"Spontaneous creation, dynamics and interaction of vortices in Bose–Einstein condensates"

When a system crosses a second-order phase transition on a finite timescale spontaneous symmetry breaking can cause the development of domains with independent order parameters, which then grow and approach each other creating boundary defects. This is known as Kibble-Zurek mechanism [1,2]. Originally introduced in cosmology, it applies both to classical and quantum phase transitions, in a wide variety of physical systems. We will discuss the conditions for the spontaneous creation of defects in Bose–Einstein condensates via the Kibble-Zurek mechanism and we will show that its typical signatures, such as the power-law scaling of the defects density on the quench time, can be recovered [3]. These defects are identified as quantum vortices orthogonally oriented to the symmetry axis of the confining trap, as expected for solitonic vortices in a highly anisotropic condensate [4].

The real-time dynamics of vortices can be followed in the condensate using a weakly destructive stroboscopic technique, hence allowing for an accurate comparison between experimental data and theoretical models of dynamics of vortices in superfluids [5]. In configurations with two vortex lines simultaneously present in the condensate signatures of interaction are observed in the form reconnections, rebounds and annihilation [6]. This opens a new perspective to studies in the domain of quantum turbulence.


All DQ-mat members and all interested are cordially invited to attend.