Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Students' Annual Seminar

Coarsening dynamics of Incompressible Dry Active Matter

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Dry active matter systems such as granular rods on vibrating plates or cells crawling on hard substrates are characterized by the absence of momentum conservation and stability of long range order. The fact that polar active particles move in the direction in which they point to, is what distinguishes them from equilibrium systems like classical ferromagnets. This characteristic feature leads to an advective non-linear term in the hydrodynamic equations of motions which were proposed by Toner and Tu to study long time, large wavelength behaviour of active systems. The macroscopic theory shows that for two dimensional active systems the advective non-linearity stabilizes the long range order which otherwise is destroyed by the presence of fluctuations for their equilibrium counterparts. While an inevitable ordered state is the eventual fate of dry active matter, the dynamical properties of the transition from a randomly oriented state to an ordered one still remains unexplored.

In the present work, we numerically study the effect of advective non-linearity on the coarsening dynamics of dry active matter in the high density limit. Our main results are:

(a) Incompressible Dry active matter exhibits faster coarsening, as compared to quenched "inactive" matter (classical ferromagnets) where the characteristic length scale grows diffusively.

(b) The transient states enroute to long range order show signatures of turbulence, noticeably the presence of forward enstrophy and energy cascades for polar order parameter in two and three dimensions respectively.

In conclusion, we present a simplified picture for dynamics of energy transfer to corroborate the findings of our numerical studies.

Wednesday, Apr 24th 2019

2:30 PM (Tea/Coffee at 2:00 PM)

Seminar Hall, TIFR-H