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Interacting Dirac Fermions and Neutrino-Like Oscillation in Twisted Bilayer Graphene LEDE XIAN, ZHENGFEI WANG, M.Y. CHOU, School of Physics, Georgia Tech — The low-energy quasiparticles in graphene can be described by a Dirac Hamiltonian for massless fermions, hence graphene has been proposed to be an effective medium to study exotic phenomena originally predicted for particle physics, such as Klein tunneling and Zitterbewegung. In this work, we show that another important particle-physics phenomenon – the neutrino oscillation can be studied and observed in a particular graphene system, namely, twisted bilayer graphene. It has been found that graphene layers grown epitaxially on SiC or by the chemical vapor deposition (CVD) method on metal substrates display a stacking pattern with adjacent layers rotated by an angle with respect to each other. The quasiparticle states in two distinct graphene layers act as neutrinos with two flavors, and the interlayer interaction between them induces an appreciable coupling between these two "flavors" of massless fermions, leading to neutrino-like oscillations. In addition, anisotropic transport properties manifest in this specific energy window, which is accessible in experiment for twisted bilayer graphene. We demonstrate that combining two graphene layers enables us to probe the rich physics involving multiple interacting Dirac fermions.

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