



Exotic Leaky-Wave Phenomena in Meta-Structures and Their Connections to the Electromagnetic Pioneers from Last Century

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Leaky waves have been extensively studied in microwave engineering over several decades. They are known to dominate the radiation properties of several geometries, including open waveguides, gratings and arrays, and have been used to tailor the radiation patterns with large flexibility for many applications. In metamaterials, leaky waves have played a fundamental role since the beginning of this research field. Composite right-left-handed metamaterials have been used to address one of the fundamental challenges in leaky-wave antennas, their cut-off at broadside. Since then, many unusual features of leaky-wave radiation in metamaterial structures have been discussed. In this talk, we will review our latest progress in the area of metamaterials and meta-structures [1-6], pointing out the fundamental role that leaky-waves play in several of these phenomena. We will discuss unusual leaky-wave radiation with infinite radiative lifetime associated with embedded eigenstates, and the possibility of realizing non-reciprocal leaky-wave radiation by using spatio-temporally modulated transmission-lines. We will also discuss the role of leaky waves in the first observation of topological edge states in metamaterials with non-trivial topological order, mimicking topological insulators for photons. After overviewing these concepts, we will discuss the exciting opportunities offered by metamaterials in this established field of research, and how unusual wave interactions in meta-structures may push forward a new wave of interest in leaky-wave phenomena. We will also discuss opportunities, potentials, challenges and fundamental limitations enabled by these approaches, physical insights, and their implications from basic science to technology.

References

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