Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

**Superfluid-like shock waves in nonlinear optics** WENJIE WAN, JASON W. FLEISCHER, Princeton University — It is well-known, but often underappreciated, that condensate dynamics has analogies with nonlinear light propagation in optics. In both cases, a single, macroscopic wavefunction describes the coherent wave behavior of interest. Here, we take advantage of this correspondence and examine superfluid-like spatial shock waves by propagating coherent light through a nonlinear crystal. We report the observation of both 1D and 2D shock waves, their nonlinear behavior as a function of intensity, and double-shock wave collisions. Analytical calculations and numerical simulations show excellent agreement with the experimental results. The fine structures and features observed here match similar observations in previous shock studies using superfluids and BEC, obtained in this case in a table-top apparatus, without the need for vacuum isolation, ultracold temperatures, etc. Moreover, the inherent optical advantages of easy control of the wavefunction input and direct imaging of the output make us optimistic that the nonlinear photonic systems described here will lay the foundation for a whole series of condensate-inspired experiments, many of which would be difficult (if not impossible) to perform in the corresponding condensed matter environments.

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Date submitted: 04 Dec 2005 Electronic form version 1.4