

Abstract Submitted
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Direct observation of mean-field induced phase collapse and retrieval in soft bosonic lattices¹ WEI LI, ARI TUCHMAN, HUI-CHUN CHIEN, MARK KASEVICH, Stanford University — We study the response of BEC+optical lattice system to sudden frustration of Josephson tunneling between adjacent lattice sites in the large filling factor (soft) regime[1]. We introduce a new experimental method which effectively discriminates between homogeneous (on-site) phase diffusion[2] and inhomogeneous (site-to-site) dephasing mechanisms. With this method, we observe quantitative agreement between the predicted and measured phase diffusion times. In particular, we demonstrate that the phase diffusion time can be increased by reducing the number fluctuations associated with the initial lattice states. This work extends the work of Greiner, et al.[3] to the large filling factor regime. Finally, we describe and demonstrate a technique for retrieval of long range phase coherence from this system. Surprisingly, coherence can be suddenly regained by abruptly allowing Josephson tunneling. We discuss the implications of these observations for envisioned superfluid de Broglie wave interferometers and in the study of non-adiabatic effects in superfluid/Mott-insulating systems.

[1] Orzel, C., Tuchman, A. K., Fenselau, M. L., Yasuda, M. & Kasevich, M. A. *Science* **291**, 2386-2389 (2001). [2] A. Imamoglu, M. Lewenstein & L. You. *Phys. Rev. Lett.* **78**, 2511(1997). [3] M. Greiner, O. Mandel, T. Esslinger, T. W. Hänsch & I. Bloch. *Nature* **415**, 39 (2002)

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