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Planar lipid bilayers as model biological membranes for structural neutron studies

Monday 20 March 2023 14:00 (30 minutes)

Cells, the basic units of living organisms, are well delineated and separated from the external environment by membranes. Capable of both enclosing the cellular constituents and allowing exchanges with the outside world, these membranes are only a few nanometers thick. To study the dynamics and function of these amazing objects, physicists first seek to understand their structure. This involves experiments on model systems, simpler and better controlled than real membranes, and can profit from a probe that is able to access different scales of size and time: thermal neutrons. Since the pioneering work in the seventies on cell membrane structure by neutron scattering, developments driven by constantly improving neutron instrumentation, coupled with development of measurement and analysis methods, have involved both the optimization of samples towards more biologically relevant model systems and include the use of more complex lipid mixtures up to natural extracts. A natural lipid deuteriation facility has been set-up at the ILL (http://www.ill.eu/L-Lab) and recent results on lipid production and characterisationn will be presented.

Recent developments in the study of the structure of membranes will be presented including neutron and x-ray reflectometry study of the out-of-equilibrium fluctuations of phospholipid membranes induced by the active transmembrane protein bacteriorhodopsin (BR) [1] and the effect of phospholipase2 on lipid bilayers [Corucci et al., submitted].
Furthermore, the use of neutron scattering methods to study the interaction of the spike protein of SARS-CoV-2 virus will be presented [2], including results revealing the different roles of peptides present within the fusion domain and the role of intracellular calcium levels that could provide an indication to where and how the viral and host membranes fuse during SARS-CoV-2 infection [3].

References

[1] Insertion and activation of functional Bacteriorhodopsin in a floating bilayer by T. Mukhina et al., JCIS (2021)
[2] Lipid bilayer degradation induced by SARS-CoV-2 spike protein as revealed by neutron reflectometry, by A. Luchini et al. Scientific Reports (2021)
[3] Strikingly Different Roles of SARS-CoV-2 Fusion Peptides Uncovered by Neutron Scattering", by A. Santamaria et al., J. Am. Chem. Soc. (2022).

Author: Dr FRAGNETO, Giovanna (ILL)

Presenter: Dr FRAGNETO, Giovanna (ILL)

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