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CENTER FOR MULTISCALE THEORY AND COMPUTATION

Physikalisches Institut | Institut für Festkörpertheorie

Integriertes Seminar

Aktuelle Probleme dimensionsreduzierter Festkörper

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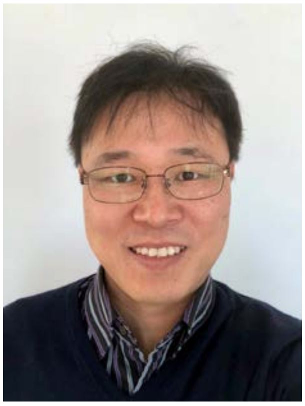
Chiral Light-Matter Interaction in Dielectric Photonic Topological Insulators

Sang Soon Oh

School of Physics and Astronomy, Cardiff University, Cardiff, United Kingdom



A photonic topological insulator (PTI) can control the light propagation based on a different mechanism from conventional optical devices or photonic crystals [1]. Interestingly, the edge modes at the interface between two PTIs with different topological invariants can be unidirectional and topologically protected against defects and dislocations. There has been extensive effort in realizing time-reversal symmetric PTIs using metamaterials and dielectric photonic crystals [2]. For example, a PTI composed of a honeycomb lattice of dielectric rods was shown to have two counter-propagating modes which can be associated with two pseudo-spin states [3].

In this talk, I will start with a brief introduction to the concepts of Berry curvature, Chern number and topological photonics. Then I will show a photonic bandgap opens as we increase the perturbation strength by changing positions of rods in two types of dielectric PTIs: honeycomb lattice and Kagome lattice. For these, we can achieve extremely low reflection at the bending of interface with an angle of 60 degrees, 120 degrees. Furthermore, I will show how the edge modes in the two types of PTIs behave differently under geometric perturbations. Lastly, I will show that the chiral light-matter interaction that arises between the circularly polarized dipole source and the two counter-propagating edge modes in a dielectric PTI depends on both the spin and position of the dipole source.

[1] L. Lu, J. D. Joannopoulos, M. Soljačić, "Topological photonics," Nat. Photonics, vol.8, p. 821, 2014.

[2] A. B. Khanikaev, S. H. Mousavi, W.-K. Tse, M. Kargarian, A. H. MacDonald, and G. Shvets, "Photonic topological insulators," Nat. Mater., vol.12, p. 233 (2013).

[3] L.-H. Wu and X. Hu, "Scheme for achieving a topological photonic crystal by using dielectric material," Phys. Rev. Lett., vol. 114, p. 223901, 2015.

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