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Diffusive Dynamics in Protein solutions studied by Neutron Spin Echo

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1. Introduction

Neutron Spin Echo [1] being a high-resolution quasielastic neutron scattering technique gives access to dynamics on the timescale of pico- to nanoseconds providing spatial resolution down to few Å. This technique is capable of measuring diffusion of proteins in solution with spatial resolution being in accordance to inter-protein distances. The dynamical picture detected by Neutron Spin Echo is composed of the centre-of-mass dynamics in the low Q-range and, at higher Q-values, of internal and of solvent dynamics.

2. Neutron Spin Echo measurements

We have studied these protein dynamics and the solution structure performing Neutron Spin Echo on different proteins [2]. In the special case of globular proteins, the inter-particle interactions are (almost) isotropic, and knowing the protein form factor, the structure factor of the solution system can be easily obtained. The dynamics results can be compared with the fundamental Einstein-Stokes predictions. At intermediate Q-values, water dynamics lead to an initial decay of the intermediate scattering function measured in Neutron Spin Echo. While this is treated often as background, studies at small spin echo times give access to these dynamics. Measurements at higher spin echo times give access to centre-of-mass dynamics. The amplitude and time scale of these dynamics are influenced by the inter-particle interactions and the solvent.

3. Conclusion

We have explored the dynamical picture of proteins in solution being accessible by Neutron Spin Echo. Solvent and protein dynamics can be separated by time-scale and Q-range. Theoretical concepts for the description of interacting proteins in solution are the topic of ongoing work, and multiplication of experimental data is important.

References

[1] F. Mezei, Z. Phys. **255** (1972) 146.
[2] W. Häußler, Eur. Biophys. J. **37** (2008) 563.

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