

Generation and interaction of defects of different kinds in square lattice of parametrically excited Faraday ripples

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Generation of topological defects and growth of defects in number is one of the possible scenarios for transition to chaos in spatially-periodic extended systems. We report results on investigation of defect interactions in parametrically excited capillary waves (Faraday ripples). The experiments were carried out in a layer of liquid (silicon oil) 0.5 mm thick oscillating homogeneously at a frequency of 95Hz. Two mutually orthogonal pairs of standing capillary waves (modes) forming a square lattice arose on the surface of the liquid layer above the threshold of parametric generation.

In our previous papers [1, 2] we found out that with increasing supercriticality (amplitude of harmonic oscillation) pattern is evolving through different stages: perfect tetragonal lattice, tetragonal lattice with some disturbances of order in the form of topological defects and spatio-temporal chaos. It was revealed that each disturbance of order was a bound state of two topological charges of the same sign belonging to one standing wave forming tetragonal lattice [1, 2]. Perpendicular standing wave did not have any disturbances in the vicinity of bound state. Such bound state moved along the wave front of its mode and that's why we named it "Climb Defect" - CD.

In the present communication we show that at a high supercriticality new type of defects can arise before transition to chaos. We named these defects "Diagonal Defects" - DD - because they are moving at the angle of 45 degrees to the standing wave fronts. In contrast to CD, DD is a bound state with disturbances of order in both orthogonal standing waves: there are two topological charges in one mode (similar to CD) and two topological charges with opposite signs in perpendicular mode (local defect - LD). The LD can annihilate and appear again during DD movement. Trajectories of DD are very close to the nodes of the two perpendicular standing waves.

It was found that two types of defects can exist simultaneously but appearance of DD occurs at the higher supercriticality than appearance of CD. We have explained it by strong nonlinear interaction between orthogonal standing waves due to the increasing of the wave amplitude. For the large amplitude topological charges belonging to one standing wave are able to excite topological defects in the perpendicular standing wave and a new type of bound state (DD) emerges. Appearance of a new type of defect leads to new types of interactions in the system. Because of that we consider patterns of Faraday ripples with DD as a stage of transition close to chaos.

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- [2] A.B.Ezersky, D.A.Ermoshin, S.V.Kiyashko, "Dynamics of defects in parametrically excited ripples", Phys. Rev. E 1995, 51, n 4, p.4411-4118.