

Post-doctoral position in biological physics

Modelling phase transitions in the nucleus

The DNA-PolyChrom project

(funded by the ANR - French national research agency, involving PHENIX and LPTMC-M3V labs at Sorbonne Université, and Thomas Gregor lab at Pasteur Institute)

Inside our cells, the nucleus is filled with a DNA-protein assembly called **Chromatin**. This giant supramolecular *spaghetti* is organized into separated domains. These domains may either be defined by measuring the level of genetic activity at their vicinity, or through the presence of biochemical markers called **epigenetic marks**. Epigenetics is indeed known to be central to the control of gene activity. A rich scientific field is constantly growing around the understanding of the relationships between epigenetics and the physical properties of chromatin, in order to explain the mechanisms of genetic regulation.

The DNA-PolyChrom project aims at designing new models to understand the key physical phenomena controlling chromatin structure and dynamics. We have already designed a new methodology to extract the best information from super-resolution microscopy images of chromatin, showing that experimental data are compatible with the behavior of a polymer close to a phase transition called **coil-globule transition**. We have also developed a scheme to describe the diffusion of specific sites along chromatin, in the framework of **polymer dynamic models**. Moreover, we now wish to explore multicomponent models, where **the polymer phase transition is coupled to a liquid-liquid phase separation of mobile proteins** in the nucleus.

The postdoctoral mission within DNA-PolyChrom

The post-doctoral researcher will perform simulations of simple models of chromatin (such as lattice models of chromatin and mobile proteins), using either Monte Carlo or Brownian Dynamics algorithms.

The aim of this modelling work is to explore the interplay between the polymer phase transition of chromatin, and the liquid-liquid phase separation within the nucleoplasm (the fluid inside the nucleus). Interactions between several epigenetic domains (polymers and the surrounding liquid phases) shall also be considered. Recent experimental data will be used to set up these models.

Candidate's profile – PhD in physics, biological physics, physical chemistry or theoretical chemistry. Strong interest for (1) biophysical problems, (2) computational approaches and numerical simulations.

Salary – 2300-2600 €/month (gross, depending on experience). Funded by ANR for 12 to 15 months. Additional funding may possibly extend the postdoctoral mission.

Location – Sorbonne Université is part of a vibrant academic community in Paris center. PHENIX is a laboratory of Sorbonne U. The group has developed multiscale theoretical modelling for the dynamics of complex systems, starting from the ab initio descriptions to analytical methods. The main collaborator on this project, the M3V team of LPTMC laboratory, is also on Sorbonne U campus.

Contact

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References related to the project

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