HL 46: Transport in high magnetic field/quantum-Hall-effect

Time: Thursday 11:45–12:45 Location: EW 202

HL 46.1 Thu 11:45 EW 202

The role of the electric Hall field in the QHE — •Tobias Kramer — Institut I: Theoretische Physik, Universität Regensburg, Germany

I present a model of the quantum Hall effect, which incorporates the electric Hall field non-pertubatively. The presence of crossed electric and magnetic fields causes a quantization of the electronic drift current and leads to a non-linear transport theory, which explains the breakdown of the QHE at high currents.

For low temperatures (or high currents), the electric field splits higher Landau levels into non-integer sublevels. The appearance of the substructure and the non-integer plateaus in the resistivity is NOT linked to electron-electron interactions, but caused by the presence of a (linear) electric field. Some of the resulting fractions correspond exactly to half-integer plateaus.

References:

T. Kramer A heuristic quantum theory of the integer quantum Hall effect International Journal of Modern Physics B, 20, 1243-1260 (2006) http://arxiv.org/abs/cond-mat/0509451

HL 46.2 Thu 12:00 EW 202

quantum hall ferromagnetism in graphene: SU(4) bosonization approach — •ricardo doretto[1,2] and cristiane morais smith[2] — [1]Institut feur Theoretische Physik, Universitaet zu Koeln, Koeln, Germany — [2]Institute for Theoretical Physics, Utrecht University, Utrecht, The Netherlands

We study the quantum Hall effect in graphene at filling factors $\nu = 0$ and $\nu = \pm 1$, concentrating on the quantum Hall ferromagnetic regime, within a non-perturbative bosonization formalism. We start by developing a bosonization scheme for electrons with two discrete degrees of freedom (spin-1/2 and pseudospin-1/2) restricted to the lowest Landau level. Three distinct phases are considered, namely, the spin-pseudospin, spin, and pseudospin phases. The first corresponds to a quarter-filled ($\nu = -1$) while the others to a half-filled ($\nu = 0$) lowest Landau level. In each case, we show that the elementary neutral excitations can be treated approximately as a set of n-independent kinds of boson excitations. We then apply the formalism to an effective continuous model proposed by Alicea and Fisher. For each quantum Hall state, an effective interacting boson model is derived and the dispersion relations of the elementary excitations are analytically calculated. We propose that the charged excitations (skyrmions) can be described as a coherent state of bosons. We calculate the semiclassical limit of the boson model derived from the SU(4) invariant part of the original fermionic model and show that it agrees with the results of Arovas et-al. for SU(N) quantum Hall skyrmions. We briefly discuss the influence of the SU(4) symmetry breaking terms in the skyrmion energy.

HL 46.3 Thu 12:15 EW 202

Fibre optical interferometer for analysis of microelectromechanicalsystems — •Tjark Windisch, Martin Borowski, Marc A. Wilde, and Dirk Grundler — Physik Department E10, Technische UniversitätMünchen, James-Franck-Strase 1, D-85748 Garching

We realize a system for measurements on microelectromechanicalsystems (MEMS) based on a fibre optical interferometer. Our system is designed for low-temperature($<$ 300 mK) and high-field ($>$ 15 T) measurements and includes a piezoelectrical positioning system (x, y, z and θ) with spatial resolution up to 200 nm. To minimize the external mechanical noise the system is embedded in an active piezoelectric vibration isolation system. The positioning system allows us to position in situ the fibre in relation to the micron sized samples. The goniometer enables us to adjust the tiltangle between the fibre and the sample which reduces the scattering losses and thus increases the signal-to-noise ratio.

By this, we can detect the static deflection of a MEMS device with spatial resolution up to 200 nm as well as detect the shift in the eigenfrequencies. The system is in particular designed to perform de Haas-van Alphen-effect measurements on miniaturized cantilever magnetometers (MCMs). First results are shown.

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HL 46.4 Thu 12:30 EW 202

Topological Hall Effect studied in simple models — •Georgo Metalidis[1] and Patrick Bruno[2] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe, D-76128 Karlsruhe — [2]Max-Planck-Institut für Mikrostrukturphysik, D-06120 Halle

Recently, a contribution to the Hall effect in ferromagnets has been found that is induced by the Berry phase, and does not involve a magnetic flux nor spin-orbit coupling. We have investigated this effect in a two-dimensional electron gas subject to a simple magnetic texture. Both the adiabatic regime, where the electron spin follows the magnetic texture exactly, and its nonadiabatic counterpart are studied, including the effect of disorder. In doing so, an ongoing discussion about the correct adiabaticity criterion in the diffusive limit is clarified.