



# INTERACTING QUANTUM MATTER

Fall Semester 2022  
PHYS-502

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# ORGANISATION

- Lectures (Andreas Läuchli) on  
Wednesday 10:15-12:00 and 13:15-14:00 in CM 012
- Exercises (Ivo Maceira) on  
Wednesday 14:15-15:00 in CM 012
- There will be a Moodle page, with slides, supporting material, and the exercise sheets.
- There might be lecture notes in the end.
- Oral examination 30 minutes.

# YOUR BACKGROUND ?

- This is a MA3 lectures, which can also be taken by PhD students. It is not recommended for MA1 students.
- Solid State Physics / Topological Insulators ?
- Statistical Physics / Quantum Phase Transitions ?
- Quantum Information ?
- Quantum Field Theory ?

# OUTLINE

- What is “Interacting Quantum Matter” ?

# IMPORTANT CONCEPTS

- Universe in a “spin chain”
- For condensed matter systems: quantum magnets, metals, superconductors, fractional quantum Hall systems, ...
- For synthetic quantum systems: quantum simulators, quantum computers, different platforms: atoms, ions, superconducting qubits, photons, ...
- For high energy physics: black hole information puzzle, “it from qubit”, lattice gauge theories
- For quantum field theory, statistical physics, quantum information
- For numerical methods: e.g. tensor network methods

# OUTLINE

- What is “Interacting Quantum Matter” ?
- Planned Content:
  - Entanglement in Quantum Many Body Systems
  - Quantum Phase Transitions
  - Topological Insulators, SPT Phases, Topological Order
  - Non-equilibrium Phenomena
- Focus is on phenomena and qualitative understanding.
- Exercises will consist both of analytical and numerical problems.

