HL 17 Invited Talk Geim

Time: Tuesday 14:30–15:15 Room: HSZ 01

Invited Talk HL 17.1 Tue 14:30 HSZ 01

QED in a Pencil Trace — •Andre Geim and Kostya Novoselov — University of Manchester, UK

Dimensionality is one of the most defining materials parameters such that the same chemical compound can exhibit dramatically different properties, depending on whether it is arranged in a 0, 1, 2 or 3 dimensional structure. While quasi-0D, quasi-1D and, of course, 3D atomic crystals have been well recorded and investigated, dimensionality 2 was conspicuously absent among experimentally known crystals. I will describe free-standing atomic crystals that are strictly 2D and can be viewed as individual planes pulled out of bulk crystals or, alternatively, as unrolled single-wall nanotubes. After discussing the preparation and characterization of such crystals, this talk will concentrate on electronic properties of graphene that is the most 'clean' of the 2D crystals obtained so far. Our experiments show that electron transport in graphene is essentially governed by the relativistic Dirac equation rather than the (non-relativistic) Schrödinger equation and its charge carriers mimic particles with zero rest mass and an effective speed of light. We have found a variety of unusual phenomena characteristic of two-dimensional Dirac fermions. In particular, we have observed that a) the quantum Hall effect in graphene is anomalous in that it occurs at half-integer filling factors; b) graphene's conductivity never falls below a minimum value corresponding to the conductance quantum, even when carrier concentrations tend to zero; c) the cyclotron mass of massless carriers in graphene is described by Einstein's equation E =mc2; and d) Shubnikov-de Haas oscillations in graphene exhibit a phase shift of pi due to Berry's phase.