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Resolving Hydrodynamic Interactions in Crowded Proteins Solutions with Coherent X-Ray Scattering at XFELs

Tuesday 27 August 2024 16:30 (20 minutes)

Exploring how proteins move within cells is essential for understanding various biological processes, such as reaction rates and transport of molecules within the cytoplasm. Here I will present results from our recent study, which addresses the influence of hydrodynamic interactions on the diffusion of proteins on the molecular scale. By employing advanced protein megahertz X-ray Photon Correlation Spectroscopy (MHz-XPCS) at the European X-ray Free-Electron Laser (XFEL) [1], we observed protein movement in concentrated ferritin solutions at molecular scales and microsecond timescales [2].

Our findings reveal the phenomenon of De Gennes narrowing, which points to cooperative behavior among proteins, highlighted by a peak in the hydrodynamic function, H(q). Theoretical models based on colloid theory match our experimental data when both short- and long-time diffusion coefficients are considered. The intensity autocorrelation function, g2(q,t), shows a non-exponential decay pattern due to these diffusion coefficients, suggesting the presence of cage effects.

These results provide significant insights into how proteins interact and move in crowded environments. Such knowledge can contribute to enhancing the design and effectiveness of drug delivery systems by better understanding the dynamics of molecular diffusion in dense solutions.

[1] Reiser et al. Nat. Commun. 13, 5528 (2022)
[2] Girelli et al. under review (2024)

I plan to submit also conference proceedings

No

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