BuildMoNa

UNIVERSITÄT LEIPZIG

## SCIENTIFIC AND METHOD MODULES

| Module name | Quantum Coherence in Nanostructures (Minisymposium) |
|---|---|
| **Number** | 2012-A3 |
| **Aims** | This module deals with macroscopic coherent quantum states such as superfluids, superconductors or Bose-Einstein condensates that hold great promise for applications such as frictionless, dissipationless transport or ultralow threshold lasers, if brought to room temperature. It also elucidates the role of spins ("spintronics") and light-matter interactions (nanophotonics) in nanoscience. The field is partly a challenge in materials physics, partly a challenge in theoretical understanding. The fundamentals of the field and several practical examples will be considered. |
| **Basics** | ***Recommended knowledge:*** thematic modules T1, T3<br>***Required knowledge:*** quantum mechanics, solid-state devices, thermodynamics, electron transport, dielectric structures, excitons |
| **Contents** | Bose-Einstein condensates ("conventional" condensates of atoms [atom laser, vortices], polariton condensates in microcavities at higher temperatures [GaAs, CdTe, ZnO, GaN]), Superfluidity, Quantum Hall effects, Topological insulators, Plasmons. |
| **Methods** | Magnetotransport measurements, angular-resolved optical spectroscopy, modelling (Landauer transport and Ginzburg-Landau theory) |
| **Type** | Two-day block course/ yearly recurrence with modification |
| **Date (month/year)** | 4/5 October 2012 |
| **Time** | 9:00 a.m. |
| **Work load** | 15 hours presence/ 45 hours self-study |
| **Examination** | Poster presentation about a self-chosen topic about "quantum coherence in nanostructures" (own research or from literature) and discussion (oral) in front of the poster with the organizer(s) |
| **Credit points** | 2 (graded) |
| **Responsible scientists** | Grundmann, Rosenow |
| **International guest lecturers** | J. Smet (MPI f. Festkörperforschung, Stuttgart), K. Ensslin (ETH Zürich), G. Refael (Caltech, Pasadena), C.M. Marcus (Niels Bohr Institute, Copenhagen), H. Buhmann (Universität Würzburg), B. Trauzettel (Universität Würzburg), J. Bloch (CNRS LPN, Paris), N. Grandjean (EPF Lausanne), P. Eastham (Trinity College, Dublin) |
| **Industrial partners** | - |
| **Recommendations for literature, e-learning** | The Physics of Semiconductor Microcavities, B. Deveaud, ed. (Wiley-VCH, 2007)<br>Introduction to Mesoscopic Physics, Y. Imry (Oxford University Press, 2008) |

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**SCHEDULE for Module 2012-A3**

| Time | Lecturer | Programme | Location |
|---|---|---|---|
| **4 October 2012** | | | |
| 9:00-9:10 | M. Grundmann, Universität Leipzig | Welcome address | Wislicenus-Hörsaal |
| 9:10-10:00 | J. Smet, MPI f. Festkörperforschung, Stuttgart | Higher order fractional quantum Hall states in graphene | Wislicenus-Hörsaal |
| 10:00-10:20 | | *Coffee Break* | *SR 101/102* |
| 10:20-11:10 | K. Ensslin, ETH Zürich | Scanning gate experiments on quantum point contacts and cavities | Wislicenus-Hörsaal |
| 11:10-12:00 | G. Refael, Caltech, Pasadena | Unconventional magnetic and electric Josephson signatures of Majorana bound states in quantum wires | Wislicenus-Hörsaal |
| 12:00-14:00 | | *Lunch Break* | *Mensa* |
| 14:00-14:50 | C.M. Marcus, Niels Bohr Institute, Copenhagen | Proximity effect in nanowires | Wislicenus-Hörsaal |
| 14:50-15:40 | H. Buhmann, Universität Würzburg | HgTe, a topological insulator | Wislicenus-Hörsaal |
| 15:40-16:00 | | *Coffee and pastry* | *SR 101/102* |
| 16:00-18:00 | | Poster session | Foyer |
| 20:00 | | *Symposium Dinner* | *Ratskeller* |
| **5 October 2012** | | | |
| 9:00-9:50 | B. Trauzettel, Universität Würzburg | Transport properties of helical Tomonaga-Luttinger liquids | Wislicenus-Hörsaal |
| 9:50-10:40 | J. Bloch, CNRS LPN, Paris | Polariton condensates in semiconductor microcavities: Propagation and localization | Wislicenus-Hörsaal |
| 10:40-11:10 | | *Refreshments* | *SR 101/102* |
| 11:10-12:00 | N. Grandjean, EPF Lausanne | Polariton condensation in III-nitride based microcavities | Wislicenus-Hörsaal |
| 12:00-12:50 | P. Eastham, Trinity College, Dublin | Semiclassical and quantum models of polariton condensates | Wislicenus-Hörsaal |
| 12:50-13:00 | B. Rosenow, Universität Leipzig | Closing remarks | Wislicenus-Hörsaal |
| 13:00 | | *Lunch* | *Mensa* |

**Didactic elements:**
Lectures, discussions

**Expected performance:**
Active participation in discussions, poster presentation