BuildMoNa

UNIVERSITÄT LEIPZIG

## SCIENTIFIC AND METHOD MODULES

| Module name | Basic Concepts in Physics |
|---|---|
| Number | 2015-B3 |
| Aims | Doctoral researchers without a physics background will be brought up to a level necessary to understand the thematic and advanced modules (T1–T6, A3, A2). The doctoral researchers will gain insight into the physical principles of materials, the size-dependence of properties, strength- and length dependence of interaction energies, Brownian motion, quantum mechanics and molecular dynamics. They will also be exposed to fundamental concepts of statistical physics and thermodynamics. Moreover, they will gain a feeling for the quantitative analysis that is the basis of physical thinking. |
| Basics | |
| Contents | Fundamentals of matter, solid-state physics (charge transport, band structure, Bloch oscillation, point contacts, tunnelling, magnetotransport). Diffusion (Brownian motion, mass transport, random motion, ballistic motion, dissipation). Hydrodynamics. Nanoconfinement (electrons, photons, phonons, structured dielectric media/photonic crystals, plasmons, metallic nanostructures). Spin physics (magnetic resonance, spin currents), optics (ray optics, nonlinear optics). Computer simulations (molecular dynamics, Markov chain Monte Carlo methods). Polymer physics (entropic forces, viscoelasticity, polymer dynamics). |
| Methods | |
| Type | Two-day block course/ yearly recurrence with modification |
| Date (month/year) | 6/7 May 2015 |
| Time | See page 2 |
| Work load | 15 hours presence/ 45 hours self-study |
| Examination | Written |
| Credit points | 2 |
| Responsible scientists | Haase, Janke, Käs |
| International guest lecturers | |
| Industrial partners | |
| Recommendations for literature, e-learning | • H. E. Stanley: *Introduction to Phase Transitions and Critical Phenomena*, Oxford Press, Oxford, 1979.<br>• M. E. J. Newman and G. T. Barkema: *Monte Carlo Methods in Statistical Physics*, Clarendon Press, Oxford, 1999.<br>• W. Janke: *Monte Carlo Simulations in Statistical Physics - From Basic Principles to Advanced Applications*, in: *Order, Disorder and Criticality: Advanced Problems of Phase Transition Theory*, Vol. 3, ed. Y. Holovatch, World Scientific, Singapore, 2012, pp. 93-166. |

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**SCHEDULE for Module 2015-B3**

| Time | Lecturer | Programme | Location |
|---|---|---|---|
| **6 May 2015** | | | |
| 14:00-17:00 | Käs | Diffusion (Brownian motion, mass transport, random motion, ballistic motion, dissipation), hydrodynamics, optics (ray optics, nonlinear optics), polymer physics (entropic forces, viscoelasticity, polymer dynamics). | Linnéstr. 5 SR 534 |
| **7 May 2015** | | | |
| 10:00-13:00 | Janke | Introduction of fundamental concepts of statistical physics and thermodynamics (statistical ensembles, partition functions, simple models, phase transitions and critical phenomena).<br>Computer simulations overview, Molecular Dynamics and Markov chain Monte Carlo methods, data analyses, examples from polymer physics. | ITP, Brüderstr. 16 SR 113 |
| | | | |
| 14:00-17:00 | Haase | Spin physics and spectroscopies: Origin of magnetic moments, spin (main experimental evidence), spin current (magnons), magnetic resonance. Light phenomena. | Linnéstr. 5 SR 532 |

**Didactic elements:**
Lecture, discussions, practical training – lab demonstration, etc.

**Expected performance:**
Active participation in discussions during lab demonstration etc.

Doctoral candidates from the physics field are allowed to take part in the module but will not receive any credit point or mark for attendance.

Doctoral candidates who have already received two credit points and a mark for the attendance of this module can participate, but cannot receive two graded credit points again or improve their mark.