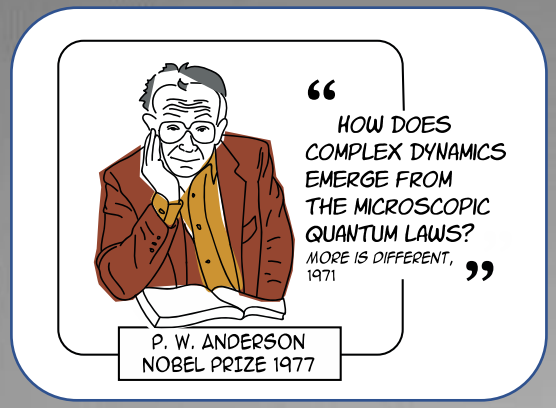
# The challenge

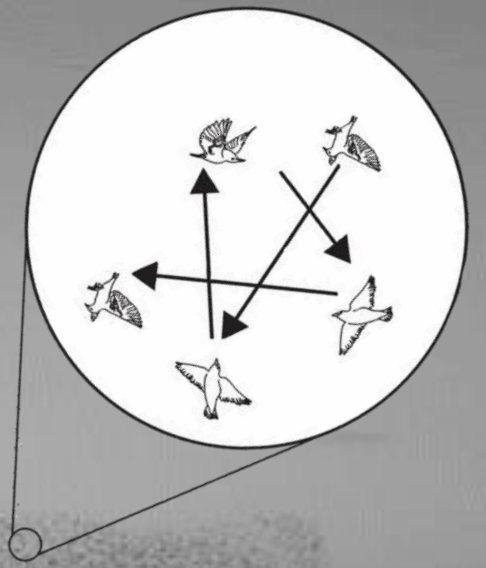



# Difficulty and importance

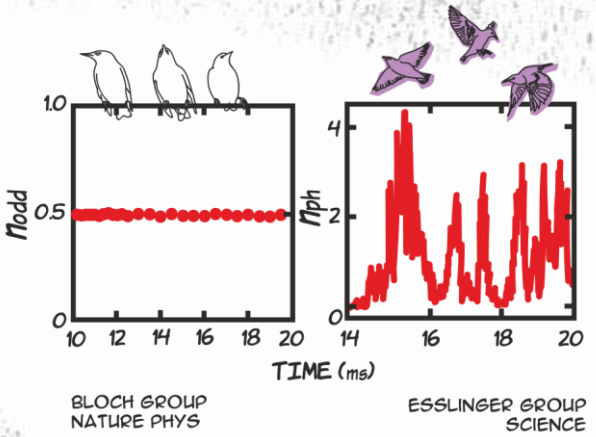
- **Very** challenging for **strongly interacting** quantum systems (quantum materials)
- Useful phases at room temperature

non-equilibrium quantum many body physics

- **EXISTING approaches focus on specific <u>stationary</u> systems**
- **cannot solve Anderson’s long-standing question**



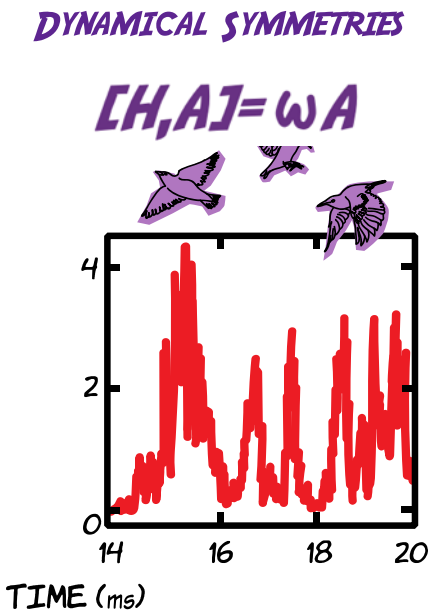
$[H,A]=\omega A$

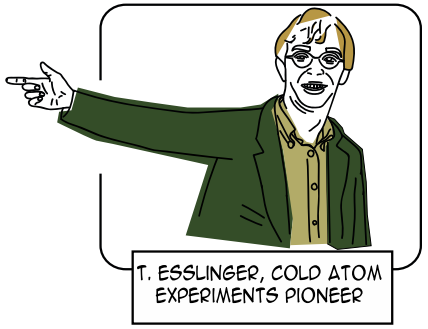


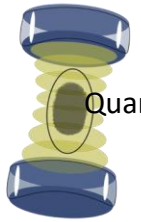

A= + + ...

