

The use of the dissipative self-organizing structures theory for the analysis of burning problems in cooperative phenomena: the important example that has been developed for quantum computer implementation

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General key problems as applied to the theory of dissipative structures to the analysis of current cooperative phenomena of the wide range of applications are discussed. We have identified the main methods of solution of these phenomena on the basis of the theory of self-organizing systems, which can simultaneously be useful in analyzing such different problems as cooperation between living things as well as between social things, and for example, formation of a qubit network for quantum computers [1]. It is emphasized that the use of the theory of dissipative structures is not less promising, than the use of thermodynamically equilibrium structures with off-diagonal long-range order (see our other report at Granda-2015).

The treatment is based on a visual and fairly easy to understand example, which nevertheless very clearly shows and reproduces all the basic features of the emergence of coherence in complex systems. An open resonator with periodic boundaries is just such an example. In particular, we investigate in detail how, under certain distances between the resonator mirrors, that depend on the wavelength of electromagnetic field and on the parameters of periodical reflection coefficient, the spatial distribution of the amplitudes of the own resonator modes (standing radiation waves) becomes a periodic structure having extremely high peaks at certain points. This effect, which we have called the effect of the "field crystallization", takes place in the steady-state conditions when radiation is injecting into the resonator. For the first time we proposed to use this structure to create an effective and coherentized system of the neutral atoms traps. It is shown that such an ensemble of atoms can be regarded as a promising and realistic method of forming a system of qubits in creating a real full-scale quantum computer.

The same example we used as a model for the critical behavior of social groups at external influence on the network.

[1] T.M Makhviladze, M.E Sarychev, Theoretical study of some dissipative and equilibrium self-organizing systems, promising to form a quantum computer structures. Moscow: Nauka (2015), Proceedings of Institute of Physics and Technology (Trudy FTIAN), Russian Academy of Sciences, vol. 25 (to be published, manuscript received January 15, 2015).