MATERIALS SCIENCE GRADUATE PROGRAM

SEMINAR ON LIQUID CRYSTALS

FALL 2022

KENT STATE UNIVERSITY

WEDNESDAY, AUGUST 31ST 3:20PM

AMLCI RM 00101

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Spatial Structure of Topological Defect Lines in 3D Nematic Liquid Crystals

Abstract: Topological defect lines in nematic liquid crystal systems often exhibit intricate spatial structures with nontrivial morphology. Using the the Landau-de Gennes framework, we theoretically and numerically study the structure and energetics of topological defect configurations that arise in various nematic liquid crystal systems. We investigate the role of different experimentally tunable parameters such as system size and boundary condition in dictating the minimum-energy form of the topological defects. In particular, motivated by experiment, we study the equilibrium structure of the defect patterns in the presence of matching and non-matching surface disclinations at the two opposite boundaries of the system. Interestingly, we find that the morphology of the three-dimensional disclination lines that connect different surface defects crucially depends on the thickness of the system and other system parameters. These structures and transitions arise from the geometric conflict, enforced by boundary conditions, between short defect paths and small elastic distortion around them. We put forward a simple theoretical argument which explains the structure of the observed line defects and paves the path for creating line defects having a desired shape in nematic liquid crystal systems. Our theoretical findings corroborate the experimental observations.

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