Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Exact Solution for Vortex Dynamics in Temperature Quenches of Two-Dimensional Superfluids[1] ANDREW FORRESTER, HAN-CHING CHU, GARY WILLIAMS, UCLA — An exact analytic solution for the dynamics of vortex pairs is obtained for rapid temperature quenches of a superfluid film starting from the line of critical points below the critical temperature T_{KT}. An approximate solution for quenches at and above above T_{KT} provides insights into the origin of logarithmic transients in the vortex decay, and are in general agreement with recent simulations of the quenched XY model. These results confirm that there is no "creation" of vortices whose density increases with the quench rate as predicted by the Kibble-Zurek theory, but only monotonic decay of the thermal vortices already present at the initial temperature. The problem in the Kibble-Zurek argument is the artificial restriction to measuring the vortex density only at the "freezeout" sampling time, which increases with the quench time. But since the the pairs continually decay, of course this will always result in lower vortex densities for a longer quench time and hence a later sampling time. But in fact the vortex densities can be measured at all times, and it then becomes quite clear that the instantaneous superfluid quench has the lowest vortex density at all times of any quench rate, since it most rapidly gets to the lowest temperature.

[1]Work supported by the NSF, Grant DMR 09-06467

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Date submitted: 07 Nov 2012 Electronic form version 1.4