Introduction to Mesoscopic Transport

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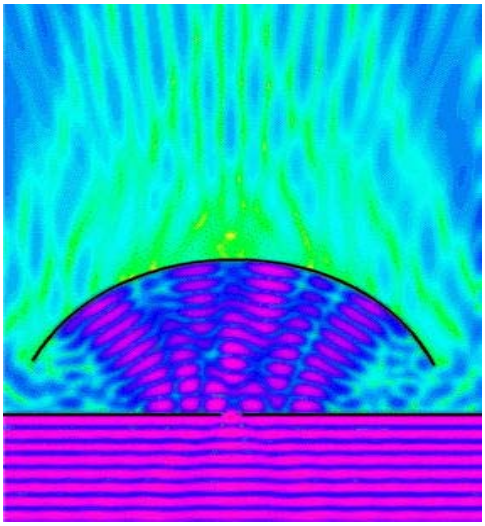
10 lectures from 3rd till 14th March, every working day at 10:00-11:30,
Faculty of Mathematics, Physics & Informatics, Comenius University
Bratislava, Mlynská dolina F1, seminar room 326



10 LECTURES

1. Two-dimensional electron gases
2. Quantum point contacts
3. Landauer-Buttiker formalism
4. Multichannel transport and integer QHE
5. S-matrix formalism
6. Green's functions and Fisher-Lee relations
7. Kubo formalism for linear quantum transport
8. Feynman diagrams in disordered systems
9. Drude formula and diffusons
10. Weak localization and cooperons.

Mesoscopic physics art (Eric Heller, Harvard). Electrons arrive as plane waves from below and enter through the tiny hole into the cavity made of the horizontal line and the circular segment. Since the hole is tiny, only at resonance can the electrons enter the cavity. A pleasing example of an actual mesoscopic device---resonant diode.

After a brief review of relevant experimental systems for studying two-dimensional electron gases, two major theoretical techniques for studying coherent mesoscopic transport will be introduced: the Landauer-Buttiker formalism and the linear response Kubo formalism. Topics in the syllabus include the transport of the quantum point contacts, integer quantum Hall effect, scattering matrix formalism, computationally useful Fisher-Lee relations (with specific algorithm allowing for transport calculations), Feynman diagrams for disordered conductors, diffusions and cooperons for studying quantum correction to transport (weak localization).

prerequisites: quantum mechanics, statistical physics (basic solid state physics helpful but not a must). The course is for advanced undergraduate students as well as for graduate students and junior researchers. Homework sets will be distributed for additional study.

recommended literature: S. Datta: Electronic transport in mesoscopic systems (Cambridge, 1997)

For more info contact Prof. Dr. J. Fabian at jaroslav.fabian@physik.uni-r.de

http://www.physik.uni-regensburg.de/forschung/fabian/pages/teaching_file