About significant enhancement of optical phase conjugate wave formed via dynamic holographic technique

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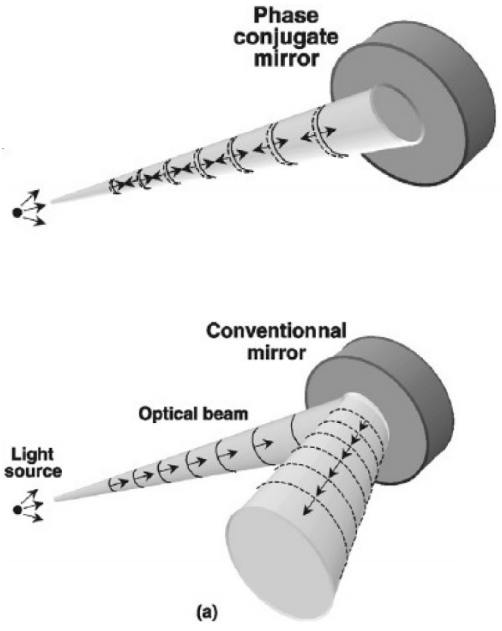
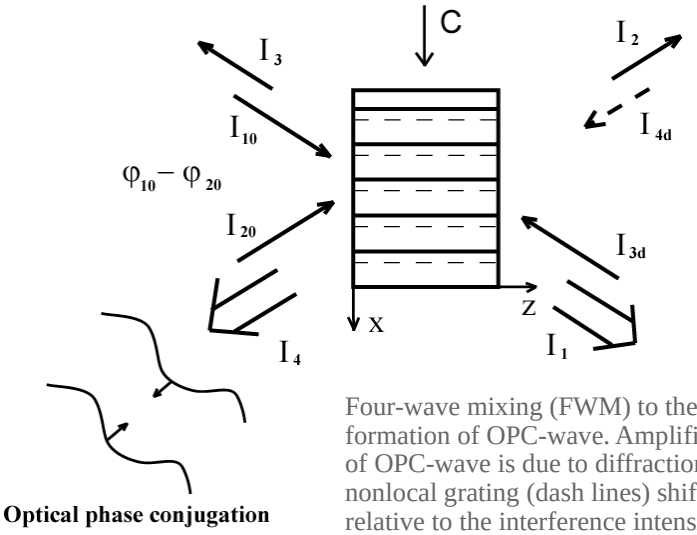
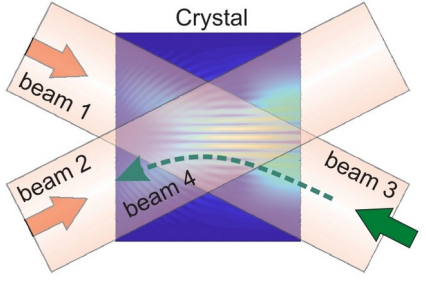
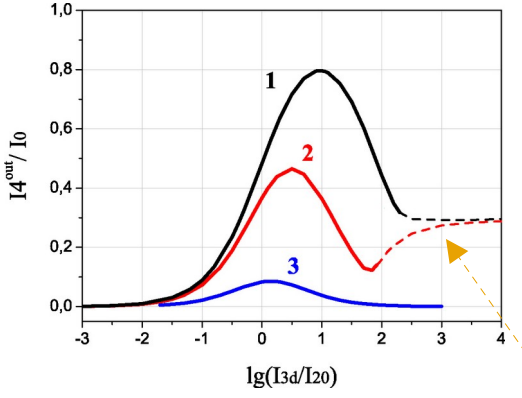


H.J.Eichler, O.Mehl, Phase conjugate mirrors,
J. Nonlinear Optical Physics & Materials, **10**(01), 2001.

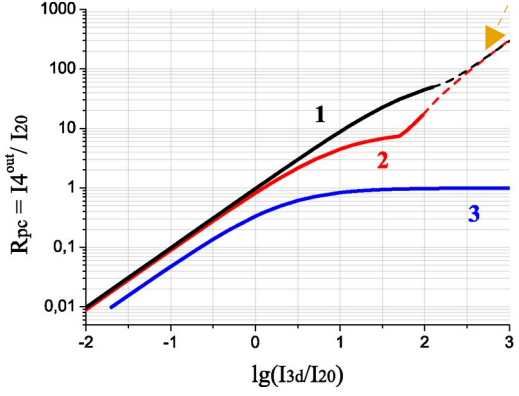


Four-wave mixing (FWM) to the formation of OPC-wave. Amplification of OPC-wave is due to diffraction on a nonlocal grating (dash lines) shifted relative to the interference intensity pattern (solid lines).





Unstable solutions



OPC-wave intensity and OPC-mirror reflection coefficient (Rpc) as a function of pump intensities during FWM.

