Announcement

Computational Quantum Physics

apl. Prof. Simone Montangero

Description

The course aims to provide the students with the basics and advanced knowledge needed to perform numerical analysis for physicists, with a particular focus on methods developed to study many-body quantum systems.

Learning Outcomes

Numerical methods, Programming skills, many-body quantum physics.

Content

Tentative program:

1. Computers for physicists
   - Fundamentals
   - Architectures
2. Software for physicists
   - Programming good practices
   - Automatizing repetitive work
   - Debugging
3. Presenting results
   - Latex environment
   - Plotting and fitting
4. Basic concepts
   - Solution of linear equations
   - Eigenvalue problem
   - Sampling theorem
   - Fast Fourier Transform
5. Differential equations and integrals
   - Differential equations
   - Schrödinger Equation
   - Integration
6. Wave-function approximations
   - Mean field
   - Hartree-Fock methods
7. Renormalization methods
   - Quantum Phase Transitions
   - Renormalization group
   - DMRG
   - Tensor network methods

8. Parallel processing

- Grids and clusters
- MPI
- OpenMP
- GPU

Prerequisites

Quantum mechanics

Literature

- Various review papers published in the major international scientific journals
- Computation in Modern physics, W. R. Gibbs, World Scientific.
- Writing scientific software, S. Oliveira & D. Stewart, Cambridge University Press.

Additional Information

The seminars consist in programming exercises and weekly reports. The exam is based on a final project. The course will be held in English.

6 ECTS credits

Lecturer

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