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Order and Disorder in Short Block Polymers[1]

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Block polymers have captivated the interest of scientists and engineers for more than half a century. The phase behavior of this class of self-assembling soft material is well understood in the limit of infinite molecular weight, based on the self-consistent mean-field theory pioneered by Leibler. At practical molecular sizes, typically around N $\approx$ 1000 repeat units, fluctuation effects become highly significant in the vicinity of the order disorder transition. One-loop corrections to mean-field theory, first described by Brazovski and applied to block polymers by Fredrickson and Helfand, are not expected to be applicable in this limit. Moreover, the drive towards ever smaller domain dimensions, and the opportunity to circumvent transport limitations associated with entanglements, have motivated experiments with yet lower molecular weight block polymers, N less than 100. This presentation will describe the consequences of fluctuations and the equilibrium structural properties of short model AB diblock polymers in the symmetric (f = 1/2) and asymmetric (f $\rightarrow$ 0) regimes above and below the order-disorder transition. The consequences of fluctuations and access to equilibrium states will be described in the 1-dimensional stripped (lamellar) phase and the ordering of point particles in 3-dimensions, respectively. As N $\rightarrow$ 1 computer simulation with realistic molecular detail becomes feasible presenting exciting opportunities to compliment the associated theoretical challenges.

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