Hyperbolic media with a twist

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Abstract

In the last decades, the connection between physics and topology has resulted in the discovery of several new phenomena. A celebrated example is the field of topological insulators, in which topological quantities of the bulk medium in reciprocal space dictate the presence of protected boundary transport. Differently, the intrinsic open or closed topology of a medium isofrequency contours, which strongly depends on the system symmetries, also plays a major role on wave propagation. For instance, open hyperbolic contours are strongly anisotropic and support highly directional ray-like waves, whose features are relevant to waveguiding, sensing and imaging. Coincidently, the rapid expansion of twistronics beyond solid-state physics has showed the potential of rotations as an interesting knob for controlling and breaking the symmetries of a medium. Inspired by these ideas, we have investigated how the interplay between the twist and the medium contour topology permits to explore the impact of progressive symmetry breaking on wave propagation. Here, we present some recent results linked to the combination between macroscopic hyperbolic phononic metasurfaces and additional rotations, ranging from twisted multilayers to oddly-shaped cavities, thereby providing an overview of the physical mechanisms at play and their potential practical implications.

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