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Anomalous scattering of light: from invisibility to superscattering

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In the talk, diverse scenarios of invisibility will be reviewed and exemplified. Extensive development of invisibility cloaks which can make good scatterers invisible has been mainly connected with the raise of metamaterials in the early 2000s. Metamaterials enable Transformation Optics offering such desired distributions of the material parameters of the cloak, a specific coating of the object, that redirection of the light "rays" around the object enables its invisibility for far-zone observer, while nearly zero field values are kept within the object region. In turn, scattering cancellation is achieved in core-shell spherical or cylindrical structures, or arrays on their basis, due to the different signs of polarizability of the core and the shell, which are made of different homogeneous materials. Invisibility scenarios based on the inner resonances, such as Localized Surface Plasmon resonances, Mie resonances and Fabry-Perot interferences, typically do not allow keeping zero fields in the object region but still enable invisibility for far-zone observer. The numerical examples will be presented and discussed for the scenarios of this type. Moreover, the approaches were proposed to achieve invisibility of spatial distortions at a flat or a gradually curved surface, by covering them by a sophisticatedly designed coatings. Besides, the external cloaking will be discussed, which may hide a radiation source located outside the cloak. As a counterpart of invisibility, superscattering may appear which means that the scattering is unusually strong for a given small scatterer. The best known scenarios of superscattering utilize some kinds of Localized Surface Plasmon resonances. As far as the spoof surface plasmons are achievable by means of the structured metallic or metallo-dielectric surfaces, they constitute a suitable route to superscattering that allows avoiding scattering suppression connected to the losses in the used natural materials. Finally, examples will be presented for switching between weak and strong scattering regimes and for different mechanisms of invisibility in the closely spaced frequency ranges. The both are achieved by using tunable materials as the coating's materials.

Topics

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