BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA

INSTITUTO DE FÍSICA
"Luis Rivera Terrazas"

SEMINARIO
"DR. JESUS REYES CORONA"

"Metafluid with anisotropic dynamic mass"

Dr. J. Jesús Arriaga Rodríguez
Instituto de Física
Benemérita Universidad Autónoma de Puebla.

Anisotropy is a property which is usually associated with crystal solids. Fluids and glasses are naturally isotropic in the absence of external fields. Anisotropy may, however, be artificially stimulated by embedding periodic structures in naturally isotropic fluids. Then these artificial structures — so called phononic crystals — may have very unusual properties. Within a narrow band of frequencies of sound the effective mass or the effective elastic modulus of specially designed phononic crystals may become anisotropic, take negative values, or acquire abnormally large imaginary part. Due to such "strange" properties that do not exist for natural materials these artificial structures are usually called *metamaterials* or *metafluids* We show that a fluid filling the space between solid cylinders arranged in a two-dimensional lattice exhibits anisotropic dynamic mass for sound waves propagating through the lattice, if its unit cell is anisotropic. Using the plane-waves expansion method proposed in Ref. [1] we derive (in the long wavelength limit) a formula for the effective mass tensor of the metafluid. The proposed formula is very general and it is valid for arbitrary Bravais lattices and arbitrary filling fractions of the cylinders. In particular, we calculate the effective mass tensor for sound waves in air with embedded lattice of aluminum cylinders having different cross sections. We consider cylinders with circular and triangular cross sections arranged in both rectangular and hexagonal lattice. The proposed method of calculation may find numerous applications for tailoring of metafluids with prescribed anisotropy which is necessary for design of acoustic cloaks [2].

[1] A.A. Krokhin, J. Arriaga, and L. Gumen, *Phys. Rev. Lett.* **91**, 264302 (2003).
[2] S.A. Cummer and D. Schurig, *New J. Phys.* **9**, 45 (2007).

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