

Abstract Submitted  
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**Observation of the supersolid stripe phase in spin-orbit coupled Bose-Einstein condensates**<sup>1</sup> JUNRU LI, JEONGWON LEE, WUJIE HUANG, SEAN BURCHESKY, BORIS SHTEYNAS, FURKAN TOP, ALAN JAMISON, WOLFGANG KETTERLE, Massachusetts Inst of Tech-MIT — Supersolidity combines the property of superfluid flow with long-range spatial periodicity of solids and has not been observed since predicted in condensed matter systems. The concept of supersolidity was then generalized to include other superfluid systems which break continuous translational symmetry. Bose-Einstein condensates with spin-orbit coupling are predicted to possess a stripe phase with supersolid properties. Here we report the first observation of the predicted density modulation of the stripe phase using Bragg reflection – the evidence for spontaneous long-range order in one direction while maintaining a sharp momentum distribution – the hallmark of superfluid Bose-Einstein condensates. In our system, the spin-orbit coupling was realized in an optical superlattice as described in [1]. Briefly two lowest bands in the superlattice were used as pseudospins and a Raman process was implemented to provide coupling between pseudospin and momentum. Our work establishes a system with unique continuous symmetry breaking properties, associated Goldstone modes and superfluid behavior. References: [1] J. Li *et. al* PRL **117**.185301 [2] J. Li *et. al* arXiv:1610.08194

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Junru Li  
Massachusetts Inst of Tech-MIT

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