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The role of geometry in nonlocal superfluids. KALI WILSON, DAVID VOCKE, Heriot-Watt University, EWAN WRIGHT, University of Arizona , FRANCESCO MARINO, Universita di Firenze, IACOPO CARUSOTTO, Universita di Trento, BRIAN P. ANDERSON, University of Arizona, DANIELE FACCIO, Heriot-Watt University — In this work we perform numerical and experimental studies that demonstrate the key role of fluid geometry when the fluid is also nonlocal. We show that the Bogoliubov dispersion relation associated with elementary excitations in a nonlocal quantum fluid may be modified by the system geometry, such that the system can be pushed into a regime where superfluid behavior is observed despite a high degree of nonlocality. This interplay between geometry and nonlocality is a general feature of the nonlocal interaction, with applications to dipolar BECs and nonlocal photon fluids. Tailoring the system geometry thus provides external control of the effective nonlocal length characterizing the fluid, and sets a threshold wavevector below which a linear, sonic dispersion relation consistent with superfluidity may be observed. We discuss this interplay in the context of recent experimental observations of superfluid behavior in a room-temperature, nonlocal photon fluid in a propagating geometry. We have experimentally observed signatures of superfluid behavior in the dispersion relation, and in the nucleation of vortex cores as the photon fluid flows past an extended obstacle, despite working with a highly-nonlocal thermal nonlinearity expected to suppress such superfluid behavior.

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