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Formation of topological defects in a two-dimensional Bose gas through quench cooling

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We have shown experimentally that quench cooling of a Bose gas in a quasi two-dimensional geometry leads to the formation of topological defects. We trapped atoms in an original geometry with a strong confinement in the vertical direction and a flat-bottom in-plane potential. The in-plane confinement is realized by an optical dipole potential created by imaging a dark pattern onto the atomic plane whose shape can be easily changed. In a uniform square potential we demonstrated the creation of quantized vortices and for atoms confined in a ring we observed the creation of quantized currents along the ring. For both cases we investigated the statistics of this stochastic creation of defects as a function of the quench cooling time. We found results compatible with the prediction of Kibble-Zurek mechanism for Bose-Einstein condensation. In this specific geometry we also demonstrated that the transition crossed during the quench cooling is described by a transverse condensation mechanism.