Abstract Submitted
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Two-particle vortices in graphene[1] MIKHAIL PORTNOI, University of Exeter, CHARLES DOWNING, University of Strasbourg — We show that a pair of two-dimensional massless Dirac-Weyl fermions can form a bound state independently on the sign of the inter-particle interaction potential, as long as this potential decays at large distances faster than Kepler's inverse distance law. The coupling occurs only at the Dirac point, when the charge carriers lose their chirality. These bipartite states must have a non-zero internal angular momentum, meaning that they only exist as stationary vortices. This leads to the emergence of a new type of energetically-favorable quasiparticles: double-charged zero-energy vortices. Their bosonic nature allows condensation and gives rise to Majorana physics without invoking a superconductor. The presence of dark-matter-like silent immobile vortices explains a range of poorly understood experiments in gated graphene structures at low doping.

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