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Quantum Hall effect and edge states in graphene. LUIS BREY, CSIC-Madrid — The experimentally observed quantum Hall effect (QHE) in graphene has renewed the interest in the study of multivalley semiconductors in high magnetic fields. In this work we study some properties of graphene in presence of a high magnetic field.
1) We discuss the form of the quantization of the Hall conductivity. We argue that the Hall conductance can be understood in the general framework of the theory of the QHE in two-dimensional systems.
2) We study the properties of undoped graphene in the QHE regime. We find that the Zeeman coupling combined with the electron-electron interaction favors a spin-polarized ground state against a valley-polarized state. This ground state support low energy collective excitations that are combinations of spin and valley density waves. We discuss the possibility that spin texture excitations, Skyrmions, become the low energy charged excitations in the spin-polarized ground state.
3) Finally we analyze the properties of the edge states in the QHE regime. Due to the valley degeneracy occurring in graphene, electron-like and hole-like Landau levels with different spin and valley orientation cross at the edge of the sample. In the undoped samples Coulomb interaction produces repulsion between the states and forces the states to anti-cross, creating a valley and spin coherent stripe at the edge of the sample. We analyze the excitations occurring in this stripe and discuss their possible relevance in tunnelling experiments.

Luis Brey
CSIC-Madrid

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