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

Internal Webinar

Universality in active single file dynamics

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We study the single-file dynamics of three classes of active particles: run-and-tumble particles, active Brownian particles and active Ornstein-Uhlenbeck particles. At high activity values, the particles, interacting via purely repulsive and short-ranged forces, aggregate into several motile and dynamical clusters of comparable size, and do not display bulk phase-segregation. In this dynamical steady-state, we find that the cluster size distribution of these aggregates is a scaled function of the density and activity parameters across the three models of active particles with the same scaling function. The velocity distribution of these motile clusters is non-Gaussian. We show that the effective dynamics of these clusters can explain the observed emergent scaling of the mean-squared displacement of tagged particles for all the three models with identical scaling exponents and functions. Concomitant with the clustering seen at high activities, we observe that the static density correlation function displays rich structures, including multiple peaks that are reminiscent of particle clustering induced by effective attractive interactions, while the dynamical variant shows non-diffusive scaling. Our study reveals a universal scaling behaviour in the single-file dynamics of interacting active particles.

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