3D organisation of the fruit fly genome

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Internship proposal for : Master 1 or Master 2

Laboratory
Biological Physics and Systems Biology
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Subjects
1.: physical and mathematical modeling
2.: chromatine
3.: conformation capture

Tools and methodologies
1.: polymer physics
2.: Monte Carlo simulations
3.: optimisation

Summary of lab's interests

Our team develops physical, mathematical and computer science approaches for the understanding of the functioning of biological systems. At the centre of our approaches is the multi-scale modelling of the biological processes by using statistical physics, dynamical systems and stochastic processes techniques. Our priority is to identify system's critical targets and essential mechanisms. This knowledge can be used to elaborate new therapies against complex diseases.

Summary of project

We want to reconstruct the 3D DNA conformation of the fruit fly D. melanogaster using capture of conformation data (4C) obtained in G.Cavalli lab (IGH, Montpellier). From a mathematical and physical point of view, this is a question of reconstructing the disposition of the DNA in the physical space from the probability of interaction between fragments (this probability, translating physical nearness, results from 4C data). First, we will model the relation between the probability of contact and the euclidean physical distance between fragments by using models of polymer conformation. Then, from the distances between pairs of segments, we will reconstruct the 3D structure of the chromatin. The resulting model will be used to identify which local interactions are catalyzed by regulating proteins, such as the proteins Polycomb.