Configuration of vortex-antivortex lattices at output mirror of wide-area microchip laser.

Alexey Okulov
Russian Academy of Sciences
119991, Moscow, Russia
alexey.okulov@gmail.com

Pattern formation outside the equilibrium is a long-term research trend [1, 2]. The vortex lattices in high Fresnel number solid-state microchip lasers that appear a wide range of experimental parameters [3] were predicted theoretically in [4]. The subsequent numerical investigations [5] have shown the deep similarity of optical vortex lattices in lasers with spatial patterns that spontaneously occur in Faraday instability [6]. The phase of optical field is a precise indicator of electromagnetic energy circulation [7]. Exactly as in the early models of type-II superconductors placed in external magnetic field [8] the macrosopic photons wavefunction Ψ, which is visualized by electric field amplitude E, demostrates the regular lattices of field zeros with counter-rotating whirls around them [9]. The computational model for Ψ comprizes convolution integral with nonlinear kernel evaluated via Fast-Fourier transform [10] and the relaxation oscillator for gain medium coupled with wavefunction Ψ. The regular square lattices appear in a well defined region of laser gain and Fresnel numbers (fig.1). The inherent feature of these nonstationary patterns are vibrations of observed lattices which are known as optical and acoustical modes (fig.2) [3,4].

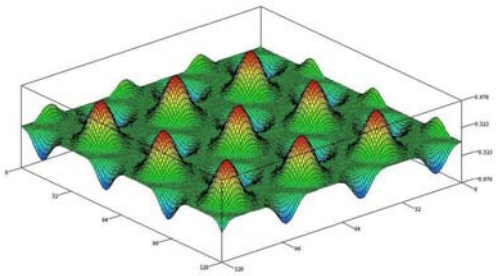

fig.1.

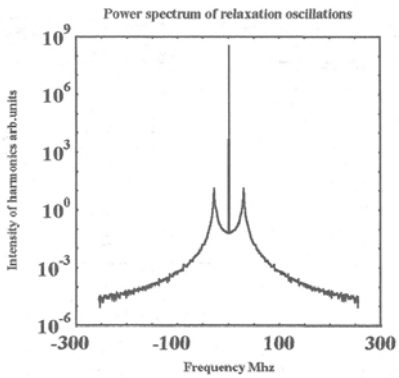

fig.2

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