MASTER 2 RESEARCH INTERNSHIP

From intracellular mechanics to embryo morphogenesis : *physical and computational approaches*

Laboratory: *Center for Interdisciplinary Research in Biology (CIRB)*
CNRS UMR 7241 / INSERM U1050.
Collège de France - 11, place Marcelin Berthelot, 75005 Paris

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Team: *Multiscale Physics of Morphogenesis* www.virtual-embryo.com

PhD thesis after internship: YES

Expected profile: The candidate should be trained in **soft-condensed matter** or **complex systems physics**, and demonstrate **excellent programming skills** (**C++** and Python). She/he should have the true desire to work at the interface of biology, in an international and interdisciplinary environment.

Project:

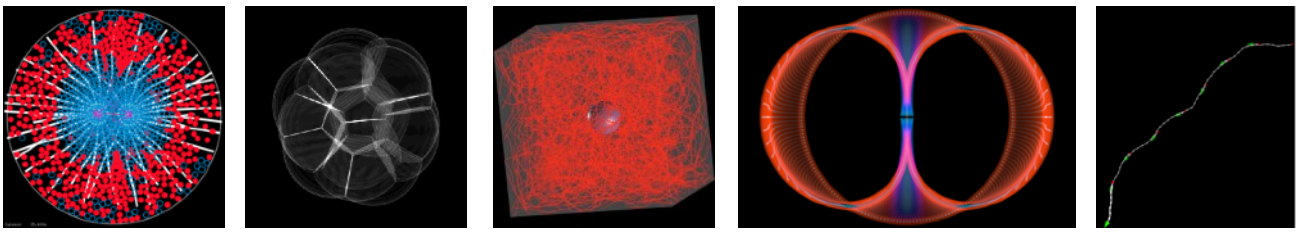
The lab aims generally at combining realistic numerical simulations and theoretical modeling to fill the gap between molecular descriptions of cytoskeletal elements in the cell and their mechanics at the mesoscopic scale. The internship will rely on the stochastic simulation engine Cytosim to simulate cytoskeletal filaments such as actin or microtubules in interaction with molecular motors, cross-linkers and other intracellular organelles.

Several subjects in the line with this thematic are available and will have to be discussed in person with the supervisor. The computational part of the project will always be combined with an analytic theoretical approach the problem.

Examples of projects include :

- physical modeling of the interaction between the yolk and the mitotic spindle during the first embryonic divisions of marine embryos : an intracellular jamming transition ?
- physical modeling of the coupling between cell shape and mitotic spindle dynamics during cell division : toward a multicellular model of division patterning.

In the framework of the ERC grant DeepEmbryo awarded to the laboratory, the student will furthermore have the opportunity to explore deep learning approaches to analyse statistically the results of her/his simulations.



Working environment:

The student will be integrated in a team of 6-8 scientists working on various physical, mechanical or mathematical aspects of early embryo morphogenesis. The lab has established tight collaborations with biologists around France and Europe, allowing us to have access to unique experimental material. A notebook will be provided to the student, that will also have access to powerful computing resources (650 CPUs + 12 GPUs). The student will benefit from the large and renovated lab space, located in the prestigious scientific environment of Collège de France, where she/he may have direct access to public lessons in soft-matter, biophysics, biology and applied mathematics.