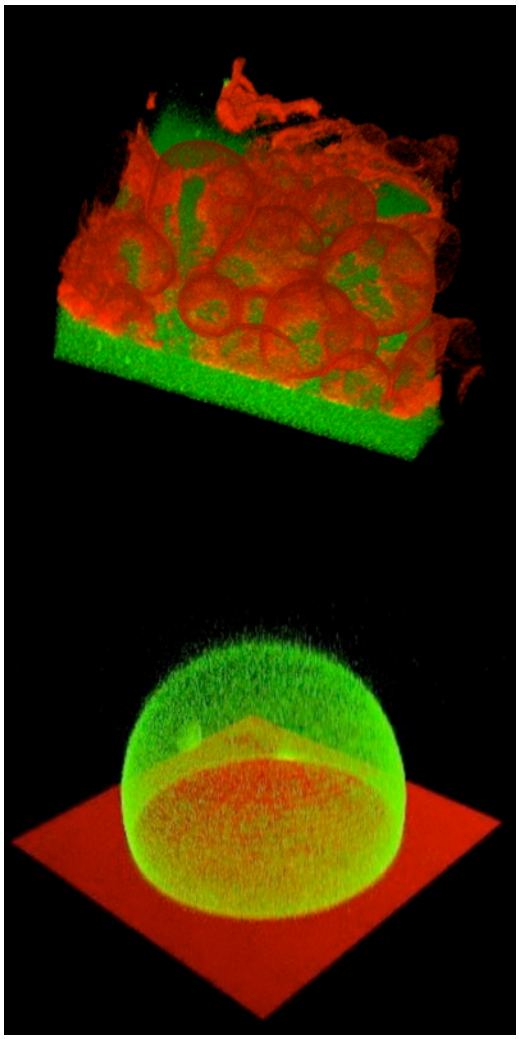
Bio-membranes under stress

PhD supervisors : Carlos Marques and André Schröder
INSTITUT CHARLES SADRON, 23 RUE DU LOESS, 67034 STRASBOURG CEDEX 02
TEL : 03 88 41 40 45 AND 03 88 41 40 57; E-MAIL : MARQUES@UNISTRA.FR AND ANDRE.SCHRODER@ICS-CNRS.UNISTRA.FR .



Fluid bilayers self-assemble from phospholipid solutions as molecularly thin membranes of roughly 5 nm, building in the living realm the walls of cells and cellular organelles. Phospholipid vesicles can also be assembled from aqueous solutions providing simple models to understand cell and cell membrane behavior: adhesion and fusion, mechanical resistance or transport properties. In this context Giant Unilamellar Vesicles or GUV's are of particular interest: with cell dimensions, of order of tens of micrometers, they can be studied by several optical microscopy and micromanipulation methods.

Figure 1: Confocal fluorescence images of lipid membranes exposed to hydration and adhesion forces. Observation and micromanipulation of biomimetic membranes provides a unique and powerful environment for controlling and understanding the effect of external stresses on lipid bilayers.

In the real conditions where lipid membranes assemble, move and function, they are exposed to numerous external stresses of a physical or a chemical nature: viscous forces, electric fields and oxidation reactions, only to name a few. Such stresses determine not only the shape transformations of these liquid-like capsules but also key physical properties of the membrane such as bending and stretching rigidity, permeability or stability.

We have recently shown that area increase of lipid bilayers can be promoted and finely tuned with stresses generated by electrical fields and by lipid oxidation [1,2]. The challenge of this project is to create novel cell-size architectures of bio-mimetic membrane systems by developing tools for stress-controlled area changes. The candidate will benefit from the experimental environment of the MCube group at the Charles Sadron Institute (http://www.ics-cnrs.unistra.fr/Mcube), in strong collaboration with Swiss and German partners of the IRTG Soft Matter Science (http://www.softmattergraduate.uni-freiburg.de). He or she will employ and develop up-to-date techniques including optical microscopy (epifluorescence, confocal, interferential reflection) as well as neutrons and x-ray scattering. Strong interactions with concomitant theoretical developments will also be encouraged.

[1] Lecuyer, S. *et al,* The European Physical Journal E, **2006**, *21*, 153-159
[2] Weber, G *et al. Soft Matter* DOI: 10.1039/c3sm52740a