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Roton-maxon excitation spectrum of Bose condensates in a shaken optical lattice LI-CHUNG HA, LOGAN W. CLARK, COLIN V. PARKER, CHEN-YU XU, CHENG CHIN, The University of Chicago — We present a resonant lattice shaking technique for engineering the dispersion of a cesium Bose condensate. Through phase modulating an optical lattice at a frequency near the band splitting, the dispersion of the condensate can evolve from quadratic to quartic and finally into a double-well structure. We observe effective ferromagnetism in the double-well regime [1], and atoms form domains within one well in momentum space. We study the elementary excitations of this system by implementing projection-based Bragg spectroscopy and find a roton-maxon feature in the excitation spectrum in agreement with a Bogoliubov calculation [2]. Consistent with Landau's prediction, we observe a suppressed superfluid critical velocity due to the existence of the roton. We will introduce more precise characterizations of the dispersion in an effort to pinpoint the critical point at which the dispersion is purely quartic, and study the dynamics of particles in that case. This work is supported by NSF, ARO and Chicago MRSEC.

[1] Direct observation of effective ferromagnetic domains of cold atoms in a shaken optical lattice, Nature Physics 9, 769 (2013).
[2] Roton-maxon excitation spectrum of Bose condensates in a shaken optical lattice, Phys. Rev. Lett. (in press).

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