A METAMATERIAL THAT COMPENSATES FOR OPTICAL DIFFRACTION

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Optical metamaterials are nanomaterials that offer unparalleled control over the propagation and generation of light. We design optical metamaterials that compensate for optical diffraction [1, 2]. Consisting of silver nanorods in glass [3], they admit light propagation only in a set direction. We further tune the material to exhibit very low absorption and reflection.

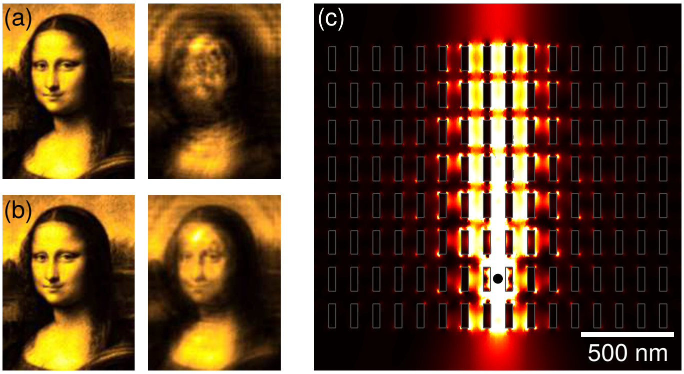

Figure 1: An image of Mona Lisa propagates through (a) a 200 µm thick slab of glass, and (b) a slab of a diffraction-compensating metamaterial of the same thickness. The smallest feature size in the image is 1 µm. In (c), the radiation of an emitter (black dot) placed inside the material propagates in a narrow beam.

Our material can transfer arbitrary optical images over long distances without distortion. Figures 1a and 1b illustrate propagation of an image of Mona Lisa through glass and the metamaterial, respectively. In glass, the image is blurred by diffraction beyond recognition, but in the metamaterial, it is surprisingly well preserved. Figure 1c shows that a dipole source placed inside the material radiates into a narrow, intense beam that is free of optical diffraction [4]. We discuss how the unidirectional propagation effect allows optical waveguides to be formed by light itself, leading to a possible future platform for optical circuits and other integrated optical devices.

[1] V. Kivijärvi, M. Nyman, A. Shevchenko and M. Kaivola, *J. Opt.* **18**, 035103 (2016).
[2] V. Kivijärvi, M. Nyman, A. Karrila, P. Grahn, A. Shevchenko and M. Kaivola, *New J. Phys.* **17**, 063019 (2015).
[3] V. Kivijärvi, M. Nyman, A. Shevchenko and M. Kaivola, *Opt. Express* **24**, 9806 (2016).
[4] M. Nyman, V. Kivijärvi, A. Shevchenko and M. Kaivola, "Generation of light in spatially dispersive materials", under review in *Phys. Rev. A*.