BB et al. Nat. Comm. 10 1730 (2019)

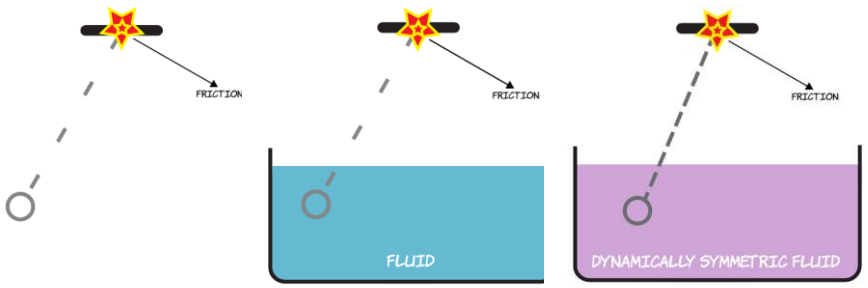
# Example of a new phase of matter: Dissipative time crystal



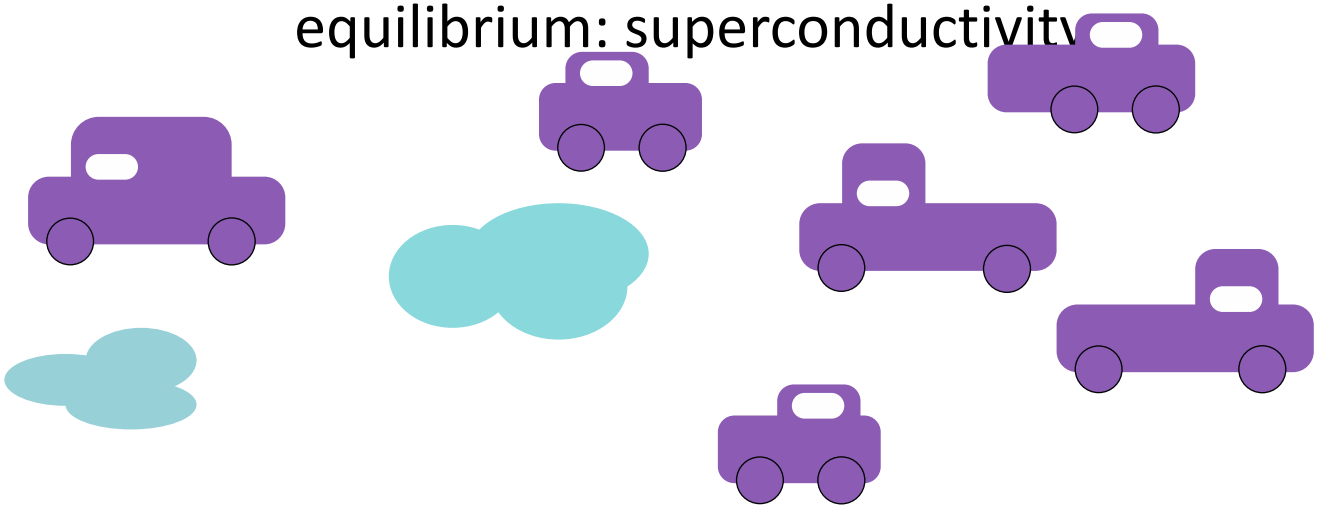



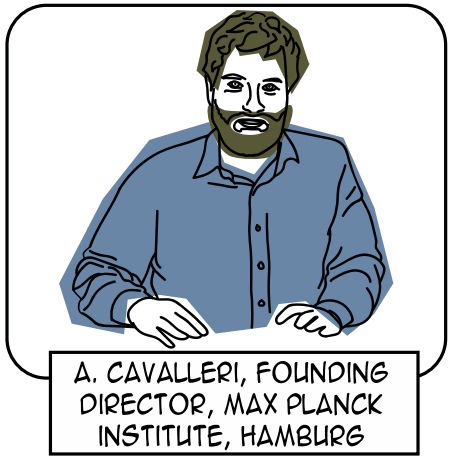
Quantum gas In an optical cavity

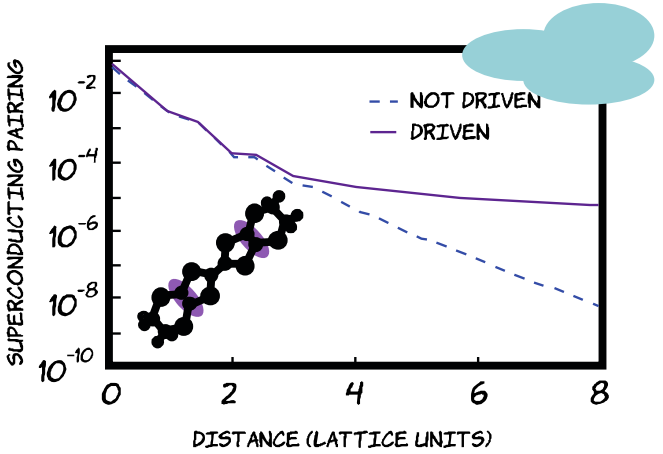



Analogy

# Example of a known phase of matter out-of-equilibrium: superconductivity

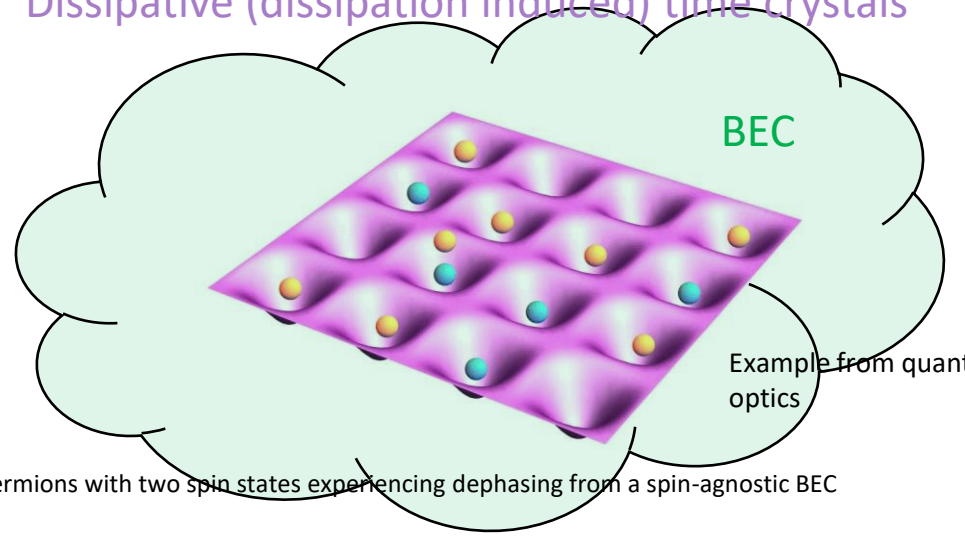





Cavalleri group
Phys. Rev. X

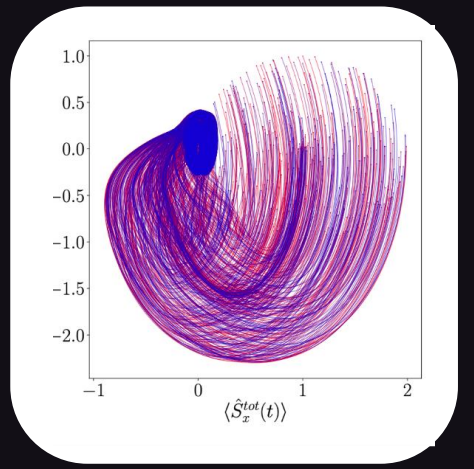
## Dissipative (dissipation induced) time crystals




Example from quantum optics

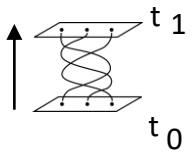
Fermions with two spin states experiencing dephasing from a spin-agnostic BEC

## quantum complex dynamics





## Stabilized quantum coherence




## and stranger still