CPP 17: Liquid Crystals

Time: Tuesday 14:00–15:15 Location: ZEU 114

Topical Talk CPP 17.1 Tue 14:00 ZEU 114

Modulated mesophases: from labyrinths to liquid ferroelectric chords. — •Alexey Eremin[1], Ulrike Kornek[1], Ralf Stannarius[1], Antal Jákli[2], and Hideo Takezoe[3] — [1]Otto-von-Guericke Universität, IEP/ANP, 39106 Magdeburg — [2]Liquid Crystal Institute, Kent State University, USA — [3]Dept. of Organic and Polymeric Materials, Tokyo Institute of Technology, Japan

Competition between incompatible ground states often leads to frustration, which is manifested by spatially modulated states. This phenomenon can be found in various physical and chemical systems such as semiconductors, lipid membranes, ferrofluids, or superconductors. Here we show an example of a polarization modulated liquid crystal phase exhibiting a variety of fascinating structures. Those include labyrinths of layer dislocations in free-standing films and stable ferroelectric fibres with liquid-like order of molecules in cylindrically wrapped layers. Using non-linear optics and polarising microscopy we get insight into the internal organisation of the polar structure of the phase in different geometries as well as the mechanical properties the fibres.

CPP 17.2 Tue 14:30 ZEU 114

Reconfigurable knots and links in chiral nematic fluids — •Uroš Tkalec[1,2], Simon Čopar[3], Miha Ravnik[3,4], Slobodan Žumer[3,2], and Igor Muševič[2,3] — [1]Max-Planck-Institute for Dynamics and Self-organization, Göttingen, Germany — [2]Jožef Stefan Institute, Ljubljana, Slovenia — [3]Faculty of Mathematics and Physics, Ljubljana, Slovenia — [4]Rudolf Peierls Centre for Theoretical Physics, Oxford, United Kingdom

Creation and control of non-trivial topological objects is important in various biological and condensed matter systems. However, detailed studies of knotted structures in all these systems remain challenging due to their inherent smallness and typically large but poorly controllable ensemble of configurations. We show that knots and links of fascinating complexity can be realized and specifically reconfigured in the molecular orientational field of chiral nematic liquid crystal using optical manipulation of topological defect loops, which are spanned on ordered microparticle arrays. We also unveil a simple reknitting mechanism, based on a tetrahedral rotation of two relevant disclination segments, that allows us to predict and topologically characterize all available entangled configurations. These principles reveal a novel manifestation of knot theory in a concrete physical phenomenon and offer a way to interpret akin topological structures in physically analogous condensed matter systems.

CPP 17.3 Tue 14:45 ZEU 114

Morphological evolution of pi-walls in nematic liquid crystals under microfluidic flow — •Anupam Sengupta, Stephan Herminghaus, and Christian Bahr — MPI-DS, Bunsenstrasse 10, 37073, Goettingen

Microflows of pure nematic liquid phase are studied by the authors using polarizing microscopy and fluouroscence confocal polarizing microscopy.Varying the combinations of surface anchoring, channel dimensions and flow rates, different textures and defect structures evolve: stable, unstable or flow-stabilized. The authors use the forces present when such systems flow through an appropriate microfluidic device to manipulate the structures. Novel colloidal systems dispersed in nematic matrices, can selectively be transported over large length scales, using the nematic bulk or the flow-induced textures and defect structures.

CPP 17.4 Tue 15:00 ZEU 114

Entropy-driven enhanced self-diffusion in confined reentrant supernematics — •Marco Mazza — Stranski-Laboratorium für Physikalische und Theoretische Chemie, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany

We present a molecular dynamics study of reentrant nematic phases using the Gay-Berne-Kihara model of a liquid crystal in nanoconfinement. At densities above those characteristic of smectic A phases, reentrant nematic phases form that are characterized by a large value of the nematic order parameter $S \simeq 1$. Along the nematic director these “supernematic” phases exhibit a remarkably high self-diffusivity which exceeds that for ordinary, lower-density nematic phases by an order of magnitude. Enhancement of self-diffusivity is attributed to a decrease of rotational configurational entropy in confinement. Recent developments in the pulsed field gradient NMR technique are shown to provide favorable conditions for an experimental confirmation of our simulations.

Ref.: M.G. Mazza, M. Greschek, R. Valiullin, J. Kaerger, M. Schoen, Phys. Rev. Lett. 105, 227802 (2010).