Announcement

Advanced Seminar on "Numerical methods for quantum physics"

apl. Prof. Simone Montangero

Description

Numerical methods are one of the most important tools available to physicists, whether for calculating and displaying results, simulating experiments, or solving complex systems of equations. In this Hauptseminar we will review the fundamental tools for numerical simulations of quantum systems from standard well known methods to simulate the Schrödinger equation to up to date research border line numerical methods to study time evolution and ground state properties of many body quantum systems.

Learning Outcomes

Numerical methods, Programming skills.

Content

Possible themes are:

Mostly numerical

- Simulation of time evolution of continuous quantum systems
- A small quantum computer simulator
- Minimization of multi-variable functions in complex patterns
- Chaos in the quantum world
- Monte Carlo methods
- Shell scripting: automating long and repetitive processes
- Exploring parallel computing

Mostly theoretical

- Quantum Optimal control
- Numerical Renormalization group
- Density Matrix Renormalization Group methods
- Matrix Product states
- Bethe Ansatz
- Jordan-Wigner transformation
- Tight-binding model
- One-dimensional quantum liquids
- Gutzwiller's variational approach

Prerequisites

No specific prerequisite as the topic will be based on the level of knowledge of the students.

Literature

Every topic is based on specific books and/or research papers published in the major international scientific journals.

Additional Information

Synergies with the course on *Computational Quantum Physics* might be explored. The course will be held in English.

4 ECTS credits

Lecturer

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