IAP Seminar

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Tuesday, 13th November 2018, 16:00 s.t.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10
Yellow Tower „B", 5th floor, SEM.R. DB gelb 05 B

Surface forces and nanoscale alignment of anisotropic fluids probed with the Surface Force Apparatus

Soft anisotropic materials that change their macroscopic properties in response to external stimuli such as electric field, light, heat or mechanical stress are central to several new directions of technology, including optics, micro-mechanics and bioengineering. The Surface Force Apparatus (SFA) is a powerful tool for investigating such materials at the nanometer scale and reveal the fundamental link between microscopic anisotropic order and macroscopic response.

We recently developed a new method for analyzing the complex multiple-beam interference patterns arising from optically anisotropic multilayers in SFA experiments. We demonstrated that the method can be used to accurately measure both the thickness and twist angle of a nematic liquid crystal (LC) layer confined under twist-inducing parallel boundary conditions, and characterize the electro-optical response of LC films as thin as a few nanometers. Moreover, we characterized the mechanical response of thin films of spontaneously twisted nematic ("cholesteric") LCs with the helical axis normal to surfaces. The periodic modulation of molecular alignment along the helix produced an array of dislocation loops in the sphere-plane confinement geometry of the SFA. Weak oscillatory forces were observed upon increasing the LC film thickness due to periodic stretching of the helix and discontinuous (first-order) transitions between equilibrium configurations with different twist angles. Remarkably, structural forces were amplified more than 100 times as the film was compressed and the helix was trapped between large energy barriers in a metastable state with constant twist angle. Barriers were due to the high nucleation energy of dislocation defects in the periodic LC structure, in analogy with the mechanical hardening produced by grain boundaries in solid metals.

All interested colleagues are welcome to this seminar lecture (45 min. presentation followed by discussion)

Friedrich Aumayr
(LVA-Leiter)

Markus Valtiner
(Seminar Chair)