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Bragg Spectroscopy of Excitations of a Quantum Bose Gas in a Lattice XU DU, EMEK YESILADA, CHANGHYUN RYU, SHOUPU WAN, DANIEL HEINZEN, The University of Texas — We have measured the excitation spectrum of a quantum degenerate Bose gas in an optical lattice with Bragg spectroscopy. We begin each cycle of the experiment by producing a magnetically trapped ^{87}Rb Bose condensate. We then superimpose a three-dimensional optical lattice of cubic symmetry onto the condensate. We turn the lattice potential on adiabatically, so that the gas temperature remains very close to zero. This provides an experimental realization of the Bose-Hubbard model, which exhibits a quantum phase transition between a superfluid and an insulating state. We find that in the superfluid state, the resonant excitation energy in the phonon-like regime decreases with increasing lattice strength. In the insulating regime, we observe the appearance of a sharp increase in the excitation rate at non-zero frequencies, which we interpret as a measurement of the gap in the insulating state of the gas.

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