PHYSICAL MATHEMATICS SEMINAR

Topological Soft Matter from Nematic Liquid Crystal Colloids

MIHA RAVNIK

Faculty of Mathematics and Physics, University of Ljubljana, Ljubljana, Slovenia
Centre of Excellence NAMASTE, Ljubljana, Slovenia

ABSTRACT:

Liquid crystal colloids show a variety of interesting mechanisms –including self-assembly, activity, memory, and material flow- that can be used to create complex optical and photonic structures. Here, I will present our recent modeling work, in full collaboration with partner experiments, on the control of nematic colloids as a topological soft matter. Starting with single particle solutions, I will show three-dimensional colloidal crystals that can be assembled using the analogy between elastic and electric dipoles. Next, I will generalize the assembly to entangled nematic colloids, where delocalized disclinations bind and form multi-particle states, with the prime examples being microscopic knots and links of disclinations. Made-to-order assembly of microscopic knots and their basic statistics on regular particle arrays will be demonstrated, commenting also on the self-linking number as an important topological invariant. Further, I will show structures of nematic produced by microscopic particle-knots, where complex topology is imprinted into the material by the particle shape. Finally, the assembly of a Penrose P1 tiling will be presented, using nematic colloidal pentagonal platelets as a route for introducing quasicrystalline symmetry into a soft material, where the nematic host allows for tessellation at multiple hierarchical length scales, i.e. sizes of the platelets, which is a work in the direction of fractal tilings as photonic materials.

Selected recent references:

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[2] A. Sengupta, U. Tkalec, M. Ravnik, J.M. Yeomans, C. Bahr, S. Herminghaus, Phys. Rev. Lett. 110, 048303 (2013).
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[4] M. Ravnik, G. P. Alexander, J. M. Yeomans, S. Zumer, Proc. Natl. Acad. Sci. USA 108, 5188 (2011).
[5] U. Tkalec, M. Ravnik, S. Copar, S. Zumer I. Musevic, Science 333, 62 (2011).
[6] A. Martinez, M. Ravnik, B. Lucero, R. Visvanathan, S. Zumer, I. I. Smalyukh, *Mutually tangled knots of colloidal particles and nematic field*, accepted.
[7] J. Dontabhaktuni, M. Ravnik, S. Zumer, *Quasicrystalline tilings in nematic colloidal platelets*, submitted.

TUESDAY, OCTOBER 22, 2013
2:30 PM
Building E51, Room 149
(MIT-Tang Center)

Reception following in Building E17, Room 401A
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