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Nematic disclination loops in the presence of sharp-edged colloids and boundaries

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For cylindrical and cubical homeotropic colloidal particles in nematic liquid crystals, companion defect configurations and effective interactions are strikingly different than in the well-studied case of spherical colloidal particles. I will present results of Landau-de Gennes (LdG) numerical modeling, which show that disclinations pin at portions of the colloidal particles' sharp edges. This leads to kinked disclination lines with interesting multistable configurations, and to shape-tunable oblique particle alignment relative to the far-field nematic director, as confirmed in accompanying experiment. These findings raise the possibility of selecting self-assembled colloidal structures via nematic elasticity by tuning particle shape. I will also present LdG numerical modeling of disclination rings around microposts in nematics. Here, the nematic director's winding sense at the sharp boundaries, where the micropost meets the substrate or air, plays a crucial role in the determining the existence and form of the disclination in the bulk, which in turn guides the assembly of far-away colloids at the nematic-air interface. Finally, if time permits, I will discuss a tensorial approach to studying director fields of cholesteric liquid crystals, and connections between this picture and the Landau-de Gennes free energy.

This is joint work with Mohamed Gharbi (McGill University), Iris Liu (University of Pennsylvania), Marcello Cavallaro, Jr. (W. L. Gore & Associates), Simon Copar (University of Ljubljana), Zheng Shi (Harvard University), Tobias Baumgart (University of Pennsylvania), Shu Yang (University of Pennsylvania), Randall Kamien (University of Pennsylvania), Kathleen Stebe (University of Pennsylvania), Thomas Machon (University of Warwick), Daniel Sussman (University of Pennsylvania), Gareth Alexander (University of Warwick), and Ricardo Mosna (Universidade Estadual de Campinas).

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