What is active matter?

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Equilibrium systems

Definition (Equilibrium)

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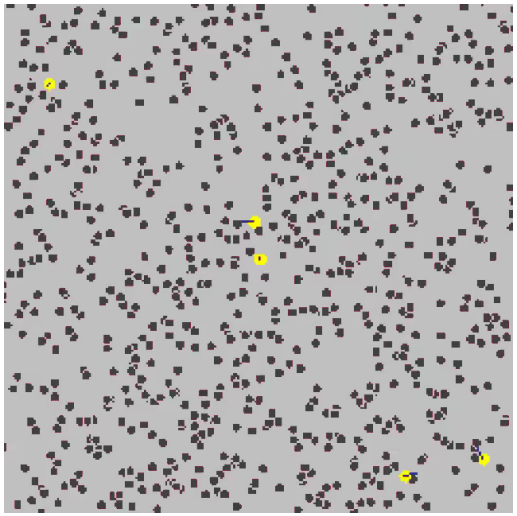
"At equilibrium" does not mean "arrested": there are equilibrium fluctuations!



Three general classes of non-equilibrium systems [Cates, Tailleur, Annu. Rev. Condens. Matter Phys. (2015)].

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Example

Thermal system adapting to its thermostat, glasses.

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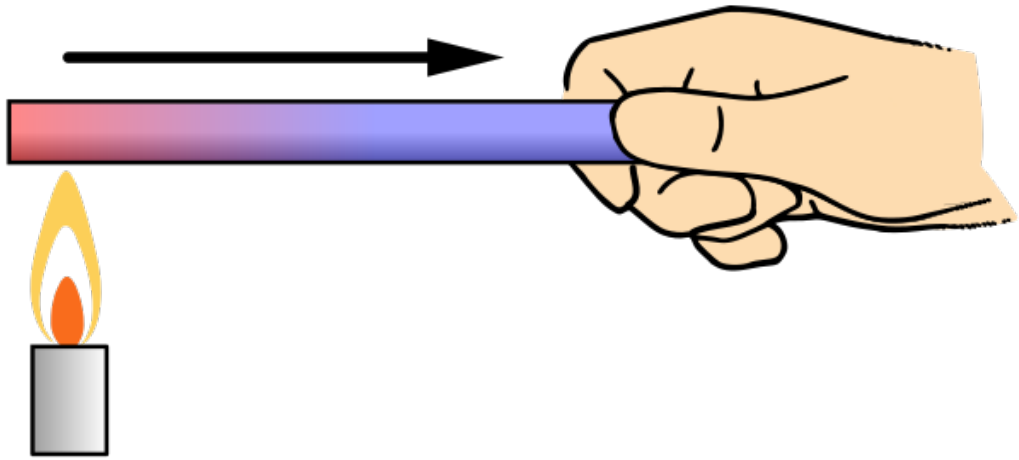
Example

Sheared liquid, metal rod between two thermostats.



Non-equilibrium systems

Three general classes of non-equilibrium systems [Cates, Tailleur, Annu. Rev. Condens. Matter Phys. (2015)].

- Systems relaxing towards equilibrium.
- Systems with boundary conditions imposing steady currents.
- Active matter.

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System composed of self-driven units, **active particles**, each capable of converting stored or ambient free energy into **systematic movement** [Marchetti *et al.*, Rev. Mod. Phys. (2013)].

