Stability spectroscopy: recurring roton signatures in a dipolar-BEC phase diagram

JOHN CORSON, JILA, NIST, and University of Colorado, RYAN WILSON, JQI, NIST, and University of Maryland, JOHN BOHN, JILA, NIST, and University of Colorado — When a strongly-dipolar Bose-Einstein condensate (BEC) is tightly confined in either one or two dimensions, the excitation spectrum is predicted to exhibit a nontrivial local minimum, termed “roton.” Rotons have proven to be elusive in dipolar-BEC experiments, and it is therefore of interest to devise a straightforward scheme whereby rotons may be measured. We propose observing the stability of a dipolar BEC that is perturbed by a tunable optical lattice. When the stability is mapped in terms of lattice depth $s$ and spacing $\lambda$, we find regularly-spaced features whose positions and periodicity are determined by the roton wavelength. In this sense, a measurement of the phase diagram represents a spectroscopic measurement of the roton itself. In quasi-two-dimensional geometry, the polarization tilt plays an important role in determining which features appear in the stability diagram.

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