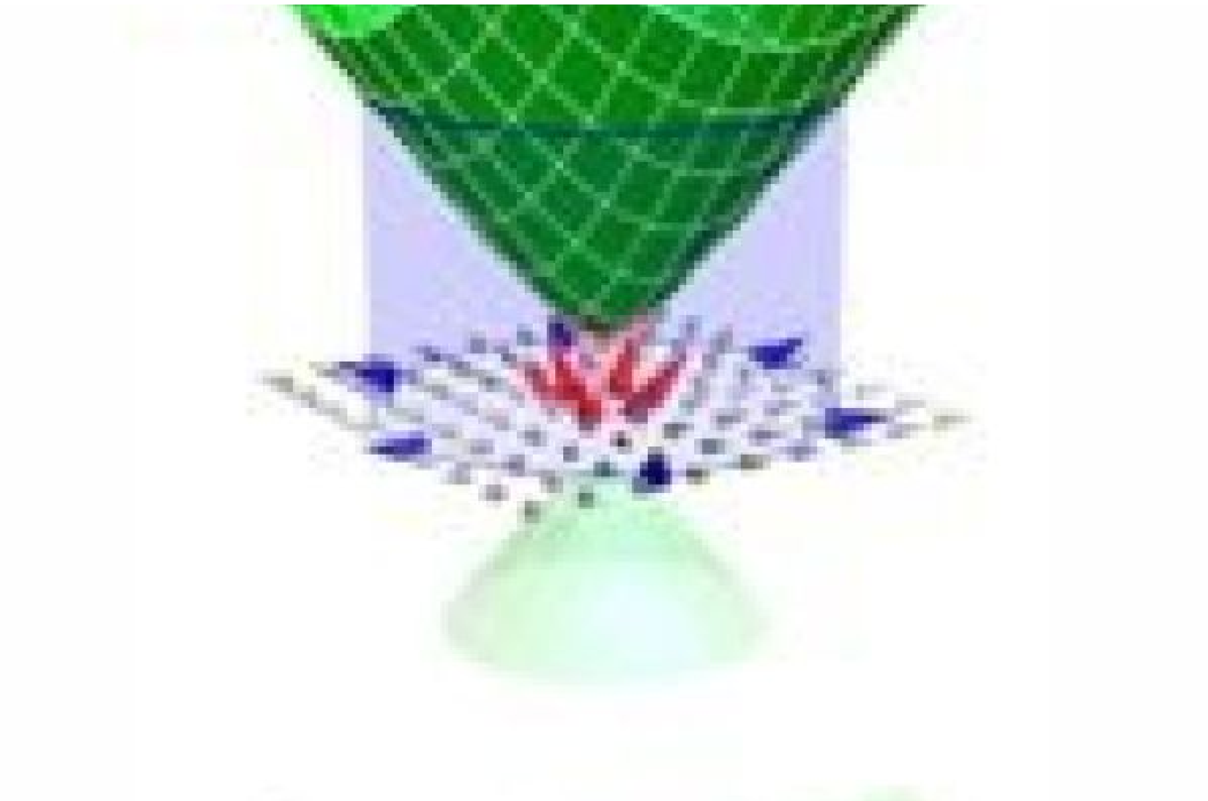

Science Perspective

ICFO researcher gives insights on graphene valleytronics

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ICFO Postdoctoral research Mark Lundeberg in the Nano-optoelectronics group led by Prof. Frank Koppens, in collaboration with researchers from University of British Columbia (CA), offers insights in the PERSPECTIVE section of *Science* into work recently published in this journal, putting into focus the possibility of new graphene enabled devices with long lived valley freedom.

One of the unusual electronic characteristics of graphene is that the direction of motion of its charge carriers is locked to an extra quantum mechanical degree of freedom, known as pseudospin. Graphene is in this way similar to the conducting surface layer of a topological insulator, where the direction of motion of the carriers is locked to their true spin-that is, to their magnetic moment. Whereas the true spin state of an electron can be described as a superposition of spin-up and spin-down components, pseudospin in graphene is a superposition of electron orbitals of the two carbon atoms in a hexagonal lattice unit cell. To date, graphene's pseudospin has played only a subtle role in carrier scattering, and in phenomena that are directly sensitive to the phase of a quantum mechanical wave function.

The paper reviewed in this Perspective article entited "Harnessing chirality for valleytronics" by Gorbachev et al. shows that pseudospin, modified in the right way, can be used to drive a so-called valley current in a graphene device. That is, a voltage applied across the device gives rise to counter-propagating streams of carriers in graphene's two band structure valleys. By harnessing its built-in chirality, an all-electrical valleytronic circuit using graphene is demonstrated.