Dr. L. Morini  
School of Engineering, Cardiff University, Cardiff, UK  
morinil@cardiff.ac.uk

Quasicrystalline multilayered metamaterials: negative refraction and self-similarity of the Bloch-Floquet spectrum

The seminar will be given in English

We investigate the problem of an antiplane wave obliquely incident at the interface between an elastic substrate and a laminate is investigated. The considered layered media possess a quasicrystalline structure, generated according to the Fibonacci substitution rules [1]. The substrate-laminate system is studied combining the transfer matrix method to the normal mode decomposition technique [2]. The diffraction angles associated with the transmitted modes are estimated by means of the space averaging procedure of the Poynting vector [3]. We show that, with respect to a periodic classical bilayer [4], on the one hand, beyond a certain frequency threshold, high order Fibonacci laminates can provide negative refraction for a wider range of angles of incidence, on the other, they allow negative wave refraction at lower frequencies. Moreover, the performed numerical results illustrate that the Bloch-Floquet spectrum corresponding to this class of laminates has a self-similar character linked to the specialization of the Kohmoto’s invariant, a function of the frequency that was recently studied by the authors for periodic one-dimensional quasicrystalline-generated waveguides [5]. This function is able to explain two types of scaling occurring in dispersion diagrams. The obtained results represent an important advancement towards the realisation of multilayered quasicrystalline metamaterials.

References
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