S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Physics of Complex Systems

28th December,2023 **4.00 PM** **ONLINE / FERMION**

SPEAKER

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TITLE OF THE TALK

Flocking by turning away

ABSTRACT

The phenomena of flocking, wherein the spontaneous breaking of orientational symmetry leads to emergent collective motion, has been widely studied. Here, we report, combining theory, numerics and experiments on self-propelled metal-dielectric Janus colloids1, that torques which reorient particle pairs away from each other can exhibit flocking, exhibiting spontaneous alignment of orientations and velocities. Building a coarse-grained description and going beyond mean-field arguments2,3, we show that an asymmetry in pair distribution function leads the hydrodynamic transport coefficient for the polar order to be non-zero, rendering net non-zero collective torque.

Further, using Boltzmann kinetic theory4, using binary scattering statistics, we show that interactions that turn particles away from each other generically lead to flocking. Our results could help to reconcile the fact that cell trains5 and layers can flock6 despite cells turning away from others through contact inhibition of locomotion. Similarly, our work also provides strategies to design robotic collectives that can flock while avoiding collisions by turning away from other robots7. More fundamentally, our work shows how macroscopic polar order can emerge even in the absence of microscopic alignment interactions.

References

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3. Großmann et al., Nature Communications 11, 5365 (2020)
4. Lam et al., New Journal of Physics, 17 113056 (2015)
5. Desai et al., Journal of the Royal Society Interface, 10 20130717 (2013)
6. Smeets et al., PNAS 113, 14621-14626 (2016)
7. Chen et al., arXiv:2302.10525 (2023)

HOST FACULTY

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DEPT. OF PHYSICS OF COMPLEX SYSTEMS

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