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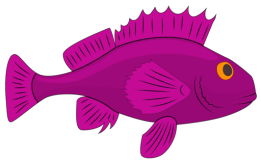

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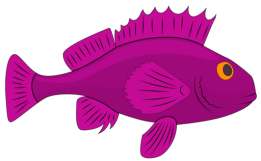

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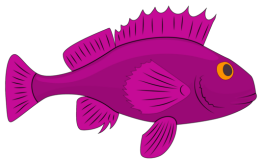
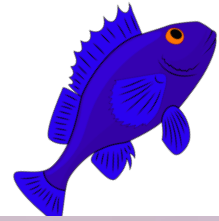


persistent motion

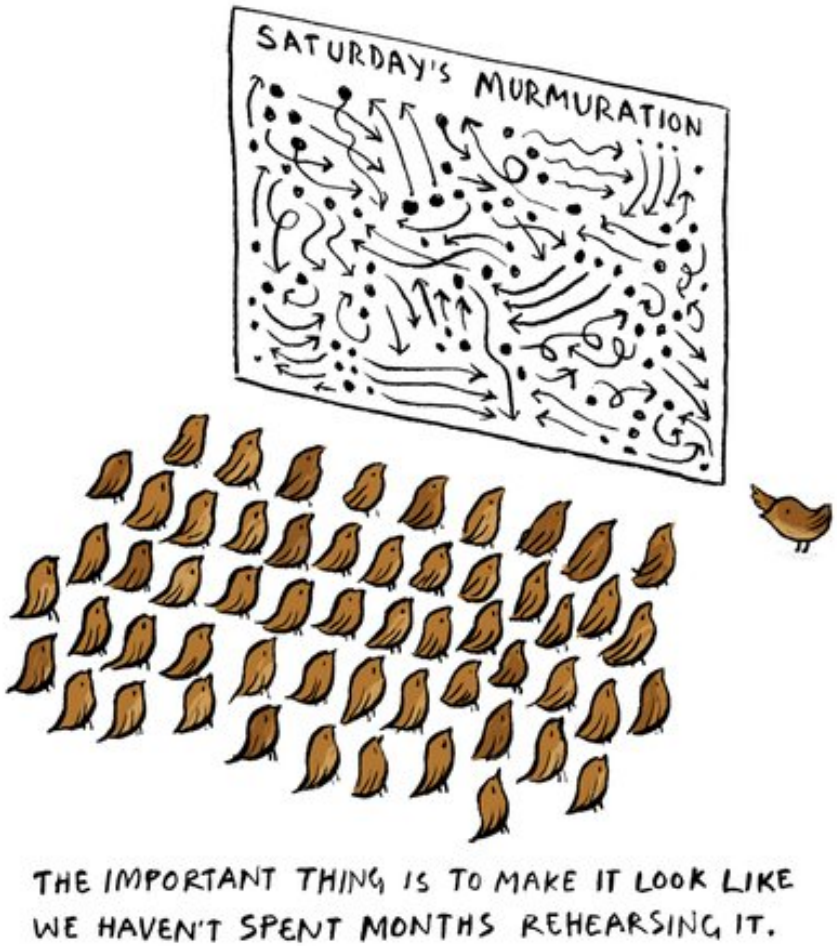
hinders motion



[BBC Earth (2017)]

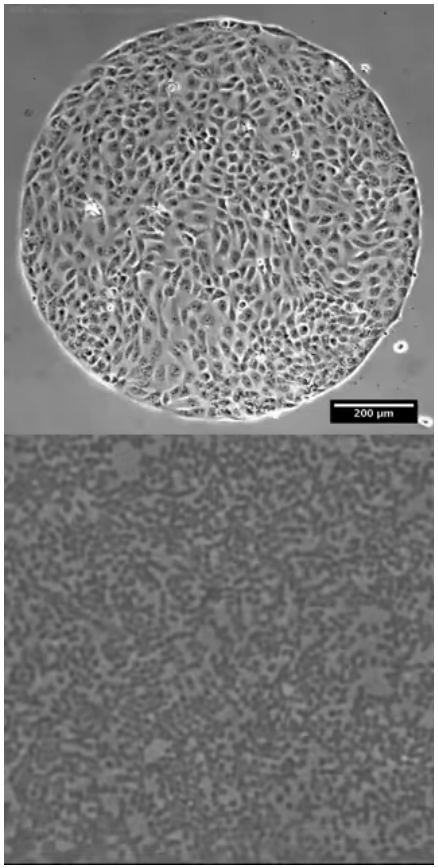
[Patel (2021)]

