Biophysics & Structural Biology at Synchrotrons BSBS 2019 Biological NMR Session

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Received: 20 March 2019 / Accepted: 15 April 2019 / Published online: 23 May 2019

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The workshop, Biophysics & Structural Biology at Synchrotrons, was held at the University of Cape Town in January 2019 (Fig. 1). Although the workshop was aimed primarily at introducing early career bioscience researchers from Africa to synchrotron-based facilities, the focus was on biomolecular structure determination using synchrotron and other biophysical techniques. As well as lectures and practicals on X-ray diffraction and cryo-EM, nuclear magnetic resonance (NMR) spectroscopy was included to cover structure and dynamics of biomolecules in solution and in membrane systems. Three lectures on NMR spectroscopy were given by Frances Separovic on Monday, 21 January, on the following topics: (i) Introduction to Biological NMR Spectroscopy, (ii) Dynamics and NMR Relaxation Times, and (iii) Biological Solid-State NMR.

Before the workshop, a biophysics forum was set up online at <https://biophysicsworkshop.co.za/> with reading lists for participants. Recommended background reading for the NMR session was an article by Dominique Marion, An Introduction to Biological NMR Spectroscopy (Marion 2013). Participants were also directed to view lectures by James Keeler and Ad Bax on NMR at <https://www.youtube.com/user/ANZMAG/playlists>. In addition, tutorial notes by the lecturer on NMR relaxation were also posted.

The first lecture puts together simple vector and quantum mechanical models to introduce the concepts of spin, chemical shift and peak assignments for peptides and proteins (Claridge 2016). Pulse sequences for determining molecular motions and interatomic distances through bonds and through space were discussed. As well as high-resolution solution studies, solid-state NMR techniques applicable to biomembranes were

presented (Drechsler and Separovic 2003; Dodd and Separovic 2004). Oriented and magic angle spinning techniques applied to membrane-active peptides and proteins were described, and recent developments in dynamic nuclear polarisation (DNP) and in-cell NMR were considered (Sani and Separovic 2018; Overall et al. 2019).

The session ended with a discussion of biological solid-state NMR applied to antimicrobial peptides (AMPs) that target membranes (Gehman and Separovic 2006; Gehman et al. 2011). These AMPs disrupt cell membranes and lead to inhibition and death of bacteria but details of their mechanism of activity are lacking (Sani and Separovic 2016). Solid-state NMR allows study of the structural details of AMPs as well as their membrane interactions in situ both in model membranes (Zhu et al. 2018; Sani and Separovic 2014) and in live bacteria (Sani and Separovic 2015). Current developments in NMR spectroscopy have led to in-cell DNP-NMR studies which present exciting possibilities for studying biomolecular structure and dynamics at atomic detail in live cells.

Fig. 1 Workshop participants seated in lecture theatre at New Engineering Building, University of Cape Town. As well as questions during the lectures, further discussion took place during the breaks and poster sessions

This article is part of a Special Issue on ‘Biophysics & Structural Biology at Synchrotrons’ edited by Trevor Sewell.

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Compliance with ethical standards

Conflict of interest Frances Separovic declares that she has no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by the author.

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