Soft Living Active and Adaptive Matter

Tunable three-dimensional architecture of nematic disclination lines

Biswarup Ash
Weizmann Institute

Abstract:

Topological defects are universal patterns of nature. Nematic liquid crystals- fluid-like materials with long-range orientational molecular order- are ideal test beds for studying topological defects, particularly one-dimensional, linear disclinations. Disclination lines in nematic liquid crystal systems often exhibit intricate spatial structures with nontrivial morphology. Achieving versatile control over disclinations is critical to developing novel electro-optical devices, programmable origami, directed colloidal assembly, and controlling active matter. In this talk, I will discuss a theoretical framework enabling us to tailor three-dimensional disclination architecture in nematic liquid crystals. We produce quantitative predictions for the connectivity and shape of disclination lines found in nematic liquid crystals confined between two thinly spaced glass substrates with strong patterned planar anchoring. By drawing an analogy between nematic liquid crystals and magnetostatics, we find that i) disclination lines connect defects with the same topological charge on opposite surfaces and ii) disclination lines are attracted to regions of the highest twist. We identify critical parameters that tune the disclination lines' curvature. Our theoretical findings corroborate the numerical and experimental observations. Our work provides a powerful method to understand and practically control defect lines in nematic liquid crystals.

Date:
08/07/2023

Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Biswarup Ash completed his Ph.D. in theoretical condensed matter physics from the Indian Institute of Science Education and Research (IISER)-Kolkata, India, under the guidance of Prof. Amit Ghosal. In his Ph.D. thesis, he investigated the role of interaction and disorder in comprehending the static and dynamic responses of 'Wigner molecules' - two-dimensional systems of Coulomb interacting particles in traps - across thermal crossover from amorphous solid-to-liquid-like behaviors. His primary objective was to gain insights into how some characteristic features of glassy systems emerge in confined systems with lower spatial symmetries and long-range interactions.

Following the completion of his Ph.D., Dr. Ash joined the condensed matter physics department of the Weizmann Institute of Science (WIS), Israel, as a postdoctoral research fellow. There, he delved into the study of thermal transport in low-dimensional disordered systems with Prof. Yoseph Imry and Prof. Yuval Oreg. Later on, he transitioned to the Department of Physics of Complex Systems at WIS to collaborate with Prof. Hillel Aharoni. Currently, his research revolves around understanding the properties of topological defects in liquid crystal systems.

For more information, contact: Daniel Beller, Niranjan Sarpangala
d.a.beller@jhu.edu, nsarpangala@ucmerced.edu
Sign up at physics.ucmerced.edu/slaam/ to be included in the mailing list to receive a Zoom link.