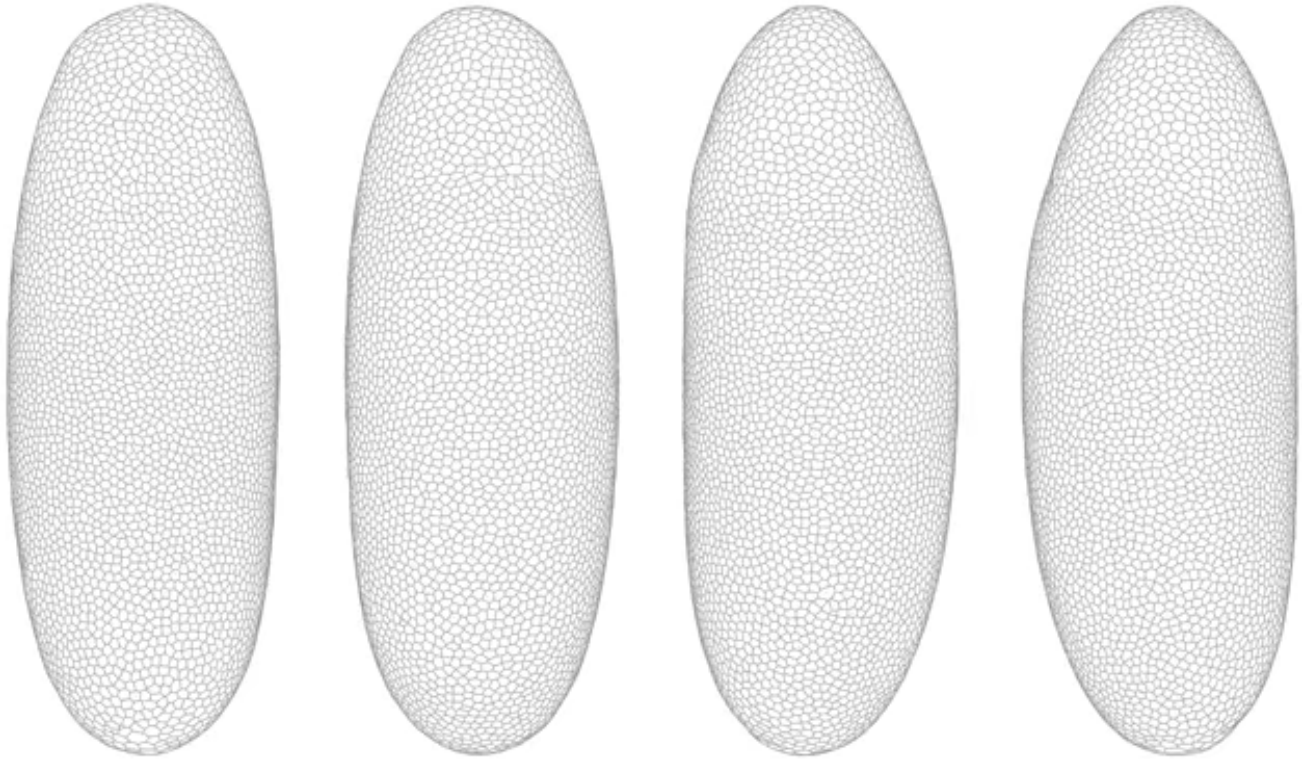
[Winter (2010)]


SATURDAY'S MURMURATION
THE IMPORTANT THING IS TO MAKE IT LOOK LIKE
WE HAVEN'T SPENT MONTHS REHEARSING IT.

