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Emergence of turbulence in an oscillating Bose-Einstein condensate

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Abstract:

Besides the already existent variety of techniques to generate vortices, new techniques can always provide new and exciting ways to explore this topic. In this work we present a new technique to nucleate vortices in a BEC, where an oscillating field generated by a set of coils is superimposed to the trapping field creating displacement, rotation and deformation of the QUIC trap. As a function of the amplitude of oscillation of the external magnetic field we observe several different behaviors of the condensate cloud. For small amplitudes the condensate oscillates its axis in a banding mode. Increasing the amplitude we observe the formation of one, two, three or more vortices in the cloud. Above certain amplitude of oscillation we observe uncountable vortices in every direction , producing a tangled vortices configuration which can be considered as the emergence of a turbulent regime in the cloud. At the same time, in a few special configurations, a three vortices/anti-vortices cluster seems to be observed. Variations of behavior during TOF for the cloud may be a signature of the turbulent regime Finally an analysis involving the fragmentation of the quantum atomic fluid due to the presence of oscillations is presented through an analogy involving time oscillation and random spatial field is presented.