

Host laboratory:

Developmental Epigenomics team at the Institut de Génomique Fonctionnelle de Lyon (IGFL), Ecole Normale Supérieure de Lyon (ENSL) <https://www.ghavihelmlab.com>

Internship supervisor:

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Research project title:

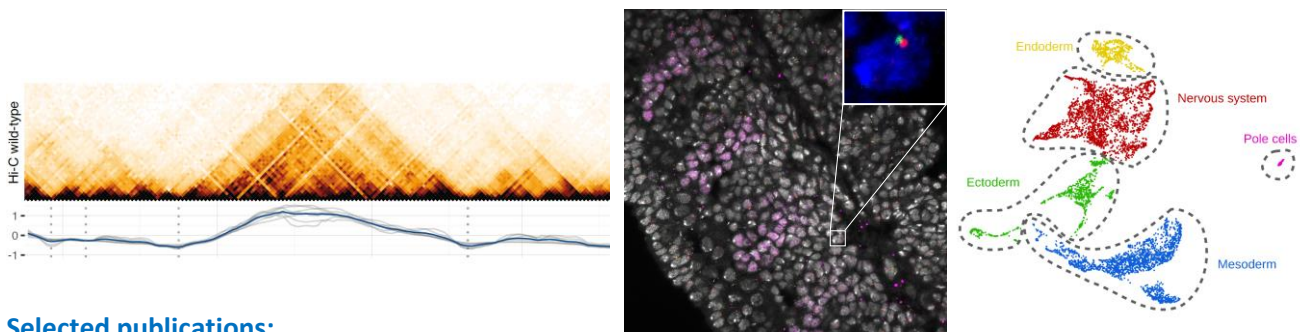
Functional dissection of enhancer-promoter interactions during *Drosophila* embryogenesis

Project description:

Our team investigates how gene expression is precisely regulated both in time and space during embryogenesis, allowing the development of a complex organism from a single pluripotent cell. The main drivers of this regulation are short regulatory elements called enhancers, which can dictate the spatial and temporal expression of a gene, even when located at large genomic distances from the promoter of that gene. Our goal is to understand how gene expression is regulated by enhancers, how this regulation is affected by the 3-dimensional organization of the genome in the nucleus, and how spatio-temporal expression patterns vary during embryonic development. For this purpose, we use *Drosophila melanogaster* as a model organism and combine a large array of genetics, genomics, imaging and computational approaches.

Different projects can be envisioned depending on the students' interests, including but not limited to:

- Characterize the effect of mutations in enhancers using quantitative immunostaining, Flow cytometry, and single-molecule FISH
- Explore the role of insulator elements in setting up long-range enhancer-promoter interactions
- Study the role of RNA modifications in chromatin organization using Hi-C
- Explore the spatio-temporal activity of enhancers using single-cell RNA-seq and spatial transcriptomics



Selected publications:

Borges Pinto P, Grasso A, Balasubramanian D, Vincent S, Tarayre H, Lajoignie D, Ghavi-Helm Y. Enhancer-promoter interactions form independently of genomic distance and are functional across TAD boundaries.

<https://www.biorxiv.org/content/10.1101/2022.08.29.505755v1>

Ghavi-Helm Y, Jankowski A, Meiers S, Viales RR, Korbel J, Furlong EEM. Highly rearranged chromosomes reveal uncoupling between genome topology and gene expression. *Nature Genetics*. 2019. doi:10.1038/s41588-019-0462-3.

Ghavi-Helm Y, Klein FA, Pakozdi T, Ciglar L, Noordermeer D, Huber W, Furlong EE. Enhancer loops appear stable during development and are associated with paused polymerase. *Nature*. 2014. doi: 10.1038/nature18962.

Moretti C, Stévant I, Ghavi-Helm Y. 3D genome organisation in *Drosophila*. *Brief Funct Genomics*. 2020 Mar 23;19(2):92-100. doi: 10.1093/bfgp/elz029. (Review)