Abstract Submitted
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Thermally activated defects in a two-dimensional lattice of Bose-Einstein condensates[1] VOLKER SCHWEIKHARD, SHIHKUANG TUNG, ERIC CORNELL, JILA, NIST and Department of Physics, University of Colorado, Boulder, CO 30309-0440, USA — We present a study of thermally activated phase defects in a two-dimensional (2d) Josephson junction array of Bose-Einstein condensates (BECs), created by adiabatically loading a pre-formed BEC into a 2d optical lattice. Each lattice site contains thousands of condensed atoms, so that the phase of each condensate is well-defined. Nearest-neighbor tunneling provides a Josephson coupling J which acts to keep the condensates' relative phases locked. A cloud of uncondensed atoms, in thermal equilibrium with the condensate array at a temperature T, on the other hand induces thermal fluctuations of the condensate phases. By varying the optical lattice depth we tune the Josephson coupling in the vicinity of the thermal energy, and thus induce a crossover between a phase-locked array for J>T and a disordered array for J<T. We observe phase defects by turning down the optical lattice on a timescale fast for the defects to heal, thus converting them to vortices and solitons in the reconnected condensate. The physics of this system is closely related to the Kosterlitz-Thouless transition observed in 2d superfluids and superconducting Josephson junction arrays.

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Volker Schweikhard
JILA, National Institute of Standards and Technology and
Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA

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