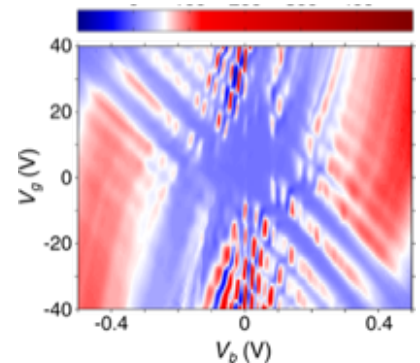
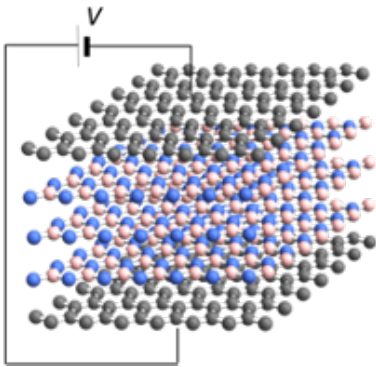


Physics research talks 2021-22

Mark Greenaway

Quantum dynamics of electrons in 2D materials

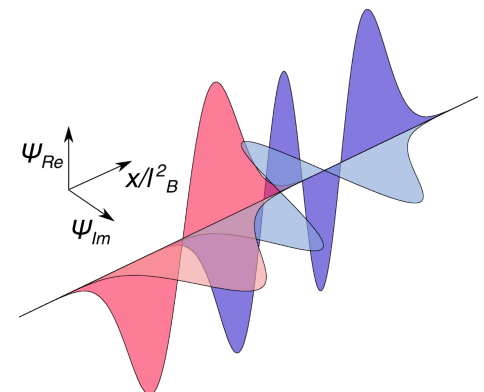
Wed 4 May 2022, 16.00
DAV1.102



Graphene, an atomically thin, two-dimensional (2D), crystal of carbon atoms, is the strongest, and one of the most conductive materials that has ever been measured. The discovery of graphene's remarkable properties since its isolation in 2004 by using Scotch tape to peel back the layers of graphite until only a single atomic layer is left, has inspired the isolation and characterisation of a vast number of other 2D crystals, for example hexagonal boron nitride and the transition metal dichalcogenides, each with unique and useful properties.

Recently it has been shown that by stacking these 2D crystals it is possible to create a new class of “designer” materials known as van der Waals (vdW) heterostructures which offer a way to tune and exploit the novel and exotic quantum properties of electrons in 2D materials. These stacked materials are particularly exciting because we can design the structures to exhibit electron transport characteristics that are tailored for specific device applications, by choosing the appropriate combination of layer materials from the growing library of 2D crystals.

In this talk, I will highlight some of the unusual and exciting properties of 2D materials and consider some of their potential applications. I will then describe various new fundamental physical phenomena recently observed when these layers are stacked together. In particular, I will introduce the graphene-boron nitride tunnel transistor, consisting of two layers of graphene separated by a few layers of boron nitride. I will show how the unusual properties of the graphene layers determine the quantum mechanical tunnelling of electrons between the layers, and how tunnelling can be tuned by changing the layer configuration to create structures useful for logic devices and high frequency electronics.



All welcome — accessible to Part A and above

Forthcoming talks

18 May, 16.00, Fasil Dejene, Charge, spin and heat transport in graphene field effect transistors