Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Quantum quench in a p+ip superfluid: non-equilibrium topological gapless state MATTHEW FOSTER, Rice University, MAXIM DZERO, Kent State University, VICTOR GURARIE, University of Colorado at Boulder, EMIL YUZBASHYAN, Rutgers University — Ground state "topological protection" has emerged as a main theme in quantum condensed matter physics. A key question is the robustness of physical properties including topological quantum numbers to perturbations, such as disorder or non-equilibrium driving. In this work we investigate the dynamics of a p+ip superfluid following a zero temperature quantum quench. The model describes a 2D topological superconductor with a non-trivial (trivial) BCS (BEC) phase. We work with the full interacting BCS Hamiltonian, which we solve exactly in the thermodynamic limit using classical integrability. The non-equilibrium phase diagram is obtained for generic quenches. A large region of the phase diagram describes strong to weak-pairing quenches wherein the order parameter vanishes in the long-time limit, due to pair fluctuations. Despite this, we find that the topological winding number survives for quenches in this regime, leading to the prediction of a gapless topological state. We speculate on potential realizations, including a proximity effect quench on the surface of 3D topological insulator.

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Date submitted: 10 Dec 2012 Electronic form version 1.4