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Veselago lensing with ultracold atoms in an optical lattice MARTIN LEDER, CHRISTOPHER GROSSERT, MARTIN WEITZ, University of Bonn — Veselago pointed out that electromagnetic theory allows for materials with a negative index of refraction, in which most known optical phenomena are reversed. A slab of such a material can focus light by negative refraction, an imaging technique strikingly different from conventional positive refractive index optics, where curved surfaces bend the rays to form an image of an object. Here we demonstrate Veselago lensing for matter waves, using ultracold atoms in an optical lattice. A relativistic, i.e. photon-like, dispersion relation for rubidium atoms is realized with a bichromatic optical lattice potential. A Raman pi-pulse technique serves to transfer atoms between two different branches of the dispersion relation, and the relativistic lensing occurs by a backwards propagation of atomic wavepackets on an energetically mirrored branch of the dispersion relation. We observe negative refraction and Veselago lensing both in a one-dimensional geometry and perform a ray-tracing simulation of a two-dimensional Veselago lens.

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