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Excitonic Pairing between Strained Graphene Layers PETER HARNISH, ANAND SHARMA, VALERI KOTOV, University of Vermont — It is well known that inter-layer electron-hole (excitonic) pairing, caused by the inter-layer Coulomb interaction, can occur between graphene sheets appropriately doped with electrons and holes. However in such a system the energy of the excitonic condensate, as well the corresponding critical temperature, are very small due to the effective screening of the inter-layer interaction potential. We study pairing between two uniaxially- strained graphene layers, focusing particularly on the dependence of the pairing gap on the applied strain. The graphene layers are modeled as anisotropic Dirac fermion systems. We find a strong dependence on the strain, particularly in the weak-coupling regime where screening is not very relevant. In this case the condensate energy is enhanced due to the increase of the density of states as a function of anisotropy. At moderate and strong coupling the pairing becomes less sensitive to strain because of the subtle interplay between density of states effects and the strain-modified screening of the inter-layer Coulomb potential. We also analyze the possibility of higher angular momentum pairing (beyond the conventional s-wave) for the strained graphene layers. In addition, we propose that pairing can be further enhanced at the Lifshitz transition point when a relatively large strain is applied in the zig-zag direction. At such topological transition the electronic dispersion deviates strongly from the simplest anisotropic (elliptical) Dirac cone and becomes quadratic in one of the lattice directions while remaining Dirac-like along the other.

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