An overview of the static and dynamic theories of nematic liquid crystals: the Landau-de Gennes theory, Beris-Edwards theory and some applications

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Nematic liquid crystals are classical examples of partially ordered materials, that combine fluidity with the ordering characteristics of solids. Nematics have long been the working material of choice for several electro-optic devices, with contemporary applications spanning across biology, functional materials and artificial intelligence. In this talk, we review the celebrated Landau-de Gennes theory for nematic liquid crystals and how it can be used to describe equilibrium properties of nematic configurations in prototype geometries. We supplement this discussion with an overview of the Beris-Edwards theory for nematodynamics, whose formulation includes evolution equations for the nematic order parameter, the fluid velocity and the anisotropic nonlinear stresses that couple nematic order and fluid velocity. We conclude the talk with case studies that illustrate the predictive power of the static and dynamic theories for nematic liquid crystals for real-life scenarios.