Vortex nucleation and transition to binary quantum turbulence in two-component Bose–Einstein condensates

S. Ishino[a], H. Takeuchi[b], and M. Tsubota[a]

[a]Department of Physics, Osaka City University, Osaka, Japan
[b]Graduate School of Integrated Arts and Science, Hiroshima University, Hiroshima, Japan

We theoretically study the instability of countersuperflow, *i.e.*, two counter-propagating miscible superflows, in uniform two-component Bose–Einstein condensates. When the relative velocity of the counterflow exceeds a critical value, the instability causes the nucleation of vortex rings whose size and number strongly depend on the relative velocity. The nucleated vortex rings expand and the vortex line density grows up with the momentum exchange between two components. A lot of reconnections with vortices are caused and lead to binary quantum turbulence, where both components become turbulent. In binary quantum turbulence, the tangled vortices in one component interact with those in the other component. We investigate statistical properties of the binary quantum turbulence. Binary quantum turbulence shows different behavior from single turbulence and offers a new avenue for study of turbulence.