197. Title: Enhanced lens by epsilon and mu near-zero metamaterial boosted by extraordinary optical transmission

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Abstract: In this paper we report directivity enhancement by a short-focal-length plano-concave lens engineered by stacked subwavelength hole arrays (fishnet-like stack) with an effective negative index of refraction close to zero, n -> 0, that arises from epsilon and mu near-zero extreme values. The plano-concave lens frequency response shows two enhancement peaks, one at the wavelength corresponding to n = -1 and, prominent in this configuration, another unexpected peak when n -> 0 that comes as a result of the similar low values of epsilon and mu. The frequency-dependent negative refractive index and beam-forming properties of the lens are supported by finite-integration-frequency and time-domain simulations and experimental results. This near-zero metamaterial lens can find applications in terahertz and even optics since the building block, stacked extraordinary optical transmission layers, has already been reported for those regimes under the name of fishnet structure.