10th APCTP-IACS-KIAS Joint Conference
2018.10.01-03
Sheraton Grand Hotel Incheon

Floquet Topological Semimetal with Nodal Helix

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Topological semimetals with nodal line are a novel class of topological matter extending the concept of topological matter beyond topological insulators and Weyl/Dirac semimetals. Here, we show that a Floquet topological semimetal with nodal helix can be generated by irradiating graphene or the surface of a topological insulator with circularly polarized light. Nodal helix is a form of nodal line running across the Brillouin zone with helical winding. Specifically, it is shown that the dynamics of irradiated graphene is described by the time Stark Hamiltonian, which can host a Floquet topological insulator and a weakly driven Floquet topological semimetal with nodal helix in the high and low frequency limits, respectively. It is predicted that, at low frequency, the π shift of the Zak phase generates a topological discontinuity along the projected nodal helix in the momentum spectrum of the Floquet states. At intermediate frequency, this topological discontinuity can create an interesting change of patterns in the quasienergy dispersion of the Floquet states.