Post-doc in experimental Biophysics:

Cilia Beating Dynamics for in vitro Gene/Cell therapy of lung tissues

Applications are invited for an **18-months** postdoctoral position in experimental biophysics immediately available and starting no later than **July 2023**, in the SoftMatter team-Laboratoire Charles Coulomb, University of Montpellier. Using **microfluidics and high-speed imaging**, the candidate will investigate the **physics of cilia beating and mucus flow on a mini-lung chamber**, taking part to a larger **gene/cell therapy project**, in collaboration with physicians and biologists from the Montpellier Hospital.

Context: Dynamic patterns resulting from the coupling in cilia beating such as metachronal waves, is a multiscale, non-equilibrium physics problem, central to transport phenomena. In lung tissues, coordinated cilia beating generates mucus flow, and ensures the continuous cleaning of our lungs. The emergence of beating waves is strongly influenced by the spatial arrangement, orientation and density of the cilia [1,2]. In the recent years, physics and microfluidics have led to the development of new tissue models [3] and methods to quantify muco-ciliary clearance in cultures of human bronchial epithelia, measuring the mucus flow properties [4,5], cilia spatial distribution, orientation and synchrony and the generated mucus flow field [6]. In our group, we specifically developed a beating analysis based on individual cilia tracking by high-speed video, to investigate the beating coordination at different scales, including the cilia and cell level [7].

Primary ciliary dyskinesia (PCD) is a rare genetic disease that affects motile cilia and can result in severe chronic lung diseases due to impaired mucus clearance. Gene therapy applied to lung tissue was proven challenging because cell engraftment is hampered by the muco-ciliary function. Our main goal is to develop an innovative therapeutic strategy to engraft genetically corrected cells using a mini-lung chamber as a testing platform.

Scientific project: The postdoc candidate will develop a microfluidics-based chamber for lung organoid cultures [3] and will investigate the physics of cilia beating and mucus flow to assess the functionality of the repaired lung tissue based on relevant biophysical parameters, in order to evaluate:

- beating recovering after genetic repair at the cilia and cellular scale
- the conditions for the emergence of coordination and setting the minimal correction (repaired to initial cells ratio) required to restore muco-ciliary clearance.

References:
[1] P. Cicuta, Biochemical Society Transactions 48 (1), 221-229 (2020); Nature Physics 16 (9), 903-904 (2020)
[2] G. R Ramirez-San Juan, A. Mathijssen, M. He, L. Jan, W. Marshall, M. Prakash,Nature Physics (2020)
[3] M. Nikolaev et al., Nature 585, 574 (2020) ; Sone, N. et al. Sci Transl Med 13, eabb1298 (2021).
[4] M. Jory et al., Frontiers in Physics 7, 1 (2019); M. Jory et al., Interface Focus (2022)
[5] M. Schneiter et al., Theory Biosci. (2020) 139, 21-45
[6] Loiseau E. et al, PRL (2022), Nature Physics 16, 1158 (2020)
[7] M Jory, Thèse de Doctorat Université de Montpellier (2019).

About the environment: You will work with Gladys Massiera and in close collaboration with Christophe Blanc, both physicists and also with experts in the field of pluripotent stem cells for lung tissues and organoids, from the John De Vos and Arnaud Bourdin teams. At the Laboratoire Charles Coulomb (L2C), you will be part of an international team of SoftMatter physicists. You will certainly enjoy living in Montpellier, a student-friendly dynamic city in the South of France.

Eligibility: We are seeking for a motivated candidate with a suitable background in the field of Physics, Biophysics and/or Soft condensed matter physics. Candidates must hold a PhD degree in Physics, Biophysics or Chemical Engineering. Previous experience in microfluidics and image/data analysis and fluency in English will be valuable.

I am available for any questions on the project/conditions. **To apply**, send your Curriculum Vitae with a list of Publications, and contact information of two references, to Gladys.Massiera@umontpellier.fr before the 17th April 2023.