Topological Photonics

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In the context of photonics, topology has emerged as an abstract, yet surprisingly powerful, new paradigm for controlling the flow of light. As such, it holds great promise for a wide range of advanced applications, from scatter-free routing and switching of light along arbitrary three-dimensional trajectories to long-distance transmission of slow-light waves. Whereas topological effects in condensed matter originate typically from the fermionic Kramer’s degeneracy or the quantum Hall effect in the presence of strong magnetic fields, these mechanisms cannot be readily adapted due to the bosonic nature of photons and the notoriously weak magnetic interactions at optical frequencies. Recently, a number of approaches for the realization of photonic topological transport have been put forward. Among these, perhaps the most promising one follows the spirit of Floquet topological insulators, in which temporal variations of solid-state systems induce topological edge states. In the context of photonics, temporal modulations serve to break the time-reversal symmetry and thereby give rise to topologically protected one-way edge states.

In my talk, I will present an introduction to topology in photonics, with a particular focus on our work on the implementation of photonic Floquet topological insulators. The purpose is to review these and other recent developments, to discuss potential applications and to stimulate new conceptual ideas.