Contribution ID: **20** Type: **Oral**

Accessing Diffusive Properties of Dilute Protein Solutions with Neutron Backscattering

Wednesday, 4 June 2025 11:15 (15 minutes)

Background:
Understanding the diffusive properties of colloidal suspensions is essential for exploring fundamental transport mechanisms, optimizing industrial formulations, developing advanced materials, and enhancing biomedical and pharmaceutical applications. Short-time diffusion is predominantly influenced by hydrodynamic interactions. Quasielastic neutron scattering (QENS) offers a non-invasive approach to studying these diffusive processes, free from the effects of multiple scattering or turbidity.

Methods:
Neutron Backscattering (NBS), due to its energy resolution and accessible q-range, enables the examination of short-time self-diffusion in colloidal suspensions. In particular, Fixed Window Scans (FWS) provide insight into the scattering function at specific energy transfers, achieving significantly higher count rates than full QENS spectra. This advantage allows for reduced acquisition times and facilitates the investigation of suspensions with weak scattering signals.

Results:
Using FWS, we analyzed dilution series of two model protein systems with concentrations reaching below 1 mg/ml. For highly concentrated protein solutions, our previously established analysis framework demonstrated quantitative agreement with center-of-mass diffusion obtained from full QENS spectra [1]. The reduced acquisition time also enables the study of kinetic processes [2]. For dilute suspensions, hierarchical diffusive processes contribute to the extracted γ(q), necessitating a refined analytical approach. We present a method for disentangling these contributions and compare the results with collective long-time diffusion coefficients derived from dynamic light scattering.

Conclusion:
NBS-FWS provides access to short-time self-diffusive properties in dilute suspensions, which were previously inaccessible using classical NBS techniques. Advanced analytical methods enable the separation of distinct diffusion contributions, offering a more comprehensive understanding of colloidal dynamics.

References:
[1] https://doi.org/10.1107/S1600576724003820
[2] Under Review in Journal of Applied Crystallography

Primary author: BECK, Christian

Co-authors: GRUNDEL, Anna; ROOSEN-RUNGE, Felix (Division of Physical Chemistry, Lund University); MOSCA, Ilaria (Institut Laue-Langevin); MATEO MINARRO, Laura (ILL-UGA); SEYDEL, Tilo (Institut Max von Laue - Paul Langevin); SCHREIBER, Frank (Universität Tübingen)

Presenter: BECK, Christian

Session Classification: Contributed talks