Confining light with negative refraction in checkerboards

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In a seminal paper, Pendry demonstrated that a slab lens with refractive index n=-1 (NRM) not only involves the propagative waves but also the evanescent near-field components of a source in the image formation [1]. Using a geometric technique it was recently shown [2] that two rectangular (semi-infinite) intersecting wedges of NRM act as an imaging system whereby a source gets imaged onto itself. This system, originally studied by Notomi [3] using a ray picture, was thus shown to involve the evanescent modes also and to act as a unique open resonator. The properties of a class of heterogeneous anisotropic perfect corner reflectors in the presence of dissipation have also been studied in [4]. It was shown that the Local Density of States (LDOS) at the corner becomes infinite in the limit of zero absorption, due to infinite degeneracy of the resonance mode. Some of us subsequently generalized this imaging effect to a rectangular checkerboard lattice where alternating cells have positive (n=1) and negative (n=-1) refractive index [5]. It was shown that a source placed in one cell would reproduce itself in every other cell of the infinite lattice. In the present study, we address confinement of light in such checkerboards when they have a finite size. A complex network of plasmon resonances at the interfaces separating positive and negative index media takes place for large enough checkerboards, leading to some subwavelength imaging of a source located within the meta-material. Finally, light confinement is photonic crystals structured as checkerboards is also investigated [7].

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