Topological band theory of network models : “anomalous” Floquet states and a photonic experiment

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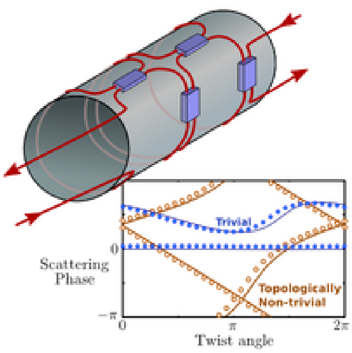
A recently proposed class of topological photonic systems is shown to map onto the Chalker-Coddington network model, which was originally formulated to study disordered quantum Hall systems. Formally, stationary states of network models are equivalent to the Floquet states of a periodically driven lattice. We show that such network models can indeed exhibit topologically protected edge states even if all bands have zero Chern number, which is a characteristic property of Floquet band structures. [1].

We also report on the measurement of a topological invariant in a (microwave) photonic implementation of the network model. Here the topological “edge” invariant is directly accessible through the winding number of the complex reflection coefficients. The experiment can be regarded as a variant of a topological pump, with nonzero winding in the reflection matrix implying the existence of topological edge states. [2].



Left : Schematic of the “topological pump” setup which was used to measure the topological invariant of a 2D photonic network. Right : Arguments of the complex scattering matrix eigenvalues for the two-cell network, as the pumping parameter is tuned through 2π. The two eigenvalues having winding numbers ± 1 corresponds to the bulk band structure being topologically non-trivial.

1. M. Pasek and Y. D. Chong, Phys. Rev. B **89**, 075113 (2014).
2. W. Hu, J. C. Pillay, K. Wu, M. Pasek, P. P. Shum, and Y. D. Chong, Phys. Rev. X **5**, 011012 (2015).