Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Supersymmetry and transformation optics MOHAMMAD-ALI MIRI, MATTHIAS HEINRICH, DEMETRIOS CHRISTODOULIDES, CREOL, The College of Optics and Photonics, University of Central Florida, NONLINEAR WAVE GROUP TEAM — Supersymmetry (SUSY) originated within the framework of quantum field theory as a means to treat fermions and bosons on an equal footing. While the verification of such theories remain an ongoing challenge in particle physics, some of their fundamental notions have been successfully adapted to other fields. As shown recently, optics can provide a versatile platform where the implications of supersymmetric transformations can be studied and observed. In this regard, any optical structure can be paired with a superpartner with similar guided wave and scattering properties. As a result, the guided mode spectra of these optical waveguide systems can be judiciously engineered so as to realize new families of mode filters and mode division multiplexers and demultiplexers. Here we show that the concept of supersymmetry can be used to synthesize scattering settings with identical scattering properties, thus giving rise to an entirely new class of transformation optics. By systematically eliminating all bound states, scattering arrangements with a low refractive index contrast can be designed to faithfully mimic the scattering behavior of high-contrast structures. Similar strategies can be used to replace negative-permittivity domains, thus avoiding unwanted optical losses.

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Date submitted: 14 Nov 2014 Electronic form version 1.4