NR determination of the structural profile of asymmetric myelin membranes and their interaction mechanism with Myelin Basic Protein (MBP)

J.M. Pusterla[1], A. Koutsioubas[2] and A. Städler[1]

[1]Jülich Centre for Neutron Science (JCNS-1) and Institute for Biological Information Processing (IBI-8), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany.
j.pusterla@fz-juelich.de
[2]Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich GmbH, Lichtenbergstr. 1, 85748 Garching, Germany.

Myelin, an asymmetric multilamellar membrane enveloping axons, comprises alternating extracellular and cytoplasmic leaflets [1]. Structural alterations in the myelin sheath, particularly demyelination, are indicative of various inflammatory neurological disorders, such as Multiple Sclerosis (MS) [2]. Experimental autoimmune encephalomyelitis (EAE) serves as a recognized animal model for MS, characterized by significant changes in the overall myelin lipid composition [3]. Previous studies have reported an approximate asymmetric lipid composition in both native and EAE leaflets [4].

This study focuses on generating flat asymmetric myelin membranes, suitable for Neutron Reflectometry (NR) analysis. Employing the Langmuir-Blodgett and Langmuir-Schaeffer techniques, we successfully adsorbed asymmetric bilayers onto silica wafers.

Our findings reveal that the asymmetric myelin membranes demonstrate minimal differences in Scattering Length Density (SLD) when using non-deuterated lipids. However, deuterated lipids, such as d45-cholesterol, significantly enhance the detection of asymmetry. The addition of Myelin Basic Protein (MBP) shows preferential adhesion to the cytoplasmic leaflet, with higher concentrations on asymmetric membranes. Notably, MBP adheres less to EAE-modified membranes compared to native ones. The thickness of the MBP layer is reduced upon binding to EAE myelin, suggesting deeper protein penetration and membrane swelling.

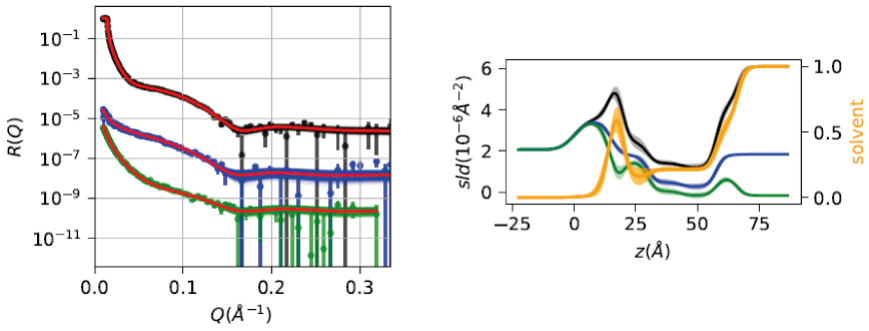

Figure 1: (left) Reflectivity curves for an asymmetric bilayer with d45-Cho in one of the leaflets. It was measured at three different contrasts: D2O buffer (black), SiMW (blue) and H2O (green). (Right) Electron density profiles for the supported membranes at three contrasts and solvent fraction curve (yellow).

References

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