Weyl Points and Topological Notions in Classical Waves

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Stimulated by the concepts of the quantum Hall effect and topological insulators, the analogues of 2D quantum Hall effect and quantum spin Hall effect have been proposed and realized in various kinds of classical wave systems. Here we show that we can create an effective gauge flux in a reduced two-dimensional system by engineering interlayer couplings, achieving an acoustic analogue of the topological Haldane model. We show that the synthetic gauge flux is closely related to Weyl points in the three-dimensional band structure and the system supports chiral edge states for fixed values of kz.

In addition, our idea can be extended to electromagnetic wave systems. We designed and fabricated a Weyl photonic crystal by introducing chiral interlayer coupling in microwave regime. Nontrivial 2D bulk band gap for fixed kz and Weyl point were confirmed by angle-resolved transmission spectra. The robustness of the associated surface states against kz-preserved scattering was experimentally observed.

In the third part of this talk, we propose a pseudospin-polarized waveguide without using bulk materials. Wave propagation in the waveguide is robust against deformations that do not induce spin flip. On the basis of our spin-polarized waveguide, a broadband field concentrator was designed and realized experimentally. The realization of pseudospin transport simply by imposing boundary conditions has the obvious advantages of using less bulk material and being less lossy as the wave is guided in air.