Defect Saturation in a Rapidly Quenched Bose Gas

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When a system undergoes a symmetry-breaking phase transition, spatial domains of the ordered phase randomly develop, and topological defects are possibly formed at their interfaces. The Kibble–Zurek mechanism (KZM) provides a universal framework for the defect formation, predicting the power-law dependence of the defect density on the quench rate. However, recently, a noticeable deviation from KZM predictions was observed in atomic gas experiments, in which a trapped sample was quenched into a superfluid phase, generating quantum vortices, which became saturated for rapid quenches. In this talk, I will present our experimental study on the defect saturation with a weakly interacting Bose gas. We observe that the number of quantum vortices exhibits a Poissonian distribution not only for a slow quench in the Kibble–Zurek scaling regime but also for a fast quench in the saturation regime. This indicates that the defect saturation is not caused by destructive vortex collisions after their formation, but by the early-time coarsening in an emerging condensate. I will discuss further experimental evidence on the early-time coarsening effect in defect formation.