A Chirality Switching Device Designed with Transformation Optics

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Switching the chirality is our dreams due to the importance of it which originates from asymmetric synthesis[1]. It is not easy to achieve because the structure needs to be changed mechanically. However people can use optical ways to "change" the chirality of certain objects effectively, for example a mirror transforms a right-handedness object to a left-handedness image. In recent years the propose of Transformation Optics[2–4] has provided a convenient way to do this, but such an approach suffers the limitations that the device is object-depended and the objects hidden inside the device must be transparent.

In viewing these previous effects, we find it still highly challenging to design a chirality-switching device. So in this paper we show that an optical device can be designed based on Transformation Optics[2–4], such that an object hidden inside would exhibit a reversed chirality (i.e., from left-handedness to right-handedness) for an observer at the far field. Distinct from a perfect mirror which also creates a chirality-reversed image, our device makes the original object completely invisible to the far field observer. Numerical simulations are employed to demonstrate the functionalities of the designed devices in both two- and three-dimensional spaces, as shown in the following figure[5].

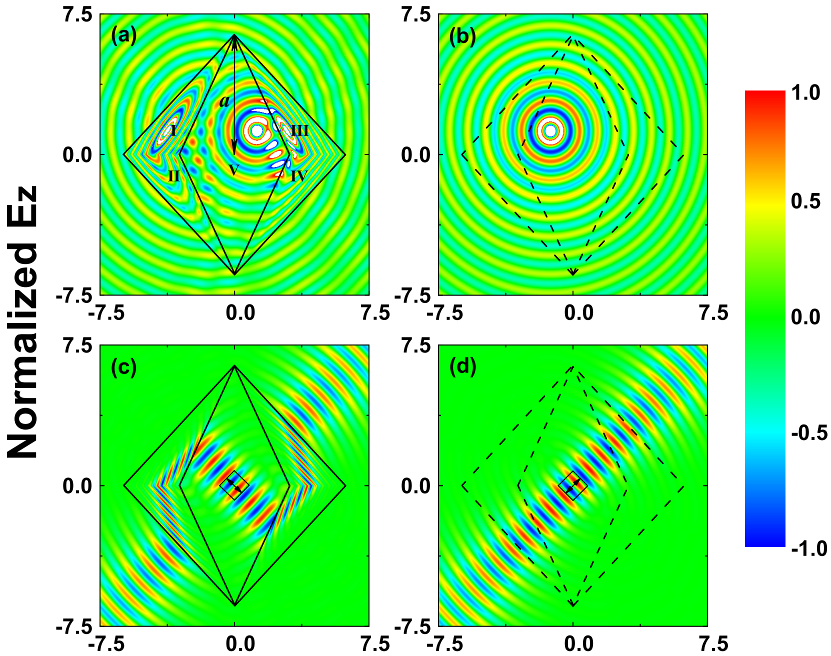

Figure 1: (a) Radiation pattern of a line source placed inside the 2D device. (b) Radiation pattern of a line source placed in free space, at the mirror-reflection position of the source. (c) Radiation pattern of a directional source inside the device, which emits rays only along two directions $\vec{k} = \pm(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 0)k_0$. (d) Radiation pattern of another direction source placed in free space, which emits rays only along two directions $\vec{k} = \pm(\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 0)k_0$.

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