Solid State Theory / Computational Physics

Module No.: MN-P-SP-ThSol, MN-P-PN-ThSol, MN-P-WaMa Version: 29.01.2014 ST

Course: Computational Many-Body Physics

Lecturers: S. Trebst, R. Bulla
Email: trebst@thp.uni-koeln.de, bulla@thp.uni-koeln.de

Category	Type	Language	Teaching Hours	CP	Semester
Core Course	Lecture	English	3+1	6	SoSe

Requirements for participation:

Training in theoretical physics at the B.Sc. level, experimental solid state physics

Type of module examinations:

Written or Oral Examination and one oral examination at the end of the module

Duration of the course:

1 semester

Aims of the course:

This course provides an overview of elementary numerical approaches to study many-body systems, both classical and quantum.

Contents of the course:

The lecture will provide an overview of modern numerical approaches to many-body systems, both classical and quantum. The in-depth introduction of elementary algorithms will be complemented by application of these methods to fundamental models and phenomena, mostly arising in the context of condensed matter physics.

A typical list of topics includes

- percolation
- phase transitions
- finite-size scaling
- Monte Carlo sampling
- extended ensemble techniques
- molecular dynamics
- Hartree-Fock / density-functional methods
- exact diagonalization
- quantum Monte Carlo
- series expansions
- numerical renormalization group
- density matrix renormalization group

Recommended literature:

J.M. Thijssen, Computational Physics, Cambridge University Press (2007)
Tao Pang, An Introduction to Computational Physics, Cambridge University Press (2006)
Werner Krauth, Statistical Mechanics: Algorithms and Computation, Oxford University Press (2006)