Engineering an Angular Momentum Bias with Linear Synthetic Motion

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Topological photonics provides an elegant framework to classify different classes of photonic crystals and waveguides with complete band gaps [1]. Conventional photonic crystals are material structures with a periodic spatial modulation of the refractive index. Recently, time has emerged as a new degree of freedom in system design. In particular, the crystal notion has been extended to structures presenting *time* modulations [2-5]. Time and spacetime modulations enable exotic and nonreciprocal light-matter interactions, which can be useful for a myriad of optical applications.

Crystals with a spacetime travelling-wave modulation, $\varepsilon = \varepsilon(x - vt, y, z)$ with v the modulation speed are especially significant as they enable a relatively simple analytical modelling and because they can be used to engineer a synthetic translational motion [2, 3]. Heuristically, nontrivial topological phases must be associated with some form of internal angular momentum [6], analogous to the angular momentum imparted on a charged particle by a magnetic field, which is at the origin of the nontrivial topology of gyrotropic materials. This property suggests that travelling-wave spacetime modulations are unsuitable to generate nontrivial topological phases. In this talk, we will show that surprinsingly this understanding is wrong, and that it is possible to engineer a synthetic spacetime rotation and nontrivial topological phases in crystals with a pure travelling-wave (linear) modulation. Our findings are not only interesting from a theoretical standpoint, but also unveil an exciting path to engineer nontrivial material topologies in spacetime crystals.

References

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