[Berger (2022)]

[Guillamat (2020)] [Stern, Shvartsman, Wieschaus, Curr. Biol. (2022)]

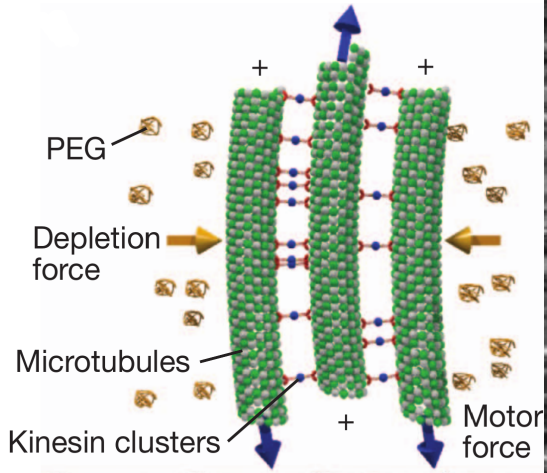


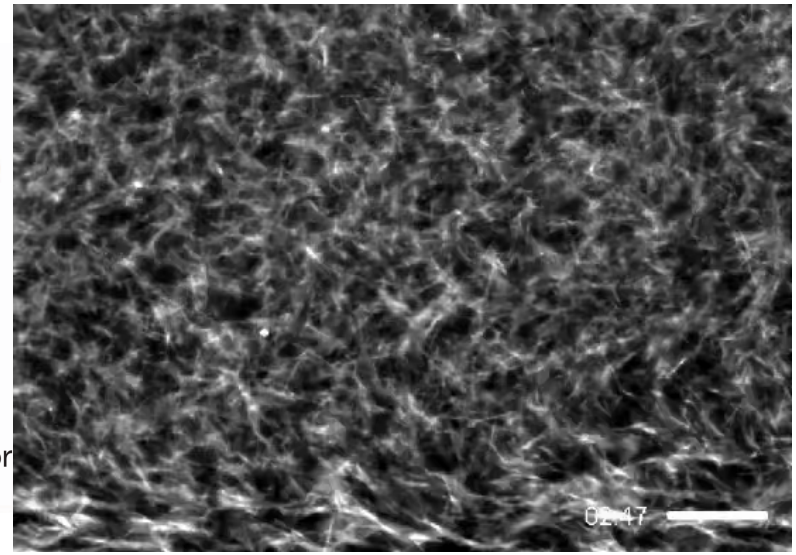


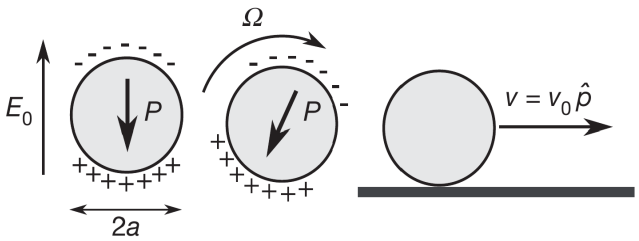
[Rabani, Ariel, Be'er, PLoS ONE (2013)]

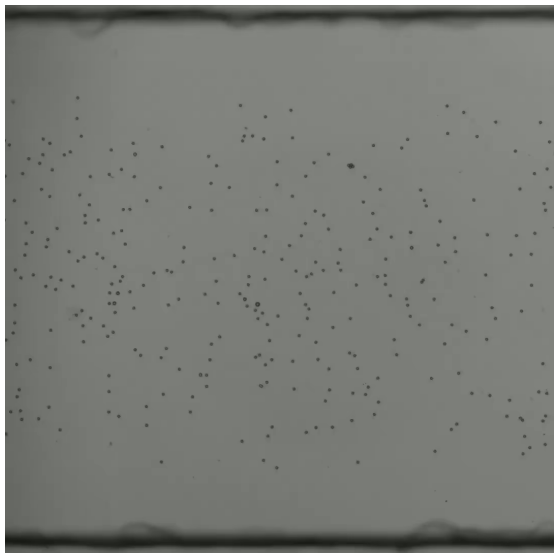
Competition between crowding effects and particle-level active forcing, which may result in collective motion on larger scales.

[Sanchez *et al.*, Nature (2012)]









[Bricard *et al.*, Nature (2013)]

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