Annexure-II

Nature Inspired Physics: Flocking and Bacterial Heat Engine

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This talk will bring out how nature inspires us to explore fascinating phenomena like flocking, a self-organized motion of vast numbers individuals of same species in same direction. It is a common behavior seen in many animals like ants, locusts, birds, fishes etc. As a physicist, I along with my colleagues have tried to understand this beautiful phenomenon in the laboratory by working with inanimate polar granular objects made active by placing them on rapidly vibrating surface amongst spherical beads[1].

The conventional macroscopic heat engine, a device to convert thermal energy to mechanical energy, is a triumph of our understanding of classical thermodynamics over the last three centuries. In recent years, taking the heat engine concepts to microscopic scale, necessarily dominated by fluctuations, has led to the development of stochastic thermodynamics. We have shown that a micrometer-sized active Stirling engine can be realized by periodically cycling a colloidal particle in a time-varying harmonic optical potential across bacterial baths at different activities[2]. Our experiments bring out a message towards the fundamental insights into the functioning of engines operating out of equilibrium.

[1] Nitin Kumar, Harsh Soni, S. Ramaswamy and A.K. Sood, Nature Communications, 5, 4688 (2014), Cond. Mat. Arvix. 1603.08535, unpublished results (2017).
[2] Sudeesh Krishnamurthy, Subho Ghosh, Dipankar Chatterji, Rajesh Ganapathy and A.K. Sood**,** NaturePhysics 2, 1134 (2016) and unpublished results(2017)