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NONLINEAR DYNAMICS IN RADIATION OF CHARGED PARTICLES MOVING IN MULTIDIMENSIONAL SPATIALLY-PERIODIC STRUCTURES

SVETLANA SYTOVA

Research Institute for Nuclear Problems of Belarusian State University

Bobruiskaya str. 11, Minsk 220030, Belarus

E-mail: sytova@inp.bsu.by

Methods of mathematical modeling were used for simulation of nonlinear stage of the processes of radiation of charged particles, moving through multidimensional spatially-periodic structures, including the processes of amplification and generation of radiation by relativistic particle moving in volume free electron lasers (VFEL). It was shown that such processes are dynamic.

In the literature, nonlinear dynamics and chaos in vacuum electronic devices such as traveling wave tube (TWT), backward wave tube (BWT) and others were studied in detail. In such devices charged particles move through a one-dimensional spatially-periodic slow-wave structures. The main difference between VFEL and these devices is the interaction of the electron beam with emerging in the field of generating two or more strongly coupled electromagnetic waves in essentially multidimensional geometry due to dynamic Bragg diffraction near the intersection of roots of dispersion equation.

Here certain aspects of chaotic dynamics of radiation in two-dimensional spatially periodic structures are discusssed. A comparison of the effectiveness of a one-dimensional (in terms of BWT) and two-dimensional distributed feedback (in VFEL) is given. It is shown that there exists an optimal set of parameters of efficient generation and this set does not apply to one-dimensional geometry. It is demonstrated that a change parameters of distributed feedback (in the transition from one-dimensional to two-dimensional case) can control the dynamics of the vacuum electronic device work. Possibility of synchronization and the influence of external signals on the nature of the solution are considered for the VFEL case.