Post-doctoral fellowship at the MSC laboratory  
Paris Diderot University (Paris, France)

Modelling the many-body interactions between protein inclusions in cell membranes

Gross salary ~ 2500 €/month. Duration ~ 12 months.

Summary of the research topic:

The MSC laboratory is a research unit at the very heart of Paris working on three main axes: non-linear physics, soft-matter and interface between physics, biology and medicine. The subject proposed here is part of a wider research effort, pursued in collaboration with three other laboratories from the Paris area, in the framework of a project financed by the ANR (French grant agency). In particular, the successful candidate will work in close collaboration with an experimental group in the Laboratory of Solid State Physics (LPS, Orsay).

Integral proteins, such as Gramicidin, experience membrane-mediated interactions due to the pinching action they exert on the membrane. In our theoretical group at MSC, we have developed a detailed, state-of-the-art, elastic model describing the energy cost of such membrane thickness deformations, and two numerical codes, in C and Haskell, to calculate the interaction energy between two inclusions coupled to the membrane thickness. Preliminary fitting of the experimental data obtained from X-rays scattering in protein doped lamellar phases [2] shows a very promising agreement with the model. A numerical study of the many-body interactions is now necessary, however, in order to fully validate our model. The candidate is expected to extend our codes in order to account for an arbitrary number of inclusions and perform Monte Carlo simulations of the fluid protein phase, in order to fit the data for various protein densities. The outcome of this study should be a clearer image of lipid membranes as two-dimensional complex fluids, as well as of the way they influence the inclusions, in particular biological molecules.

We are looking for a candidate with a good background in theoretical physics and a profound taste for numerical simulations, preferably in the areas of soft matter or continuum elasticity. He/she should hold a PhD in physics, materials science or a related topic. The numerical code solves an elliptic linear partial differential equation by means of a multipolar expansion, using standard mathematical libraries for special functions evaluation, quadratures or Fast Fourier Transforms, and the solution of systems of linear equations. Good programming skills in C and experience with Monte Carlo simulations are required. Knowledge of functional (Haskell) and literate (noweb) programming are a plus. Previous experience with biological systems or liquid state theory would be a significant asset. A good level of oral and written expression in English is mandatory. Knowledge of French is not required.

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References: