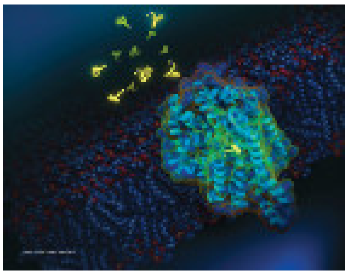

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Towards understanding membrane transport properties using quasi-elastic neutron scattering techniques

The highly dynamic nature of lipid membranes is crucial to accommodate the numerous types of biological molecules embedded within the cell membrane and help facilitate their functions. It is therefore essential to understand how lipid membrane dynamics are affected by different types of inclusions from a molecular level. One of the most important dynamic is the bending elastic modulus that controls both the nanoscale membrane fluctuations as well as the cell shape and deformability. Among other microscopic, spectroscopic, and scattering techniques, neutron spin echo (NSE) spectroscopy accesses collective membrane undulation fluctuations on the nanosecond time scales and can be used to quantify the bending modulus by comparing the measured relaxation time with theoretical derivations for the height-height fluctuations. More recently, collective thickness fluctuations with 100s nanosecond time scales have also been measured with NSE and an asymmetric bilayer model predicts that the membrane thickness fluctuations are driven by membrane compressibility and dissipated through the solvent and membrane viscosities. Accordingly, a measurement of the bilayer thickness fluctuations by NSE allows us to estimate the membrane viscosity. On one hand, we apply this technique to quantify the effects of different inclusions on the membrane elastic and viscous properties. On the other hand, this research opens new possibilities to directly compare experimental membrane viscosity with molecular diffusion behavior measured by neutron backscattering spectroscopy (BS) or other spectroscopic techniques. In this presentation, I will discuss the methodology we apply to analyze NSE data from model membrane systems as well as present a direct comparison between the membrane viscosity extracted from measurements of the thickness fluctuations and the lipid diffusion measured with BS technique.

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