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Experiments on macromolecular crowding

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Our goal is to uncover mechanisms for macromolecular transport in the crowded environment of living cells. We use a nanoscale (experimental) model polymer-colloid system to examine the interplay between excluded volume and charge in macromolecular crowding. In this system, we measure polymer structure by small-angle neutron scattering (SANS) and polymer and crowder dynamics by pulsed-field-gradient NMR (PFG-NMR) and rheology [1]. We focus on the case where polymer and crowder size are comparable. The polymer is non-ionic, and crowder charge can be controlled.

For uncharged crowder, polymer size in the polymer-dilute limit is unaffected by crowder (colloid) volume fraction Φ_F when the crowder is uncharged, but the polymer expands at high Φ_F when the crowder is charged. In addition, we find at all Φ_F that the micro-viscosity of the crowder is somewhat larger/smaller than the bulk viscosity (for charged/uncharged colloid), but that of the flexible polymer is *much* smaller than the bulk viscosity, and also dependent on crowder charge. We thus observe shape-dependent transport in a simple model system for macromolecular crowding.

[1] Swomitra Palit, Lilin He, William A. Hamilton, Arun Yethiraj, Anand Yethiraj, Phys. Rev. Lett. (2017).

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