Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Quantum Synchronization of Two Ensembles of Atoms MINGHUI XU, DAVID TIERI, EFFIE FINE, JAMES THOMPSON, MURRAY HOLLAND, JILA, NIST and Department of Physics, University of Colorado, Boulder, Colorado
— We present a system that exhibits quantum synchronization as a modern analogue of the Huygens experiment which is implemented using state-of-the-art neutral atom lattice clocks of the highest precision. In particular, we study the correlated phase dynamics of two mesoscopic ensembles of atoms through their collective coupling to an optical cavity. We find a dynamical quantum phase transition induced by pump noise and cavity output-coupling. The spectral properties of the superradiant light emitted from the cavity show that at a critical pump rate the system undergoes a transition from the independent behavior of two disparate oscillators to the phase-locking that is the signature of quantum synchronization. Besides being of fundamental importance in nonequilibrium quantum many-body physics, this work could have broad implications for many practical applications of ultrastable lasers and precision measurements. This work was supported by the DARPA QuASAR program, the NSF, and NIST.

Minghui Xu
JILA, NIST and Department of Physics,
University of Colorado, Boulder, Colorado

Date submitted: 01 Feb 2014 Electronic form version 1.4