JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Seminar: Hard Condensed Matter Theory

Room: Galileo room, 01-128 (Staudinger Weg 7)
Time: Tuesday, 21.02.2017, 14:00

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Phase diagram of a graphene bilayer in the zero-energy Landau level

We theoretically investigate the ground state structure of bilayer graphene in the quantum Hall regime. In graphene bilayers, a double layer material formed of two atomic layers of graphene on top of each other, the states of the zero-energy Landau level carry, besides the real spin, two pseudospin degrees of freedom: a valley isospin and a Landau level (n = 0, n = 1) isospin. This peculiar property leads to an octet of states that is eightfold degenerate in the absence of any symmetry breaking and can be treated in the frame of quantum Hall ferromagnetism. If this SU(8) symmetry is indeed broken, an extraordinary rich phase structure emerges, each phase characterized by a different spin and isospin configuration. Recent experiments [1] have revealed a plethora of transitions upon variation of the strength of an applied magnetic or electric field.
We start from a four-band model Hamiltonian for Bernal stacked bilayer graphene and take into account both intrinsic symmetry breaking effects as well as the influence of externally applied electric and magnetic fields. Using a Hartree-Fock treatment [2], we study the ground state spin and isospin phases as a function of external magnetic and electric field strengths. For the different filling factors of the zero-energy multiplet we predict the number of phases, as well as the nature and the properties of the phases and the respective phase transitions [3].

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K. Lee, B. Fallahazad, J. Xue, D. C. Dillen, K. Kim, T. Taniguchi, K. Watanabe, and E. Tutuc, Science 345, Issue 6192, pp. 58-61 (2014);
Y. Shi, Y. Lee, S. Che, Z. Pi, T. Espiritu, P. Stepanov, D. Smirnov, C. N. Lau, and F. Zhang, Phys. Rev. Lett. 116, 056601 (2016);
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[2] J. Lambert and R. Côté, Phys. Rev. B 87, 115415 (2013); K. Shizuya, Phys. Rev. B 86, 045431 (2012)
[3] A. Knothe and T. Jolicœur, Phys. Rev. B 94, 235149 (2016)

All interested are cordially welcome!

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