NEW YORK CITY COLLEGE OF TECHNOLOGY

Physics Department

Center for Theoretical Physics

Photonic topological insulators: from theory to practical realization

Presented by:

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Abstract

The past three decades have witnessed the discovery of the Quantum Hall Effect (QHE), Quantum Spin Hall Effect (QSHE) and Topological Insulators (TIs) which transformed our views on the quantum states of matter. These exotic states are characterized by insulating behavior in the bulk and the presence of the edge states contributing to charge or spin currents which persist even when the edge is distorted or contains impurities. In the last few years, a number of research groups have realized that the same "robust" conducting edge states can be implemented in photonic systems. An early theoretical prediction [1, 2] and experimental demonstration [3] of the topologically protected transport of light opened a new direction in photonics. In this talk I will review development of this field with focus on photonic topological insulators with preserved time-reversal symmetry that we have recently proposed and realized experimentally with the use of bianisotropic metamaterials [4]. I will present new designs of photonic topological insulators based on waveguide geometries that has been implemented at microwave frequencies and will discuss perspectives for applications. It will be shown that photonic topological insulators offer an unprecedented platform for controlling light: deliberately created distribution of the bianisotropy, which playing the role of the effective magnetic field, allows routing of photons along arbitrary pathways without significant loss or backscattering [5].

[1] F. Haldane and S. Raghu, Phys. Rev. Lett. 100, 13904 (2008).
[2] Z. Wang, Y. D. Chong, J. D. Joannopoulos, and M. Soljačić, Phys. Rev. Lett. 100, 013905 (2008).
[3] Z. Wang, Y. Chong, J. D. Joannopoulos, and M. Soljacic, Nature 461, 772 (2009).
[4] A. B. Khanikaev, S. H. Mousavi, W.-K. Tse, et al.,Nature Mater. 12, 233 (2013).
[5] A. B. Khanikaev, Nature Photon. 7, 941 (2013).

Light refreshments will be served.