

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratory Optics and Biosciences

CNRS identification code: UMR7645

Internship director's surname: Anatole CHESSEL

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Phone number:

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Internship location: Ecole polytechnique Palaiseau

Thesis possibility after internship: YES

Funding: YES

If YES, which type of funding: ERC

Quantitative study of the clonal development of the mouse cortex

How does a fully developed brain in all its complexity emerge from a limited number of neural stem cells is one of the main questions of developmental neurobiology. While much is known about brain development from a qualitative point of view through decades of work, a detailed and quantitative picture of this process, comprehensive in space and time, is still lacking. This is mainly because, until recently, it has not been possible to obtain relevant tissue-scale imaging data with cellular resolution. Through a long-term collaboration between the Laboratory for optics and biosciences (LOB) and the Institut de la vision (IDV), we have recently developed the means to obtain comprehensive clonal color labeling using the 'brainbow' technique and to map these labels over the entire mouse cerebral cortex with subcellular resolution with a new 3D microscopy methodology. In this approach, cortical stem cells are permanently labeled with random colors that are transmitted to their daughter cells as they divide, such that clonally-related neurons in the mature brain all express a color indicative of their developmental origin. By applying machine learning based image analysis approaches to these data, we are now obtaining millions of detected cells positions across different developmental stages. Within that collaboration, the intern will help with quantitative analysis and modeling of that data toward an understanding of the clonal development of the mouse cortex.

A first aspect of the project is to do further technical and biological evaluation of the detected cells and the information brought by color labels. This includes refining the color clusters used to define the clones, investigating their statistics w.r.t. the observed statistics of each color and comparing their spatial distribution with the known development of the cortex. For this, computational geometry and spatial statistics tools will be adapted and used based on previous work in the lab. Further avenues of research include looking at models of the development of the cortex as a point of comparison of our large dataset. Funding for a follow up PhD is possible.

The successful candidate would have a blend of expertise and interest in biology, data science and physics, with good programming skills in python. He/she would be integrated into and interact with an interdisciplinary collaboration between the two labs, with potential other collaborators in Marseille and Spain. The internship will take place at the Ecole polytechnique in the Paris-Saclay area, with regular visits to the IDV in Paris.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO Soft Matter and Biological Physics: YES

Quantum Physics: NO

Theoretical Physics: NO