Advances in isotropic split ring metamaterials

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Abstract— The problem of developing negative μ and negative refraction (NRI) 3D isotropic split ring metamaterials is addressed. First of all the necessary symmetries required to guarantee an isotropic behavior are analyzed. Secondly an homogenization procedure taking into account spatial dispersion is developed for magnetic split ring metamaterials. It is shown that this homogenization also accounts for all kind of waves (electromagnetic and magnetoinductive) previously reported in negative-μ split ring metamaterials. Finally, the possibility of developing isotropic NRI metamaterials from chiral split ring resonators (SRRs) is discussed in detail

In spite of many efforts in this direction (see e.g. [1], [2], [3]) the depelopment of practical 3D isotropic metamaterials is still a challenging issue. This issue will be addressed during the presentation, starting from the generalization of the well known split ring resonator (SRR) configuration. Cubic arrangements of such elements will be considered, and the necessary spatial symetries that guarantee an isotropic behavior in three dimensions will be discussed. From this analysis some proposals to develop periodic and isotropic negative-μ split ring metamaterials will come out [4], [5]. Once the spatial symmetries necessary to ensure electromagnetic isotropy have been identified, the homogenization problem is addressed. Two main kond of waves have been reported in 3D split ring metamaterials: electromagnetic and magnetoinductive [**?**]. The proposed homogenization procedure, which takes into account spatial dispersion, also accounts for both kind of waves, thus providing the basis for a unified macroscopic electromagnetic theory of 3D split ring metamaterials [6]. Finally, the development of cubic negative refractive index (NRI) split ring metamaterials is addressed. The starting point of this analysis is the possibility of develping NRI metamaterials from chiral inclusions, previously suggested by S.Tretyakov [7]. It will be shown that cubic arrangements of chiral-SRRs can provide suitable designs for this purpose [8].

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