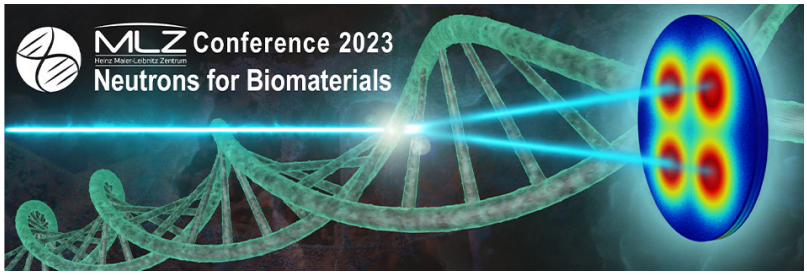

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Pressure effect on protein cluster formation induced by multivalent ions

Thursday 25 May 2023 11:40 (20 minutes)

A thorough understanding of protein interactions in aqueous solutions is crucial for many areas of research in soft matter and biology. For example, a strong interprotein attraction can lead to protein aggregation, which is observed in several pathologies such as cataract and neurodegenerative diseases.
We have shown that a patchy particle model can describe the phase behavior of a system of acidic globular proteins such as bovine serum albumin (BSA) in the presence of multivalent salts such as yttrium chloride (YCl_3). The resulting phase diagram of the studied system as a function of salt concentration and temperature is quite complex, showing reentrant condensation, metastable liquid-liquid phase separation (LLPS), cluster formation and crystallization. In particular, a lower critical solution temperature (LCST) is observed which suggests that hydration plays an essential role in the ion-mediated protein interactions.
This hydration effect is also visible by changing the solvent from normal water (H_2O) to heavy water (D_2O). It leads to an increasing attraction potential between the proteins and instead of LLPS the formation of clusters is observed. By neutron spectroscopy a slowing down of the short-time self-diffusion of the protein as a function of the number of yttrium ions per protein is observed. The effect is enhanced by increasing the temperature of the sample.
Using temperature as a control parameter has some disadvantages because temperature influences both the thermal energy and the density of the system. Furthermore, only a small temperature range is available for studying proteins since high temperatures lead to denaturation. As opposed to temperature, pressure influences only the density and can be considered to have milder effects.
Here we will present the first results from pressure dependent neutron spectroscopy experiments. In contrast to the previous studies [1-3] at and above room temperature we found, that the slowing down of the short-time self-diffusion is less pronounced. This behavior of the short-time self-diffusion will be discussed with the help of pressure dependant SAXS measurements.
[1] M. Grimaldo, et al., J. Phys. Chem. Lett. 6 (2015), 2577-2582.
[2] C. Beck, et al., Soft Matter 17 (2021), 8506-8516.
[3] M. Grimaldo, et al., Quart.Rev.Biophys 52 (2019), e7.

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