 1 (UCBL)** welcomes Marie Skłodowska Curie Postdoctoral Fellowships applications !

With 62 laboratories and more than 7000 publications per year, and leading French university in terms of the number of patents filed in collaboration with industry, Lyon 1 contributes to scientific and innovation progress in numerous fields: health, mathematics, IT, physics, chemistry, earth and space sciences, life sciences, etc. Creator of emerging knowledge and new technologies, the University is consolidating its research excellence on a global and international level by developing inter- and multidisciplinary approaches targeting the major challenges facing today society. **The Biophysics Laboratory of iLM** belongs to the **Institute of Light and Matter (iLM)**, one of the leading French institutes in condensed matter, atomic, molecular and optical physics with a strong expertise in nanoscience, soft matter and Physics of Life. The institute with CNRS researchers and University of Lyon assistant and full professors hosts 17 experimental laboratories and theoretical laboratories for a total of about 300 members (180 permanents and 120 non permanents).

## Host research lab/team

The Biophysics Lab (<http://ilm.univ-lyon1.fr/biophysique/>) is one of **the leading research lab in Europe in Mechanobiology and cell motility**. It consists of 2 professors and 3 assistant professors of Lyon 1 University, 4 permanent CNRS researchers, all listed by alphabetic order in the footnote together with their main current research topic as a PI. The team was granted by CNRS (several interdisciplinary programs), by the UCBL (equipment), by the National Research Agency (ANR, until 2028) research programs, by the HFSP international program, by “La Ligue” cancer program, and program SHAPE-Med (France 2030), the last two programs been carried out in collaboration with the cancer research center of Lyon (CRCL).

The Biophysics Lab has its own cell culture and microfabrication facilities to prepare microfluidic devices. It is equipped with several automated inverted microscopes (epifluorescence, spinning disk, 1- and 2-photon confocal, lens-free and Brillouin microscope). The laboratory is working on cellular biology issues (adhesion, motility and tumor escape, cell and membrane mechanics) with biophysical approaches on models such as *Dictyostelium discoideum*, hydra, macrophages, multicellular spheroids of breast and prostate cancer cells. The laboratory is developing original methods such as 3D

traction force microscopy to measure the mechanical forces exerted by crawling cells or by confined cells on their surroundings, microfluidics based cell sorting and cell-substrate detachments assays, automated cell tracking, homemade compression methods and micro rheological and acoustic methods to measure the mechanical properties of tissues. It is also expert in the control of cell microenvironment in particular oxygen control.

### Hosting Offer

The **Biophysics lab** of iLM offers to host a MSCA Postdoctoral Fellowship candidate (typically a post-doc of less than 8 years research experience since PhD defence), submitting an application to the next MSCA-2026-PF call for proposals (deadline 09<sup>th</sup> of September 2026), interested to work on the following research topic:

Evolution of multicellular life is inevitably constrained by slow diffusion of factors, nutrient or oxygen over large distances. It has been known for the last three decades that **cells are able to detect and adapt to various concentrations of oxygen (O<sub>2</sub>)** as just highlighted by the Nobel Prize in Medicine 2019 [1]. In a situation of hypoxia (low O<sub>2</sub>), the HIF (Hypoxia-Inducible Factor) complex associates with DNA to **regulate the expression of certain adaptation genes**. It is also well known that bacteria, rather than regulating genes for adaptation, move toward O<sub>2</sub>, a mechanism called **aerotaxis** [2].

Our recent work is a new piece in the accumulating evidence that O<sub>2</sub> exchanges (diffusion, consumption) and self-generated O<sub>2</sub> gradients lead to generic organizing principles in living beings. We found that the social amoeba *Dictyostelium* (*Dicty*) presents a spectacular aerotactic emergent behavior: when a **dense spot of cells** is covered by a coverglass (not permeable to O<sub>2</sub>), all cells quickly consume available O<sub>2</sub> and escape outward of the central hypoxia area **forming a dense expanding ring** moving at constant speed, in either nutrient and non-nutrient media [3]. More recently, we found that dense, initially homogeneously plated cells self-organize in an array of finite size mobile clusters with a size and spacing controlled by the oxygen level  $C_S$  in the surrounding atmosphere [4]. The aerotactic repulsion exerted by the large clusters depleting locally O<sub>2</sub> on their surrounding is a sufficient hypothesis to model the steady state of this **micro-phase separation**. This *in vitro* experiment mimics the *in vivo* situation encountered in tissues and organs where O<sub>2</sub> must diffuse or be transported from sources to deep layers.

The two main objectives of the proposed fellowship are :

- Characterization of the 3D structure and migration mechanism of mobile clusters using 3D fluorescence microscopy (spinning disk and confocal) and development of O<sub>2</sub> probes for intracellular and extracellular O<sub>2</sub> measurements and associated microscopy (fluorescence lifetime or ratio) to measure O<sub>2</sub> level inside and around aggregates.
- Study of the collective and emergent properties and patterns of other cellular organisms (*Acanthamoeba castellanii*, *Naegleria fowleri*, dendritic cells...) by aerotaxis and self-generated gradients.

The results will be interpreted thanks to the already existing mathematical models (microscopic, or reaction-diffusion models) [3,4] and should be published in major interdisciplinary journals.

The fellowship could last for 12 to 36 months, depending on the type of Postdoctoral Fellowship.

**References:**

1. Semenza, G. L. Hypoxia-inducible factor 1 (HIF-1) pathway. *Sci STKE* **2007**, cm8 (2007).
2. Taylor, B. L., Zhulin, I. B. & Johnson, M. S. Aerotaxis and other energy-sensing behavior in bacteria. *Annu Rev Microbiol* **53**, 103–128 (1999).
3. Cochet-Escartin, O. *et al.* Hypoxia triggers collective aerotactic migration in *Dictyostelium discoideum*. *Elife* **10**, e64731 (2021). <https://doi.org/10.7554/eLife.64731>
4. Carrère A. *et al.* Microphase separation of living cells. *Nature communication* **14**, 796 (2023). <https://doi.org/10.1038/s41467-023-36395-2>

**Supervision**

The successful Marie-Curie Post-doctoral fellow will be supervised by J.-P. RIEU and C. Anjard. J.-P. RIEU is professor in Physics and Biophysics, co-director of the new international master of Life Sciences at Lyon 1 University. He is familiar with Potts model simulations. He belongs to the Lyon-Tohoku international laboratory ElytLab where he is developing microfluidic devices for the control of oxygen together with the team of K. Funamoto (IFS, Tohoku University). C. Anjard is a molecular biologist working with *Dictyostelium* since more than 25 years.

**Application process**

Interested candidates are invited to contact us exclusively by email at [jean-paul.rieu@univ-lyon1.fr](mailto:jean-paul.rieu@univ-lyon1.fr)

Make sure that you include the reference to this offer in the title of your email. Please attach a CV, a motivation letter, your MSc marks, **as well as a 1 page research proposal.**

**Professional grant application support:**

Candidates will receive the support of the supervisors, as well as online training from a professional grant application company, and advices from successful applicants, to prepare and submit their application with the Biophysics Lab of iLM as a host laboratory, to the next MSCA-PF call for proposals.