

Toroidal moments in electromagnetic metamaterials

T Kaelberer, N Papasimakis, V A Fedotov and N I Zheludev

Optoelectronics Research Centre & Centre for Nanostructured Photonic Metamaterials, University of Southampton, UK

We report the development of a new type of metamaterials supporting resonantly induced toroidal moments, the importance of which has recently been recognized in solid state, nuclear and particle physics. Our aim is to create a classical electrodynamic system, such as toroidal metamaterial [1], that enhances the elusive toroidal moment and suppresses the background of conventional multipole excitations, thus allowing the direct observation of its contribution to optical activity, anisotropy, asymmetric transmission and the formation of negative index bands.

Microwave experiments and numerical modelling are reported for a range of toroidal metamaterial structures (see figure 1).

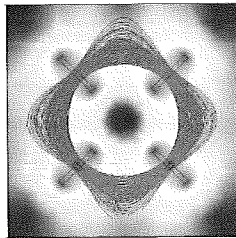


Figure 1. Simulated distribution of magnetic field lines and magnetic energy density corresponding to a toroidal moment resonantly excited in the metamaterial unit cell.

[1] Papasimakis N, Fedotov V A, Marinov K and Zheludev N I, Gyrotropy of a metamolecule: wire on a torus, Phys. Rev. Lett. 103, 093901 (2009).