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Tunable acoustic switching and rectification in one-dimensional granular crystals NICHOLAS BOECHLER, Massachusetts Institute of Technology, GEORGIOS THEOCHARIS, CHIARA DARAIO, California Institute of Technology — We study a new mechanism for tunable acoustic switching and rectification, which we experimentally demonstrate in a one-dimensional granular crystal. The granular crystal is composed of an array of statically compressed elastic spherical particles that interact nonlinearly via Hertzian contact. The granular crystal is uniform except for a single light-mass defect placed near one boundary of the crystal. Because of the interplay of the periodicity, nonlinearity, dissipation, and asymmetry of the granular crystal, vibrations applied near the defect position cause the system response to bifurcate from periodic non-transmitting states to quasiperiodic and chaotic transmitting states with broadband frequency content. We illustrate the nature of this bifurcation using numerical simulations and compare these results to experimental observations. Because the bifurcation causes a sharp transition between states, this mechanism can lead to phononic switching and sensing. Furthermore, as switches and rectification devices are fundamental components used for controlling the flow of energy in numerous applications, we envision that this mechanism could more generally enable the design of advanced photonic, thermal, and acoustic materials and devices.

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