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Topological sound in active-liquid metamaterials

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Active liquids can flow spontaneously even in the absence of an external drive. Recently, such liquids have been experimentally realized using molecular, colloidal, or macroscopic self-propelled constituents. Using active liquids as a building material, we lay out design principles for artificial structures termed topological active metamaterials. Such metamaterials break time-reversal symmetry and can be designed using periodic lattices composed of annular channels filled with a spontaneously flowing active liquid. We show that these active metamaterials support topologically protected sound modes that propagate unidirectionally (without backscattering) along either sample edges or domain walls, and despite overdamped particle dynamics. Our work illustrates how parity-symmetry breaking in metamaterial structure combined with microscopic irreversibility of active matter leads to novel functionalities that cannot be achieved using only passive materials.