

6 months Master 2 internship in theoretical biological physics (starting from February 2022)

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| Title of the research topic | “Open the channels and take a breath”: modelling membrane proteins organisation and kinetics involved in bacterial respiration and charge transfer |
| Laboratory | Laboratory Charles Coulomb, UMR5221 CNRS/University of Montpellier, Pl. E. Bataillon, 34095 Montpellier, France |
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Scientific Project:

Energy conversion in most bacterial systems involves a transmembrane electrochemical gradient that is maintained by the activity of proton transport membrane proteins connected by lipidic electron shuttles, the quinones, constituting the oxidative phosphorylation process (i.e. OXPHOS). Our working hypothesis is that clustering of OXPHOS complexes into nanodomains facilitates the turnover of quinones and explains the efficient functioning of bacterial OXPHOS.

This project has as objective to model the organisation and the dynamics of OXPHOS complexes on the bacterial membrane and reveal the functional importance of such an OXPHOS organization in nitrate respiration. To this end, we will combine physico-mathematical modelling of electrons transfer among OXPHOS complexes via quinones at the bacterial membrane with data obtained by spatially and temporally resolute high end fluorescence microscopy approaches (coll. A. Magalon and D. Marguet, Marseille).

The Master internship could open to the possibility of a PhD thesis on this topic.

Techniques used:

Statistical Physics, stochastic processes, non-linear physics, partial differential equations (PDE), numerical methods for integration of PDE, Monte-Carlo and lattice-gas numerical simulations.

Publications related to the topic:

- F. Alberge, L. Espinosa, F. Seduk, L. Sylvi, R. Toci, A. Walburger, A. Magalon, Elife 2015, 4;
- S. Bulot, S. Audebert, L. Pieulle, F. Seduk, E. Baudalet, L. Espinosa, M.-C. Pizay, L. Camoin, A. Magalon, Mbio 2019.