Ph.D. research topic

- **Title of the proposed topic:** Automatic cell type annotation for cell atlas construction
- **Research axis of the 3IA:** Theme 3 "AI for Computational Biology and Bio-Inspired AI"
- **Supervisor:** Pascal Barbry, PhD, IPMC, CNRS, barbry@ipmc.cnrs.fr
- **Potential co-supervisor:** Christophe Bécavin, PhD, IPMC UCA, becavin@ipmc.cnrs.fr
- **The laboratory and/or research group:** IPMC, “Physiological Genomics Group”

Apply by sending an email directly to the supervisor.
The application will include:
- Letter of recommendation of the supervisor indicated above
- Curriculum vitae.
- Motivation Letter.
- Academic transcripts of a master’s degree(s) or equivalent.
- At least, one letter of recommendation.
- Internship report, if possible.

**Description of the topic:** Chronic respiratory diseases (COPD, fibrosis, asthma, cystic fibrosis, ciliopathies) affect several hundred million people worldwide and the COVID pandemic has recently drawn world attention on the impact of infectious respiratory diseases. The tissue destruction that is associated with these diseases is often followed by a strong tissue remodeling of the airway tract, one of body's first line of defense. To better understand the importance of the different resident cell types in these processes and determine useful new targets for developing the therapeutical arsenal, we are developing single-cell analyses. Single-cell technologies are becoming essential in many research projects to analyze complex biological systems. The power of these approaches, which allow the determination of cell composition and delineation of complex transcriptional regulatory networks in cellular subsets, involves a large panel of numerical methods to integrate properly many different biological modalities (information about RNA expression, splicing, editing, proteins, epigenome, genome, spatiotemporal expression). Many questions are emerging when working such massive data to optimize properly the integration of several separate datasets and be able to make comparisons between different experimental situations. Deep learning methods show great promise to automate classification or dimensionality reduction. We plan to use them in order to build the cellular atlas of the respiratory tree, after identification of the most appropriate deep network structure able to identify the different cell types. The research project proposed to the PhD candidate aims to:

1. determine the most suitable model of deep neural network to automate cell classification;
(2) develop a visualization algorithm for dynamically annotate the cell types, linked to the deep learning model;
(3) use these approaches for creating a lung cellular atlas that integrates in vivo and in vitro datasets, and document the variations observed under specific phenotypic/genotypic situations.

The student will be associated with the laboratory of Pascal Barbry at IPMC (Sophia Antipolis, France). Our laboratory is the only French group associated to the seed network of the Human Cell Atlas (HCA) consortium, and Pascal Barbry is co-coordinator of the Human Lung biological network of the HCA.

**Background:** Recent work central to the proposed research:
A human airway atlas. (2020) AJRCCM. in press. Pre-publication available on Biorxiv;
SARS-CoV-2 entry factors are highly expressed in nasal epithelial cells together with innate immune genes (2020) Nature Medicine
SARS-CoV-2 Receptor ACE2 Is an Interferon-Stimulated Gene in Human Airway Epithelial Cells and Is Detected in Specific Cell Subsets across Tissues (2020) Cell.