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Bragg spectroscopy of Bose-condensed atoms in an optical lattice XU DU, SHOUPU WAN, EMEK YESILADA, CHANGYUN RYU, DANIEL HEINZEN, The University of Texas at Austin — We have carried out Bragg spectroscopy of the excitation spectrum of Bose-condensed ^{87}Rb atoms loaded into a three-dimensional optical lattice. We observe a transition between superfluid and Mott insulating states with increasing lattice height [1]. The superfluid state admits sound waves as excitations. In Bragg spectroscopy, two laser beams with adjustable frequency difference ω, intersecting at an angle θ, create such excitations. In our experiment, we monitor the energy transferred to the atoms as a function of the frequency difference at fixed angle. We find that the resonant peak in the Bragg spectrum of the superfluid moves to lower frequencies with increasing lattice strength, in agreement with calculations [2]. We also find evidence of a gap in the excitation spectrum when the gas is in its Mott insulating state. We acknowledge the support of this work by the R. A. Welch Foundation, The N. S. F., and the D.O.E. Quantum Optics Initiative. [1] Markus Greiner *et al.,* Nature **415**, 39 (2002). [2] Biao Wu, private communications.

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