Scattering Anomalies: Recent Breakthroughs and Quantum Applications

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Abstract

Scattering of light is a ubiquitous process that has driven human minds' curiosity for thousands of years, from ancient Greek philosophers to modern physicists. Enhanced light-matter interactions in structured materials lie at the heart of today's experimental physics and technology, both in classical and quantum realms. Hence, deep insight into the basics of scattering theory and understanding the peculiar features of electromagnetic scattering is necessary for the correct interpretation of experimental data, understanding the underlying physics, and advanced applications. Recently, a broad spectrum of exceptional scattering phenomena attainable in suitably engineered structures has been predicted and demonstrated, including bound states in the continuum (BIC), exceptional points in PT-symmetrical non-Hermitian systems, coherent perfect absorption, virtual perfect absorption, and nontrivial lasing. In this talk, I will discuss these unusual scattering phenomena focusing on their quantum applications. I will provide a unified description of such exotic scattering phenomena and show that their origin can be traced to the fundamental properties of the underlying S-matrix. I will show that these insights provide a powerful approach to tailoring unusual scattering regimes for various advanced quantum computing and quantum sensing applications.

Bio

Prof. Alex Krasnok earned his Ph.D. from ITMO University (2013). After spending two years (2016-2018) as a research scientist at The University of Texas at Austin, and three years with CUNY Advanced Science Research Center (New York) as a Research Assistant Professor and Founding Director of Photonic Core Facility, he joined Florida International University in 2021 as a tenure-track Assistant Professor. Prof. Krasnok' current research interests are in nanophotonics and quantum optics, with particular emphasis on cross-disciplinary research. He has made significant contributions in the areas of extreme scattering engineering, nanoantennas, metasurfaces, optics of 2D transition-metal dichalcogenides, and low-loss dielectric nanostructures. Alex has authored or co-authored five books and book chapters, four patents, and more than 150 papers. He has earned several research awards and grants, including the gold medal of Nobel Laureate Zhores Alferov's Foundation (2016) and the Early-Career Award in Nanophotonics (2021).