Properties of the Collective Motion of Asymmetric Self-propelling Particles

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Investigation of Collective Motion

Collective Motion in Nature

School of Fish

Flock of Birds

YouTube: The Greatest Bird Show on Earth

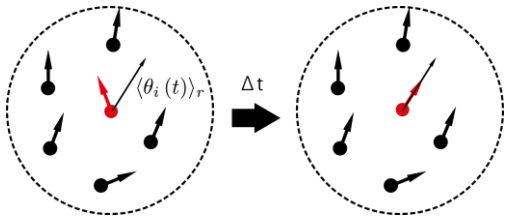
Vicsek Model

Vicsek *et al.*, 1995

$$\vec{r}_i\left(t+1\right) = \vec{r}_i\left(t\right) + \vec{v}_i\left(t\right)\Delta t$$

$$\theta_i\left(t+1\right) = \left\langle \theta_i\left(t\right)\right\rangle_r + \eta_i$$

$$\text{where } \vec{v}_i = v_0\left(\cos\left(\theta_i\right), \sin\left(\theta_i\right)\right)$$



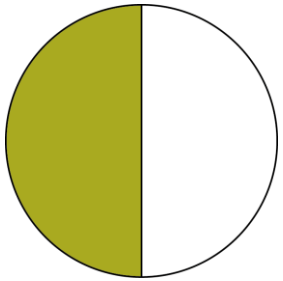
Characteristics such as
Giant Number Fluctuation in
particle number distribution is observed
from numerical simulations

$\Delta N \propto N^{0.8}$

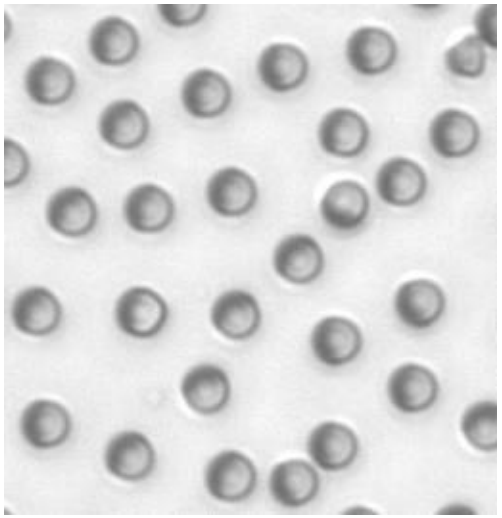
cf. $\Delta N \propto \langle N \rangle^{0.5}$ for equilibrium

Janus Particle as an Artificial Self-Propelling Particle

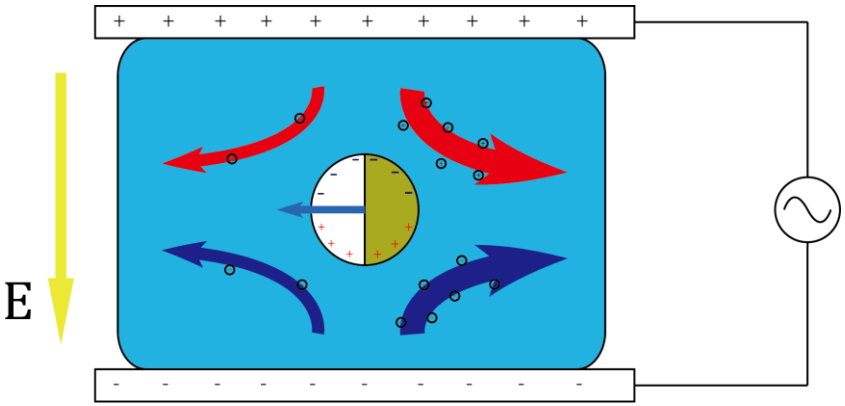
Janus Particle



Janus Particle is a particle
with its hemisphere covered by metal.



Janus Particles observed under x40 view
Dark hemisphere indicates the metal hemisphere



Under an AC field, Janus particles can swim perpendicular to the AC field because of the difference of the dielectric constant of the two hemispheres.

Collective Motion of Janus Particles