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Phonons in active microfluidic crystals ALAN CHENG HOU TSANG, Stanford University, EVA KANSO, University of Southern California — One-dimensional crystals of driven particles confined in quasi two-dimensional microfluidic channels have been shown to exhibit propagating sound waves in the form of 'phonons', including both transverse and longitudinal normal modes. Here, we focus on one-dimensional crystals of motile particles in uniform external flows. We study the propagation of phonons in the context of an idealized model that accounts for hydrodynamic interactions among the motile particles. We obtain a closed-form analytical expression for the dispersion relation of the phonons. In the moving frame of reference of the crystals, the traveling directions of the phonons depend on the intensity of the external flow, and are exactly opposite for the transverse and longitudinal modes. We further investigate the stability of the phonons and show that the longitudinal mode is linearly stable, whereas the transverse mode is subject to an instability arising from the activity and orientation dynamics of the motile particles. These findings are important for understanding the propagation of disturbances and instabilities in confined motile particles, and could generate practical insights into the transport of motile cells in microfluidic devices.

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