

SEMINAR



SERIES

北京大学工学院

力学与工程科学系

湍流与复杂系统国家重点实验室

Collective behavior of isotropic phoretic disks: from
crystalline solids to active turbulence

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地 点：北京大学工学院 1 号楼 210

主持人：满怡 助理教授

内容简介：

Chemically phoretic microswimmers have demonstrated a great potential for self-organizing into active materials. However, the self-organization of these swimmers remains mysterious owing to an insufficient understanding of their collective dynamics. Here, we conduct large-scale simulations to study a paradigmatic suspension of phoretic swimmers represented by isotropic phoretic disks, explicitly resolving their long-range hydrochemical interactions. We discover their diverse collective phenomena: formation of crystalline solids resembling Wigner crystals, melting, gas-like chain formation, and active turbulence. Notably, changing the activity solely leads to both the solid-fluid phase transition and the fluid's laminar-turbulent transition. We reproduce several experimental observations that have not been collectively captured by a single model. We develop a predictive theory delineating the solid-liquid transition and further characterize it as a defect-mediated two-step melting scenario via a hexatic phase. For the fluid phase, we identify its oscillatory instability with waves, transition due to wave-breaking clusters of swimmers, and active turbulence manifesting vortices. These progressive scenarios evidence a closer phenomenological resemblance between active and classical fluids in their laminar-turbulent transition than previously demonstrated.

报告人简介：

朱来来，新加坡国立大学助理教授。2014年于瑞典皇家理工学院获得博士学位。2014-2016在瑞士洛桑联邦理工学院担任博士后。2016-2020在普林斯顿大学Howard A. Stone教授组担任博士后。2020年至今，于新加坡国立大学担任助理教授。主要从事生物物理学、仿生设计和微尺度流动方面的理论与数值研究。当前的研究方向也包括活性物质和智能流体。

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