Magnetoexciton Superfluidity in Graphene-Dielectric-Graphene Structures

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Quantum Hall bilayers with the total filling factor $\nu_T = 1$ may demonstrate superfluidity of spatially indirect excitons that reveals itself in a non-dissipative flow of opposite electrical currents in the layers. In this report we consider the effect of magnetoexciton superfluidity with reference to bilayer graphene structures. We show that in such structures an imbalance of filling factors of the layers is required for the realization of magnetoexciton superfluidity. We analize the structures "graphene-dielectric-graphene" and "graphene-dielectric-graphene-substrate" and compute the critical (maximum) distance d_c, the critical current and the temperature of the Kosterlits-Thouless transition. It is found that the magnetoexciton superfluidity in graphene systems can be realized at rather small magnetic field B and rather large interlayer distances d. In particular, in a pure graphene-dielectric-graphene sandwich with $d = 20$ nm and the dielectric constant $\varepsilon = 4$ the critical temperature $T_c \approx 5$ K can be reached at $B \approx 0.8$ T. The effect of reduction of d_c and T_c caused by the interaction with impurities is evaluated.
Stationary waves excited by a point defect in a superfluid magnetoexciton gas in bilayers are studied. An observation of such waves for the counterflow currents larger than critical ones can be considered as a hallmark of superfluid transition. It is shown that at small d the stationary wave pattern is similar to one for superfluid weakly non-ideal Bose gases, while at d close to d_c an additional family of waves located inside the Mach cone emerges.