Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Observation of thermally activated vortex pairs in a quasi-2D Bose gas SANG WON SEO, JAE-YOON CHOI, WOO JIN KWON, SEJI KANG, JEONG HO HAN, YONG-IL SHIN, Seoul National University, QUANTUM GAS RESEARCH GROUP TEAM — The Berezinskii-Kosterlitz-Thouless (BKT) theory provides a microscopic mechanism for the 2D phase transition, where vortices with opposite circulation are paired below a critical temperature. The BKT mechanism has been experimentally tested in many 2D systems, but there has been no direct observation of the vortex pairing in a 2D superfluid. Here we report on the observation of thermally excited vortex pairs in a trapped quasi-2D Bose gas. We measure the in-plane distribution of thermally activated vortices in a trapped quasi-2D Bose gase, where the visibility of density-depleted vortex cores is enhanced by radially compressing the sample before releasing the trap. The pairing of vortices is revealed by the two-vortex spatial correlation function obtained from the vortex distribution. The vortex density decreases gradually as temperature is lowered, and below a certain temperature, a vortex-free region emerges in the center of the sample. This represents a crossover from a Berezinskii-Kosterlitz-Thouless phase with vortex-pair excitations to a vortex-free Bose-Einstein condensate in a finite-size 2D system.

[1] J. Choi, S. W. Seo, and Y. Shin, arXiv:1211.5649 (2012).

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Date submitted: 25 Jan 2013 Electronic form version 1.4