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Dynamics during an arrested phase transition in a protein system

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Phase separation in biological systems is a path for the formation of cellular organelles[1]. To understand the dynamic properties of these compounds we studied a protein solution model system during the phase separation with neutron spin-echo and back scattering spectroscopy as well as with small angle scattering. The phase separation for the investigated sample occurs for temperatures below T_p= 21°C and is due to the short-range depletion interaction induced by a polymer (polyethylene glycol). The evolution of the phase separation after a quench to temperatures below T_p was monitored though the scattered intensity measured with small angle scattering[2]. For quenches to temperature to 6°C and below the phase separation arrests. This phenomenon was previously linked to the dynamical arrest at molecular length scale due to gelation[3]. The collective diffusion agrees with anomalous diffusion and relaxation times which are two orders of magnitude smaller in the arrested state. Using back scattering we can monitor the polymers and proteins self-diffusion, showing Brownian motion on the diffusive short-time scale even in the arrested state, and a significant transition of the protein diffusion when crossing the phase separation temperature.
[1] Berry, J., Brangwynne, P. C. & Haataja, M. , Reports on Progress in Physics 81, 046601 (2018).
[2] Da Vela, S. et al., Soft Matter 13, 8756-8765 (2017).
[3] Zaccarelli, E., J. Phys.: Cond. Matter 19, 323101 (2007).

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