PhD Studentship – Biochemistry/Biophysics
Structure and Dynamics in Bacterial Photosynthesis

Supervisor
Prof. James STURGIS
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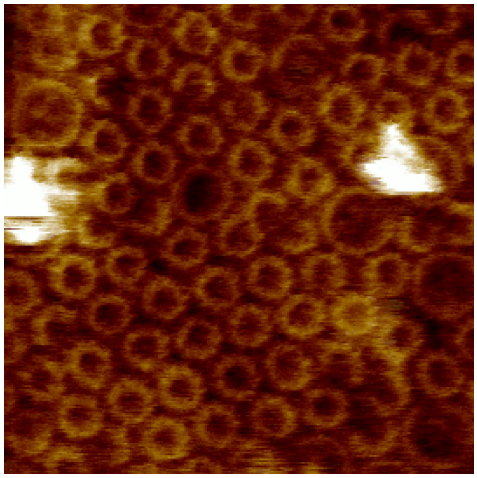
Director of the « Laboratoire d'Ingénierie des Systèmes Macromoléculaires » (UMR 7255)

The coordinated function of the molecular machines that constitute the cell and their integration into larger structures is an important area of investigation, both for fundamental science and for application in bio-inspired nano-technology. In this project the student will investigate the integration of the different molecular machines into a functional cellular structure, the limits of the biological design principles used, the mechanisms at play that ensure efficiency and the rules of assembly. The system chosen for this study is the photosynthetic system of purple bacteria, this relatively simple system is amenable to genetic manipulation, high resolution imaging and sophisticated spectroscopic techniques, making it ideal for the studies envisaged. The study will involve international collaborations with experts in time resolved spectral measurements and theoretical physics to attack these problems.


AFM image of photosynthetic membranes from Rsp. photometricum

Photosynthesis has evolved over the last 3 billion years to efficiently collect and use light energy to produce ATP. While we have a reasonable understanding of the different components involved in this process we know relatively little about their assembly. In particular, the rules that govern the assembly of the different proteins to form an active photosynthetic membrane are hardly described and the influence that the membrane architecture has on efficiency is also unexplored. The project will use the simple photosynthetic membranes of purple bacteria as a model system. The aim of this project is to address three inter-related questions. What inter-molecular forces drive assembly of the photosynthetic apparatus in bacteria? How does the bacteria control the structure and formation of the internal membrane system? What is the role of protein organization on photosynthetic performance? These questions are posed in the context of, and the project will center on, the purple bacterial photosynthetic system. However, the same questions can be posed in more general terms on how membrane proteins assemble to form larger functional assemblies in specialized membrane region. The answers will be sought using several techniques that we have developed in the laboratory over recent years, combining genetic engineering, protein biochemistry, and biophysics. Structural analysis we will use several advanced microscopy techniques to determine the structure and organization of the membranes formed (cryo-transmission electron microscopy, confocal fluorescence microscopy and atomic force microscopy). Functional analysis will use steady-state and time resolved fluorescence and absorption spectroscopy, either in our laboratory or through national and international collaborations for access to more specialized techniques. Finally the project will also involve a close collaboration with our partners expert in theoretical and computational biophysics in the University of Illinois at Urbana-Champaign, for producing structural models and insight by integrating the multiple different results.

The PhD studentship will be available from October 2014 for 3 years, funded by Aix-Marseille Université in the context of a multidisciplinary project involving the University of Illinois at Urbana-Champaign

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(USA), in the Dynamics and assembly membrane proteins group in the Laboratory of Macromolecular Systems Engineering LISM headed by James Sturgis (http://lism.cnrs-mrs.fr/JS_files/). The institute provides strong core facilities for microscopy, and mass spectrometry that will be used during the project.

Aix-Marseille Université is currently the largest university in France, offering a stimulating scientific environment on the shores of the Mediterranean. The laboratory is situated in the CNRS campus in town within easy reach of both the town center and the Calanques national park.

Bibliography

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Application

Candidates should send a CV, a letter explaining their interest in the project, togeather with the names and emails of 2 references to Prof. James Sturgis (james.sturgis@univ-amu.fr)

The callanques in Marseille a few minutes from the laboratory.

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