

Optical multivibrator: untrivial dynamics of photorefractive coherent oscillators with two types of movable charge species

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Abstract:

Unconventional operation mode of coherent photorefractive oscillators based on ferroelectric $\text{Sn}_2\text{P}_2\text{S}_6$ is described [1-3]. As distinct from previously known types of oscillation dynamics (smooth continuous wave, with the cosine temporal modulation of output intensity, and with irregular chaotic temporal behavior) the reported regime consists in periodic sequence of nearly triangular pulses with the phase alternating between two fixed values, 0 and π . The output of such an optical circuit is analogous to that of the known electronic circuit called multivibrator (relaxation oscillator) which consist of two cross-coupled transistors and switches permanently between the two discrete states.

The origin of discovered unusual dynamics nests in competition of two complimentary space-charge gratings (shifted in space exactly to half grating spacing) that are initiated by moving charge carriers of opposite sign, electrons and holes. Depending on experimental parameters (coupling strength, pump intensity ratio) it is possible to observe the pure mode of optical multivibrator or its superposition to the cosine temporal variation caused by Feinberg' frequency splitting of the phase conjugate reflectivity in backward wave four wave mixing.

The considered operation mode is specific for the material and not for particular type of the oscillator. It was first observed in semilinear photorefractive oscillator with two counterpropagating pump waves [1] and later revealed also in oscillator geometry of double phase conjugate mirror [3].

References:

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