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Isotropic-Nematic Behaviour of Semiflexible Polymers in the Bulk and under Confinement

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Semiflexible polymers in solution under good solvent conditions can undergo an isotropic-nematic transition. This transition is somewhat reminiscent of the well-known entropically driven transition of hard rods described by Onsager's theory, but the flexibility of the macromolecules causes specific differences in behaviour, such as anomalous long wavelength fluctuations in the ordered phase, which can be understood by the concept of the deflection length. A brief review of the recent progress in the understanding of these problems is given, summarizing results obtained by large scale Molecular Dynamics simulations and Density Functional Theory. These results include also the interaction of semiflexible polymers with hard walls, and the wall-induced nematic order, which can give rise to capillary nematization in thin film geometry. Various earlier theoretical approaches to these problems are briefly mentioned, and an outlook on the status of experiments is given. It is argued that in many cases of interest it is not possible to describe the scaled densities at the isotropic-nematic transition as functions of the ratio of the contour length and the persistence length alone, but the dependence on the ratio of chain diameter and persistence length also needs to be considered.