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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

PHD STUDENT SEMINAR

Thin-film Hydrodynamics of Active Nematic Fluid

By

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Abstract

Colloidal suspensions of self-propelled particles exhibit unconventional non-equilibrium behaviors at macroscopic length scales and have presented a subject of enduring interests in fluid dynamics. The present study investigates the hydrodynamics of a thin film of active nematic fluid on solid substrate. The hydrodynamic model of a droplet of active nematics was introduced by Joanny and Ramaswamy. The purpose of our work is to further investigate the statics and dynamics of the active nematic droplet by applying a variational approach based on Onsager's principle, which has been extended to model active matter. We start from a variational derivation of the thin film model which incorporates the active stress. We then analyze the case of uniform extensile activity by which a stationary shape of the droplet can be stabilized. Introducing a characteristic length measuring the competition between capillarity and activity, we derive the quantitative criterion for the droplet to reach a long and flat stationary profile that is distinct from the passive parabolic profile. By numerically solving the thin film evolution equation, we investigate the spreading dynamics of complete wetting, the stationary shape of the droplet stabilized by a finite contact angle and a uniform extensile activity and the migration of the droplet driven by a wettability gradient on the solid substrate or an activity gradient inside the droplet.

Date : 9 May 2025 (Friday)
Time : 11:00am
Venue : Room 5510 (near Lifts 25/26)

All are Welcome!