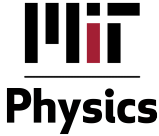
Stat Mech 2: Stochastic dynamics in and out of equilibrium

Julien Tailleur (office 6C-419)



All info on **http://www.mit.edu/∼jgt/Content-Web/Teaching/8088S308.html**

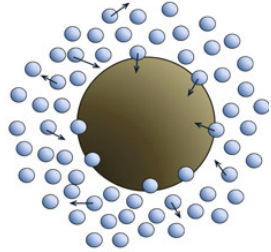
Goals

- Introduce non-equilibrium statistical physics and its applications to Active Matter & Biophysics.
- Give you the analytical & numerical tools to model and study a broad class of non-equilibrium systems
- Introduce important historical examples and current hot topics

Organization of lectures

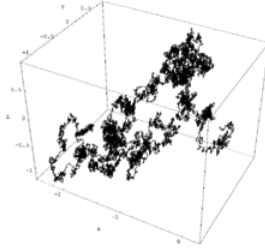
Part I: Relaxations towards equilibrium

- Dynamics of a colloid in a bath
  Trajectory: construction of Langevin equation



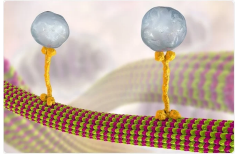
- Stochastic Itō calculus
  Probability: the Fokker-Planck equation

- Currents and time-reversal symmetry
  Path-integral representation



Part II: Non-equilibrium dynamics and Markov chains

- Ratchets: from Feynman to molecular motors
- Lattice-based models and master equations



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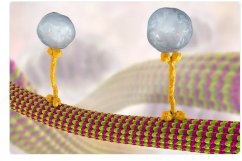

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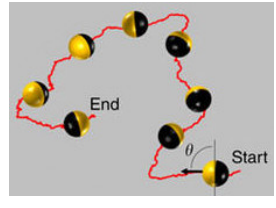
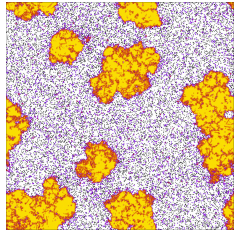
Part III: Active matter

- Active particles: bacteria and self-propelled colloids
- Collective behaviours in active systems: phase separation and collective motion





Course organisation

- Lectures: mostly blackboard
- Recitations:
  - Numerical methods
    - Implementations will be carried out using Julia
    - Bring your laptop! Check calendar
  - Important examples & illustrations
  - Alternative methods
- Four Psets: tentative due dates Jan 10, 16, 22, 28
- Office hours: JT (6C-419)/AA (TBD) on Jan 8/9, 14/15, 21/22, 27/28
- Numerical project: validate its choice with AA by Jan 24, return on Feb 2
- Final exam: Jan 31
- Grading: Pset/numerical project/final exam: 40/30/30
- Ignore canvas go to **http://www.mit.edu/∼jgt/Content-Web/Teaching/8088S308.html**
  - Except to access the piazza webpage (https://piazza.com/mit/spring2025/d840)
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