Appunti di Fisica '25

3 Aprile ore 15:00

Aula Leonardo, Dipartimento di Scienze Matematiche e Informatiche, Scienze Fisiche e Scienze della Terra (MIFT) - Università degli Studi di Messina

Emergence of Hermitian Subspaces and Perfect Absorption

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Parity-time (PT) symmetry has become a fundamental concept in the study of non-Hermitian effects, both theoretically and experimentally. Early implementations relied on a balance between loss and gain in amplifying materials. However, it was later demonstrated that effective PT symmetry can also be realized using exclusively passive materials, wherein the feeding field in an open system serves as an effective gain. In the PT-symmetric phase, such systems exhibit perfect absorption, a key concept in many photonic applications.

In this work, we introduce the concept of Hermitian subspaces in open-cavity quantum electrodynamics (QED) systems, extending previous findings beyond PT symmetry and establishing a direct connection to perfect absorption. Our results reveal that the key to balancing the feeding and loss rates in cavity QED systems, without requiring PT symmetry, is the ability to control the fraction of "photon content" within a polariton mode. Furthermore, Hermitian subspaces influence the overall structure of coherent spectra in cavity QED systems. These findings are supported by recent experimental observations in magnetic systems, based on molecular spin centers with large nuclear spin and hyperfine anisotropy. Our results significantly expand the possibility to explore and apply non-Hermitian effects in open quantum systems, offering potential applications in the design of highly efficient optical switches and modulators with high modulation depths across a broad range of spectral frequencies.