Experimental evidences of light superfluidity in a bulk nonlinear crystal

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Abstract

Quantum fluids of light merge many-body physics and nonlinear optics, through the study of light propagation in a nonlinear medium under the shine of quantum hydrodynamics. One of the most outstanding evidence of light behaving as an interacting fluid is its ability to carry itself as a superfluid. Here, we report a direct experimental detection of the transition to superfluidity in the flow of a fluid of light past an obstacle in a bulk nonlinear crystal. In this cavityless all-optical system, we extract a direct optical analog of the drag force exerted by the fluid of light and measure the associated displacement of the obstacle. Both quantities drop to zero in the superfluid regime characterized by a suppression of long-range radiation from the obstacle. The experimental capability to shape both the flow and the potential landscape paves the way for simulation of quantum transport in complex systems.

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