Institute Lecture

The Physics of Life: Flocking and Bacterial Heat Engine

Prof. A.K. Sood,
Professor, Department of Physics
Indian Institute of Science, Bangalore

22th September 2017, Time: 6:15 PM, Venue: LH-16

Abstract

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S. Ramaswamy and A.K. Sood, Flocking at a distance in active granular matter, Nature Communications, 5, 4688 (2014), unpublished results (2017).
[2] Sudeesh Krishnamurthy, Subho Ghosh, Dipankar Chatterji, Rajesh Ganapathy and A.K. Sood, A Micrometer-sized Heat Engine Operating Between Bacterial Reservoirs Nature Physics 2, 1134 (2016) and (2017).

About the speaker

Prof. A.K. Sood, FRS is an Honorary Professor in Department of Physics at Indian Institute of Science, Bangalore. He is also a Distinguished Honorary Professor of Physics at IIT Kanpur. He is currently the President of the Indian National Science Academy and the Secretary General of The World Academy of Sciences (TWAS). He was the President of the Indian Academy of Sciences from 2010 to 2012. His research interests include Physics of Nano systems such as grapheme and other 2D materials and soft condensed matter, with a strong focus on innovative experiments. The latter includes the flow behaviour such as rheochaos, nonequilibrium phase transitions, deconstruction of glass physics using colloid experiments, active matter and stochastic thermodynamics. The experimental probes used for exploring physics at nanoscale are Raman spectroscopy, Ultrafast time resolved spectroscopies including terahertz spectroscopy, transport measurements and x-ray diffractions He has published more than 390 papers in referred international journals and holds a few national and International patents. His work has been recognized by way of many honors and awards. These include the Fellowship of the Royal Society (FRS) , all the three science academies of India and TWAS ; the civilian honor, Padma Shri by Government of India, S.S. Bhatnagar Prize, G.D. Birla Award, TWAS Prize in Physics, FICCI Prize, Goyal Prize, M.N. Saha Award and Millennium Gold Medal of Indian Science Congress, Sir C.V. Raman Award of UGC, Homi Bhabha Medal of Indian National Science Academy, DAE Raja Ramanna Award of JNCASR, National Award in Nanoscience and Nanotechnology by Government of India, Nano Award by Government of Karnataka, G.M. Modi Award of Science and R D Birla Award for Excellence in Physics by Indian Physics Association.

Tea at 6.00 PM

All interested are welcome.

S. Ganesh
Dean of Research and Development, IIT Kanpur