Physical Sciences Seminar

Topological non-Hermitian origin of surface electromagnetic and acoustic waves

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More than 60 years ago it was shown that interfaces between isotropic homogeneous optical media (including dielectrics, metals, negative-index materials) can support surface electromagnetic waves, which now play crucial roles in plasmonics, metamaterials, and nano-photonics. I will show that such surface Maxwell waves have a topological origin explained by the bulk-boundary correspondence. Importantly, the topological classification is determined by the photon helicity operator within the Weyl-like representation of Maxwell equations, which is generically non-Hermitian even in lossless optical media. The corresponding topological invariant, which determines the number of surface modes, is a Z4 number (or a pair of Z2 numbers) describing the winding of the complex helicity spectrum across the interface. I will also provide similar considerations and topological explanation of the surface acoustic wave that appears at interfaces between positive- and negative-density acoustic media. Instead of helicity, its properties are described by the effective non-Hermitian four-momentum operator within the Klein-Gordon representation of sound waves, which provides a single Z2 bulk index. Our theory provides a new twist and insights for several areas of wave physics: Maxwell electromagnetism, topological quantum states, non-Hermitian wave physics, and metamaterials.

Tuesday, April 28, 2020 11:00am - 12:00pm
Heinzel Seminar Room / Office Bldg West (I21.EG.101)

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