Synthetic Topology in Graphene and Artificial Graphenes

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We have discovered a new method to generate time-reversal symmetric topological states [1] based on graphene and artificial graphenes. The nontrivial topology has its roots in the Dirac dispersion provided by the honeycomb structure, and is induced by a short-range texture respecting C_{6v} symmetry, which opens a band gap accompanied by a p-d band inversion [2]. The sign of orbital angular momentum accommodated in the hexagonal unit cell plays the role of pseudospin, and the topological edge states with pseudospin-momentum locking are similar to the helical edge states in quantum spin Hall insulators. We shall introduce our theory by showing several examples including topological photonic crystals made of conventional dielectric materials, topological LC circuits implemented in microstrips [2-4], and topological crystalline insulators with large energy gaps based on graphene with nano-hole arrays and/or under isotropic stretch [5-8].

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References:

[1] H.-M. Weng, R. Yu, X. Hu, X. Dai and Z. Fang, *Adv. Phys.* **64**, 227 (2015).
[2] L.-H. Wu and X. Hu, *Phys. Rev. Lett.* **114**, 223901 (2015).
[3] Y.-T. Yang, X. Hu and Z.-H. Hang *et al*., *Phys. Rev. Lett.* **120**, 217401 (2018).
[4] Y. Li, H. Chen and X. Hu *et al.*, *Nat*. *Commun*. **9**, 4598 (2018).
[5] L.-H. Wu and X. Hu, *Sci. Rep.* **6**, 24347 (2016).
[6] T. Kariyado and X. Hu, *Sci. Rep*. **7**, 16515 (2017).
[7] T. Kariyado, Y.-C. Jiang, H.-X. Yang and X. Hu, *Phys. Rev. B* **98**, 195416 (2018).
[8] S. Sorella *et al*., *Phys. Rev. Lett.* **121**, 066402 (2018).