Excitations of bilayer graphene in the quantum Hall regime

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We study the magnetoexcitons of the quantum Hall states, including those associated with spontaneous symmetry breaking, in bilayer graphene in a strong perpendicular magnetic and electric field.

At zero filling factor [1], a perpendicular electric field may cause a transition between a spin-polarized quantum Hall ferromagnet and a layer polarized one. We identify a long wave length instability in both states, and argue that there is an intermediate range of the electric field where a gapless phase interpolates between the incompressible quantum Hall states.

At generic integer filling factor [2], we analyze the subtle wave vector dependent many-body contributions of magnetoexcitons. These are finite even in the long wavelength limit, unlike in most conventional two-dimensional systems. We show that the mixing of different Landau level transitions significantly renormalizes these modes. Further, we argue that the mean-field theory of magnetoexcitons have limitations for the study of intra-Landau level excitations of zero-gap semiconductors.

References

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