

Field of the Master: Physics, Bioinformatics, Mathematics, Computer science, Computational biology
Level: M1/M2
Required skills: computer programming, statistics and/or statistical physics
Duration: 3 to 6 months
Period: any periods between January and July 2016

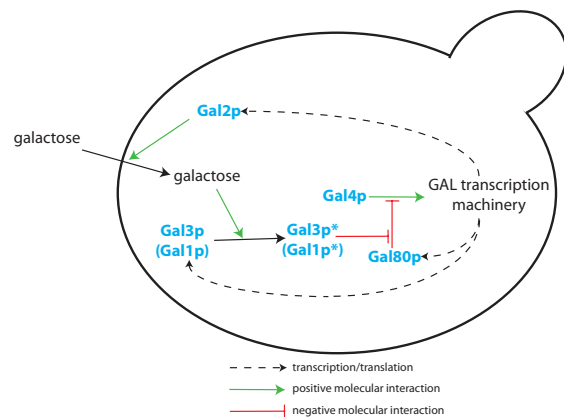
Title of the research project: Dynamic response of genetic regulatory networks in fluctuating environments

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Context: Genetics aims to map and to characterize the genetic ground (the genotype) of complex traits (the phenotype). With the important mass of data generated by high-throughput experimental techniques, a big challenge of quantitative biology is to use this knowledge to predict the responses and functions of biological systems to changing conditions and environments. In the wild, living systems have evolved under complex fluctuating environments that likely structured their genome to improve adaptation to these conditions. Therefore, understanding the relation genotype-phenotype assume understanding how this relation behaves in various environmental dynamics. In the past years, geneticists have started to address first theoretically and later experimentally this question of phenotypic adaptation to changing conditions. However, it is still not clear whether natural alleles found in wild strains confer different strategies of adaptation and how these alleles have been selected to optimize the response to some environmental constraints.

Objectives: In this internship, we propose to investigate the effect of genetic diversity on the behavior of a genetic network for various types of fluctuating environments. We will consider the galactose uptake pathway in budding yeast as a model system. Using a mathematical model already developed in the group and that describes the stochastic dynamics of this network, the student will run exact stochastic simulations of this system using advanced kinetic Monte-Carlo algorithms. For different fluctuating conditions and different parameters, he/she will classify the predicted behaviors between different types of response and will investigate the gene-environment interactions. This project will be done in close collaboration with the experimental group of Gael Yvert at ENS Lyon.



Expected results: We expect our results to open a new area in quantitative genetics that will impact on our understanding of natural phenotypic adaptation in dynamic environments and on how intra-species diversity might emerge from different environmental contexts.