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Sonic Landau-level lasing and synthetic gauge fields in mechanical metamaterials HAMED ABBASZADEH, ANOTON SOUSLOV, JAYSON PAULOSE, Lorentz Institute, HENNING SCHOMERUS, Lancaster University, VINCENZO VITELLI, Lorentz Institute — Mechanical strain can lead to a synthetic gauge field that controls the dynamics of electrons in graphene sheets as well as light in photonic crystals. Here, we show how to engineer an analogous synthetic gauge field for lattice vibrations. Our approach relies on one of two strategies: shearing a honeycomb lattice of masses and springs or patterning its local material stiffness. As a result, vibrational spectra with discrete Landau levels are generated. Upon tuning the strength of the gauge field, we can control the density of states and transverse spatial confinement of sound in the metamaterial. We also use the gauge field to design waveguides in which sound propagates robustly, as a consequence of the change in topological polarization that occurs along a domain wall in the bulk of the metamaterial. By introducing dissipation, we can selectively enhance the domain-wall-bound topological sound mode, a feature that may be exploited for the design of sound amplification by stimulated emission of radiation – SASERs, the mechanical analogs of lasers.

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