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Non-continuum correlated intermolecular dynamical displacements in entangled biopolymer solutions. KENNETH S. SCHWEIZER, ZACHARY E. DELL, BOYCE TSANG, LINGXIANG JIANG, University of Illinois at Urbana-Champaign, STEVE GRANICK, IBS Center for Soft and Living Matter
— Understanding correlated intermolecular motion is important in biology and of fundamental interest in polymer physics. We performed real space measurements of the correlated dynamical displacements of a pair of biopolymers in entangled F-actin solutions over mesoscopic and continuum length scales, and on time scales beyond the entanglement crossover but much shorter than the reptation time. A microscopic theory is constructed based on generalizing a recent force-level statistical mechanical approach for predicting the separation-dependent, non-hydrodynamic relative friction of a pair of colloids in polymer melts [1] and in dense suspensions [2]. In the mesoscopic time regime, individual biopolymers move by reptation, and the dynamically-emergent intermolecular correlation hole is proposed as the mechanism for inducing non-hydrodynamic collective Fickian motion. Non-continuum cross correlations are predicted to dominate for inter-polymer separations up to the rod length ($\sim$15 microns), beyond which a crossover to hydrodynamic behavior occurs. The theoretical results agree well with our measurements at different observation times and physical mesh values. [1] Yamamoto, Schweizer, J.Chem.Phys.139,064907(2013); [2] Dell, Tsang, Jian, Granick, Schweizer, Phys.Rev.E, in press, 2015

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