Abstract Submitted
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Nonsymmorphic Phononic Metamaterials: shaping waves over multiple length scales[1] CHEONGYANG KOH, DSO National Laboratories, S118230, Singapore, EDWIN THOMAS, School of Engineering, Rice University, P.O. Box 1892, Houston, Texas 77251, USA — The vector nature of the phonon makes rational design of phononic metamaterials challenging, despite potential in unique wave propagation behavior, such as negative refraction and hyper-lensing. While most designs to date focus on the "meta-atom" (building block) design, their "spatial arrangement" (non-locality) is equally instrumental in dispersion engineering. Here, we present a generalized design framework (DF) for PMM design, utilizing both "global" and "local" symmetry concepts. We demonstrate, utilizing specific properties of nonsymmorphic plane groups, PMMs possessing i) a low-frequency in-plane complete spectral gap (ICSG) of 102% (CSG of 88%), ii) a set of polychromatic ICSGs totaling over 100% in normalized gap size. Within the same DF, we further integrate broken symmetry states (BSS) (edge states, waveguides, etc) with designed polarization, (de)localization and group velocities. In particular, we demonstrate how these BSS may be utilized to elucidate signatures of complex polarization fields through phonon-structure interactions, leading to interesting applications in elastic-wave imaging, as well as information retrieval by probing polarization states of scattering bodies over multiple scales.

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