HL 0: Tutorial: Graphene

Time: Sunday 14:00–17:00 Location: ER 270

Tutorial HL 0.1 Sun 14:00 ER 270

Wandering through the hills of flat carbon: The electronic properties of graphene — •Uli Zeitler — High Field Magnet Laboratory, Institute for Molecules and Materials, Radboud University Nijmegen, NL-6525 ED Nijmegen

Recently a new member joined the family of two-dimensional electron systems, graphene, a single layer of carbon arranged in a wrinkled honeycomb lattice. This 2D form of carbon was long believed to be thermodynamically instable and it took until 2004 to be discovered by Andre Geim's group in Manchester.

Electrons in single graphene behave as massless chiral Dirac fermions, bilayer graphene mimics the properties of relativistic massive chiral particles. These unique electronic properties lead to a plethora of new physics and possible applications. In particular, they enable us to study quantum electrodynamics, a research field hitherto reserved to high-energy physics, in a rather simple solid state system.

In this tutorial I will give an overview on the fascinating electronic and structural properties of graphene. I will show how graphene devices are produced using mechanical exfoliation of graphite. I will relate the bandstructure of single-layer and bilayer graphene to its electronic properties and I will present high-field quantum Hall experiments mimicking quantum electrodynamics. In particular I will show how graphene's unique electronic and structural properties enable the quantum Hall effect (actually a typical low-temperature phenomenon) to surprisingly become observable at room-temperature.

Tutorial HL 0.2 Sun 15:00 ER 270

Electronic Properties of Single and Bilayer Graphene — •Vladimir Falko — Physics Department, Lancaster University, Lancaster LA14YB, United Kingdom

A review will be presented of the bandstructure of atomic monolayer and bilayer of graphite (nowadays, called graphene). It will be shown that charged carriers in graphene are chiral (similarly to relativistic Dirac particles) which will be related to their unusual transport properties and the form of Landau level formed in graphene in a strong magnetic field.

Tutorial HL 0.3 Sun 16:00 ER 270

Epitaxial Graphene — •Thomas Seyller — Lehrstuhl für Technische Physik, Universität Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen, Germany

Graphene, a single monolayer of sp^2-bonded carbon, is a very unique 2-dimensional electron gas system with electronic properties fundamentally different to other 2DEG systems. Due to its peculiar band structure, charge carriers in graphene are described by the relativistic Dirac equation for massless particles. This results in extraordinary transport properties which have recently attracted considerable attention. From a practical point of view, the observation of e.g. large and robust carrier mobility and ballistic transport has raised the hope that graphene will find its way into application in electronic devices.

While many exciting results have been obtained with exfoliated graphene, technological applications demand methods suitable for producing large area graphene layers. The possibility to grow epitaxial graphene and ultra-thin graphite layers (so-called few layer graphene, FLG) on the basal plane surfaces of the wide band gap semiconductor silicon carbide (SiC) is a promising approach.

The 2-dimensional nature of epitaxial graphene and FLG layers make them an ideal subject for surface science methods such as photo electron spectroscopy (XPS, ARPES), scanning probe microscopy (AFM, STM), and electron diffraction (LEED). The presentation gives an overview over recent studies of epitaxial graphene and FLG layers on SiC surfaces covering their growth, electronic structure, and structural properties.