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Passive control of fully developed turbulent flow by subsurface phonons. MAHMOUD HUSSEIN, SEDAT BIRINGEN, ALAN HSIEH, CLEMENCE BACQUET, MARY BASTAWROUS, University of Colorado Boulder — Flow control is a central problem in fluid dynamics where the goal is to alter a flow's natural state to achieve improved performance, such as delay of laminar-to-turbulent transition or reduction of drag in a fully developed turbulent flow. Meeting this goal promises to significantly reduce the dependence on fossil fuels for global transport, impacting air and sea vehicles as well as long-range pipelines. In earlier work, we have shown that phonon motion underneath a surface interacting with a flow may be tuned to cause the flow to stabilize, or destabilize, as desired. This concept was demonstrated by simulating a fully developed plane Poiseuille (channel) flow whereby a small portion of an otherwise rigid wall is replaced with a one-dimensional phononic crystal. A Tollmien–Schlichting wave was introduced to the flow as an evolving disturbance. Upon tuning the frequency-dependent phase and amplitude relations of the surface of the phononic crystal that interfaces with the flow, an artificially introduced instability was shown to stabilize, or destabilize, as needed. In this work, we demonstrate the applicability of the phononic subsurface paradigm to the suppression of turbulence production events in fully developed turbulent flow.

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