Ultra-transparency Induced by Spatial Dispersions

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Natural transparent materials like glass or crystal always induce a certain amount of reflection due to impedance mismatch, except for selected polarization and a single incident angle denoted as the Brewster's angle. Artificial electromagnetic materials like metamaterials or photonic crystals provide the possibility to break this limit and realize ultra-transparency. By using photonic media with spatial dispersions, which are usually viewed upon as a nuisance rather than an advantage, can surprisingly achieve totally transparency for a wide range of and even all incident angles, i.e. ultra-transparent materials. Such an ultra-transparency effect is proved numerically and experimentally by a photonic crystal with a shifted elliptical dispersion, which also supports formation of ideal virtual images without aberrations. The speaker's work provides a theory for constructing ultra-transparent spatially dispersive media, and proposes a photonic crystal approach to realize such media, opening rich possibilities in novel optical designs such as wide-angle super-polarizer and transformation optics devices.