Pseudocanalization regime for magnetic dark-field hyperlenses

Hyperbolic metamaterials (HMMs) are the cornerstone of the hyperlens, which brings the superresolution effect from the near-field to the far-field zone. For effective application of the hyperlens it should operate in the so-called canalization regime, where the phase advancement of the propagating fields is maximally suppressed and thus field broadening is minimized. For conventional hyperlenses it is relatively straightforward to achieve canalization by tuning the anisotropic permittivity tensor. However, for a dark-field hyperlens designed to image weak scatterers by filtering out background radiation (dark-field regime) this approach is not viable because design requirements for such filtering and elimination of phase advancement, i.e., canalization, are mutually exclusive. Here we propose the use of magnetic (μ-positive and -negative) HMMs to achieve phase cancellation at the output equivalent to the performance of a HMM in the canalized regime. The proposed structure offers additional flexibility over simple HMMs in tuning light propagation. We show that in this “pseudocanalizing” configuration the quality of an image is comparable to a conventional hyperlens, while the desired filtering of the incident illumination associated with the dark-field hyperlens is preserved.