nature nanotechnology

Research Highlights

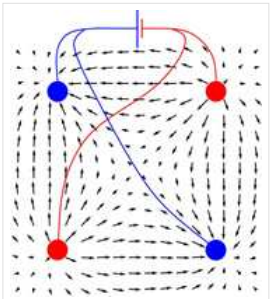
Nature Nanotechnology
Published online: 17 July 2009 | doi:10.1038/nnano.2009.222

Subject Categories: Carbon nanotubes and fullerenes | Electronic properties and devices

Graphene: Fantastic fluid

Tim Reid

The electrons in graphene form an almost perfect quantum fluid



© 2009 APS

Graphene — a single sheet of carbon atoms — appeals to researchers because of its exceptionally mobile electrons, which were until now assumed to be weakly interacting. Now, Markus Müller at the Abdus Salam International Center for Theoretical Physics in Trieste, Italy and co-workers have shown that electrons in graphene do in fact interact strongly, and behave like a 'perfect fluid'[1].

A perfect fluid will not conduct heat and has zero viscosity, so it cannot exert stress on surrounding objects. Previously, researchers believed that electrons in graphene were an example of a Fermi liquid, meaning there are no interactions between particles at low temperatures. This is true for electrons in metals, where electrons block the interactions between one another.

Müller, along with co-workers Jörg Schmalian at Iowa State University and Lars Fritz at Harvard University, used quantum kinetic theory to show that electrons in graphene have a very small ratio of viscosity (thickness) to entropy (disorder). This means that the electrons do interact strongly, and form a 'quantum critical' perfect fluid, which has only been seen in a quark–gluon plasma created in the Relativistic Heavy Ion Collider.

The findings imply that graphene sheets could show interesting quantum phenomena such as electronic turbulence. This could be important for applications of graphene in nanoscale electronics.

Reference

1. Müller, M., Schmalian, J. & Fritz, L. Graphene: A nearly perfect fluid. *Phys. Rev. Lett.* **103**, 025301 (2009). | Article |

Nature Nanotechnology ISSN 1748-3387 EISSN 1748-3395