Department of Physics
Indian Institute Of Technology Kanpur

PHYSICS COLLOQUIUM

From Chaos to Glass – How Collective Dynamics Reorganize and Arrest

Abstract

Bacterial suspensions are a paradigmatic example of active matter, exhibiting persistent motion at low densities, collective spatiotemporally chaotic dynamics at intermediate densities, and arrested (glassy) behavior at high densities. Our understanding of the microscopic mechanisms governing the crossover between these regions, especially how chaotic dynamics reorganize into dynamic arrest, remains limited. Here, we probe these transitions by tracking the dynamics of Lagrangian tracers in thin bacterial suspensions of different densities spanning collective and arrested regimes. These two dynamic regimes are characterized through complementary signatures of chaos and dynamical arrest: finite Lyapunov exponents and dynamic heterogeneities, respectively. The length-scale dependence of the decorrelation times of the tracers revealed a transition from super-diffusive motion at intermediate densities, consistent with long-range hydrodynamic interactions, to sub-diffusive behavior at high densities. Remarkably, the number of active patches evolved nonmonotonically with density: it initially increased with density up to a critical density, marking the death of vortices, and then decreased. Despite these rich dynamical crossovers, the number of active patches decreased linearly with patch area. Together, these results suggest that the transition from chaos to arrest is governed by the reorganization of the active patches, mediated by the hydrodynamic interactions.

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5:15 PM , Refreshment starts at 5:00 PM

FB 382 (Prof. Amal Kumar Raychaudhuri Seminar Room)

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