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The static and dynamic behaviors of the topological defects in a nematic liquid crystal reveal its material characteristics RUI ZHANG, TAKUYA YANAGIMACHI, NITIN KUMAR, MARGARET GARDEL, PAUL NEALEY, JUAN DE PABLO, University of Chicago — Topological defects in nematic liquid crystals (LCs) play a key role in phase transitions, domain growth, and morphology evolution. Their ability to absorb impurities offers promise for design of self-assembled, hierarchical materials. Past work has primarily studied defects in thermotropic LCs. In this work, we focus on lyotropic chromonic LCs and biopolymer LCs, and investigate how the static and dynamic properties of topological defects depend on the LC's material characteristics. Specifically, we rely on a Landau-de Gennes free energy model that accounts for variable material constants and back-flow effects, and adopt a hybrid lattice Boltzmann simulation method. We first show that the fine structure of half-charge defects is a function of the ratio of splay and bend constants. This morphological information is in turn used to infer the elasticity of an in vitro, actin-based LC suspension. We then examine the annihilation process of a defect pair of opposite topological charge. We find that the ratio of the two defect velocities is an outcome of the interplay between the LC's elastic moduli, its viscosities, and the organization of the defects. Our calculations predict a strong post-annihilation transverse flow that is further confirmed by our experiments with non-equilibrium LCs. An analysis of the asymptotic behavior of the elastic moduli allows us to elucidate the material at phase transitions. Our modelling provides a general, unified framework within which a wide class of LC materials can be understood.

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