



Canadian Association
of Physicists

Association canadienne
des physiciens et physiciennes

Contribution ID: 2750

Type: **Invited Speaker / Conférencier(ère) invité(e)**

In-Vivo Solid-State NMR for the Study of Biological Membranes

Thursday 6 June 2019 11:15 (30 minutes)

Model membranes have been used for decades in solid-state NMR, and have been very useful to study lipid order and membrane proteins reconstituted in a bilayer environment. It is only since 2011 that solid-state NMR has been extended to the study of membrane molecules within intact cells, sometimes even living cells (1). After a brief historical introduction, we will focus on recent results obtained in our laboratory. We will start with various living bacteria fed with deuterated fatty acids, and show how it can help assess bacterial membrane rigidity with ^2H solid-state NMR. After optimizing the labelling procedure, we will show how it can be used to probe membrane health and interactions with antimicrobial peptides (2). We will then switch to more complex eukaryotic systems such as the micro-alga *Chlamydomonas reinhardtii* and show how 2D ^{13}C magic-angle spinning solid-state NMR can tackle the assignment and structure of biomolecules such as lipids, proteins, sugars from the cell wall, and starch, directly within the cell (3).

(1) X. L. Warnet, A. A. Arnold, I. Marcotte and D. E. Warschawski *Biophys. J.* 109:2461–2466 (2015)

(2) V. Booth, D. E. Warschawski, N. P. Santisteban, M. Laadhari and I. Marcotte *Biochim. Biophys. Acta* 1865:1500–1511 (2017)

(3) A. Poulhazan, A. A. Arnold, D. E. Warschawski and I. Marcotte *Int. J. Mol. Sci.* 19:3817 (2018)

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Session Classification: R1-2 Membrane Biophysics Joint Session Part I (DPMB/DCMMP/BSC) | Session conjointe sur la biophysique des membranes I (DPMB/DPMCM/SBC)

Track Classification: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)