Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Spontaneous Generation and Evolution of Defects in a Quenched Bose Gas[1] NICK PROUKAKIS, Joint Quantum Centre (JQC) Durham-Newcastle, Newcastle Univ., I-KANG LIU, SHIH-CHUAN GOU, National Tsang Hua University of Education, Taiwan, SIMONE DONADELLO, SIMONE SERAFINI, TOM BIENAIME, GIACOMO LAMPORESI, GABRIELE FERRARI, FRANCO DALFOVO, INO-CNR BEC Center and Dipartimento di Fisica, Universita di Trento, Italy — We provide a detailed numerical analysis of the Trento experiments with quenched Bose-Einstein condensates in an elongated harmonic trap (Donadello et al., PRA 94, 023628 (2016)) where defects in the order parameter are spontaneously generated by the Kibble-Zurek mechanism. Using the stochastic projected Gross-Pitaevskii equation, and by quenching both temperature and chemical potential, we are able to capture both the early-time phase transition dynamics and the observed long-term coarse-graining evolution, reproducing the experimentally-observed condensate growth dynamics, and long-term defect evolution. The emerging picture sheds light into how the initial thermal state passes through a transient turbulent state of many highly-excited vortical structures, before settling into a few interacting long-lived solitonic vortices. By numerically tracking the number of spontaneously-formed defects during and after the quench, we quantify the dependence of vortex number, vortex linelength and coherence length on quench rate, also demonstrating the observed breakdown of Kibble-Zurek scaling for fast quenches, arising as a result of coarse-graining dynamics prior to experimental measurements.

[1]EPSRC, MOST Taiwan, Provinza Autonoma di Trento

Nick Proukakis
Newcastle University

Date submitted: 27 Jan 2017 Electronic form version 1.4