Simulating 2D topological quantum walks with photons transverse momentum

Quantum walks (QWs) are simple processes that can simulate exotic phenomena like topological phases of matter. Here we present a novel photonic platform realizing QWs over two-dimensional lattices, relying on the transverse momentum of a light beam. The desired dynamics is obtained by exploiting spin-orbit coupling in liquid crystals polarization gratings. The engineered QW exhibits non-trivial topological phases. By simulating the effect of an external force and observing the bulk dynamics only, we accurately detected the QW invariant, i.e. the Chern number of its eigenstates.

Reference: A. D'Errico *et al.,* Two-dimensional quantum walks in the momentum space of structured light, arXiv:1811.04001 (2018).