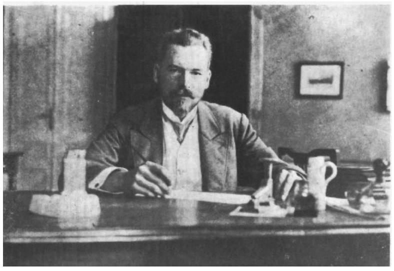

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Topological constraints of activity-driven transitions from stationary defect dynamics to nematic turbulence

Wednesday, 27 September 2023 12:10 (40 minutes)

Confined nematic liquid crystals are characterized by the interplay of ordering, elasticity, chirality, confinement, surface anchoring, external fields, flows, and activity that leads to numerous complex static and dynamic structures, including singular topological defects and nonsingular solitonic deformations. Increasing interest in active soft matter stimulated us to analyze topological aspects of three-dimensional extensile activity-driven nematodynamics topologically constrained by spherical confinement [1,2]. We used a simple mesoscopic modeling of active nematic fluids [3] that enables numerical simulations of active nematodynamics which reasonably well describes experiments with active complex fluids in thin layers and shells. These are mostly biological systems driven by the internal conversion of stored chemical energy into motion [3,4]. We demonstrated that at low activity stationary dynamic structures occur that with increasing activity undergo transitions from stationary to chaotic 3D motions - active nematic turbulence. In this seminar, I will present how the time evolution in a such system can be for a specific confinement characterized by a series of elementary topological events where nematic disclinations divide, merge, annihilate, and crossover. We limit our discussion to homeotropic anchoring, no-slip surface, and for selected activities illustrate our findings by simulated dynamics of nematic disclinations & flows accompanied by simulated optical microscopy. Our simple confined system could be a nice test ground for a machine-learning approach to active nematics [5].

The research was done in collaboration with S. Čopar, J. Aplinc, Ž. Kos, and M. Ravnik.

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