Abstract

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Wave manipulation in space-time modulated phononic crystals

Phononic crystals are periodic structures that enable control over the propagation of elastic waves through their geometry and material properties. If their effective properties are modulated in both space and time, non-reciprocal wave propagation and new mechanisms for mode conversion and wave control can emerge.
In this seminar, we will present two approaches. The first concerns a passive system based on a nonlinear granular crystal in which a longitudinal wave modulating the shear stiffness induces asymmetric propagation as well as unidirectional conversion and transmission phenomena. The second is based on an active phononic crystal incorporating piezoelectric materials, where spatiotemporal modulation is achieved through dynamic control of the electrical boundary conditions. In the sonic regime, the overlap of the dispersion branches can enable broadband parametric amplification. This system can also support abrupt temporal interfaces, placing them within the class of Floquet metamaterials. Wave-packet scattering across such interfaces reveals both general temporal effects and phenomena specific to piezoelectric coupling, including the potential for trapping electrical charges at the electrodes.

Illustrations