Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Spiral-based metamaterials: from local resonance to inertial amplification and Bragg scattering[1] ANDRE FOEHR, Department of Mechanical and Process Engineering, ETH-Zurich, OSAMA R BILAL, Department of Physics, ETH-Zurich, Department of Mechanical and Process Engineering, ETH-Zurich, CHIARA DARAIO, Division of Engineering and Applied Science, California Institute of Technology, Pasadena, CA — Materials with engineered structural periodicity, obtained repeating in space unit cells with predetermined properties, can be used to modify the propagation of waves. In solids, such materials have been suggested for application in vibration insulation, acoustic focusing or elastic wave cloaking. Unit cells consisting of Archimedean spirals have rich dynamic properties and can be fabricated at the micro- and macro-scales, targeting different frequency ranges. Here, we show that by tuning the geometry of the spirals and arranging them in a lattice, they can act as Bragg scatterers, locally resonant metamaterials, or inertially amplified systems. We analyze the parametric transition between these three different band gap-opening mechanisms. We focus on the effect of inertial amplification and observe experimentally ultra-low and ultra-wide frequency bandgaps.

[1]This work was partially supported by ETH Research Grant No. ETH-24 15-2 and ETH Postdoctoral Fellowship FEL-26 15-2.

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Date submitted: 10 Nov 2016 Electronic form version 1.4