Modified excitation spectrum and superfluidity in open-dissipative polariton condensates

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ABSTRACT

Superfluidity is the spectacular property of dissipationless flow of macroscopically occupied bosonic states. A unique BKT-like state can be produced in two-dimensional semiconductor microcavity exciton-polaritons, which exists in the presence of gain and loss. The existence and nature of superfluidity in such an open-dissipative setting is currently an open question. Several theoretical studies[1,2] have pointed out that the standard Landau criterion for superfluidity must be redefined. With a continuously and non-resonantly pumped condensate as a background, a weak, non-resonant pump pulse is injected to perturbatively excite collective density waves and the resulting propagation dynamics are measured. The dispersive and supersonic group velocities inherent to the open-dissipative polariton condensates manifest themselves as the excitation of dispersive shock waves and grey solitons. Under certain experimental conditions, we find the conventional superfluidity and sound velocity are recovered.

1. *M. Wouters and I. Carnsotto, Phys. Rev. Lett. 105, 020602 (2010)*
2. *J. Keeling, Phys. Rev. Lett. 107, 080402 (2011)*