OSS10-2010-000005

Abstract for an Invited Paper
for the OSS10 Meeting of
the American Physical Society

Negative Refraction and Radiationless Interference: The Quest for the Superlens[1]

ROBERTO MERLIN, University of Michigan

The first part of the talk will take us from the late 1800's, when Abbe published his ground-breaking paper on the limit of resolution of an optical instrument, to the turn of the 20th century, when the field of near-field optics experienced a tremendous growth, emphasizing recent developments motivated by the work of Pendry on negative-index superlenses [1]. We will also discuss how Abbe's result is related to Heisenberg's uncertainty principle and how the diffraction limit can be bypassed without violating any physical law. In the second part of the talk, the concept of near-field plates (NFPs) will be introduced [2]. These are planar structures which rely on a hitherto unrecognized property of Maxwell's equations to provide focusing well beyond the diffraction limit, at arbitrary frequencies. The subwavelength electromagnetic-field distributions closely resemble those of slabs of negative-index material. The structures' design is related to that of the Fresnel plates in that diffraction forces the input field to converge to a spot on the focal plane. Unlike the conventional zone plates, the NFPs control the near field and, as such, their superlensing properties originate from a static form of interference. Practical implementations of these plates hold promise for near-field data storage, non-contact sensing, imaging, nanolithography and wireless power transfer applications. Experimental results on a microwave near-field plate will be presented, which demonstrate focusing of 1 GHz radiation at a resolution of $\lambda/20$ [3].

[1] J. B. Pendry, *Phys. Rev. Lett.* **85**, 3966 (2000)
[2] R. Merlin, *Science* **317**, 927 (2007)
[3] A. Grbic, L. Jiang and R. Merlin, *Science* **320**, 511 (2008).

[1]Supported by AFOSR through the MURI Program.