Formation of spatially localized envelope of the grating amplitude. Derivation of CGLE

Initial system of FWM:

Coupled wave equations:

$$\frac{\partial \boldsymbol{E}_1}{\partial z} = \boldsymbol{\Phi}\boldsymbol{E}_2; \quad \frac{\partial \boldsymbol{E}_2^*}{\partial z} = -\boldsymbol{\Phi}\boldsymbol{E}_1^*$$
$$\frac{\partial \boldsymbol{E}_3^*}{\partial z} = \boldsymbol{\Phi}\boldsymbol{E}_4^*; \quad \frac{\partial \boldsymbol{E}_4}{\partial z} = -\boldsymbol{\Phi}\boldsymbol{E}_3$$

Dynamical eq. for the amplitude of the grating:

$$\frac{\partial \boldsymbol{\Phi}}{\partial t} = \boldsymbol{\gamma}\boldsymbol{S} - \frac{1}{\tau}\boldsymbol{\Phi}$$

$\boldsymbol{\Phi}(t,z)$ - the amplitude of nonlocal grating

$\boldsymbol{S}(t,z)$ - intensity in the maximums of interference field

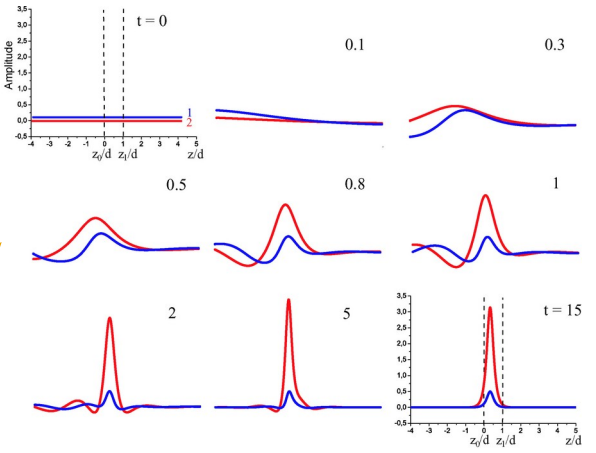
Rewrite to the system for amplitude of the dynamic grating:

$$\frac{\partial^2 \boldsymbol{\Phi}}{\partial t\, \partial z} + \frac{1}{\tau}\frac{\partial \boldsymbol{\Phi}}{\partial z} - 2\gamma_N \boldsymbol{\Phi} G = 0$$

$$\frac{\partial G}{\partial z} = -\frac{1}{\tau\gamma_N}\boldsymbol{\Phi}\boldsymbol{\Phi}^* - \frac{1}{2\gamma_N}\left[\boldsymbol{\Phi}^*\frac{\partial \boldsymbol{\Phi}}{\partial t} + \boldsymbol{\Phi}\frac{\partial \boldsymbol{\Phi}^*}{\partial t}\right]$$

Real function: $G = (I_2 - I_1 + I_4 - I_3)/I_0$

Nonlinear interaction of two coupled lattices:



Temporal changes in the amplitude envelope of the dynamic grating (denoted by plot 2) and the envelope of the interference intensity (denoted by plot 1) with the formation of a bright “soliton” profile in FWM.

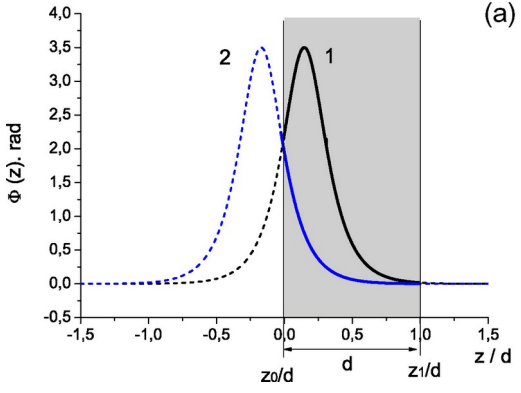
Multiscale expantion:

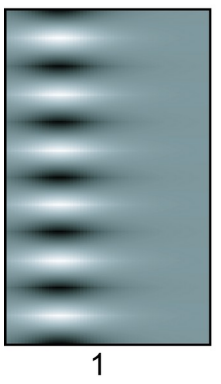
$$T_0 = t; \quad T_1 = \delta t; \quad T_2 = \delta^2 t;$$
$$Z_0 = z; \quad Z_1 = \delta z; \quad Z_2 = \delta^2 z;$$

Derived CGLE:

$$i\,\frac{\partial \mathbf{U}}{\partial \eta} - a\,\frac{\partial^2 \mathbf{U}}{\partial \zeta^2} - a\,|\mathbf{U}|^2\mathbf{U} = (q^2 a - i\beta)\,\mathbf{U}$$

$\zeta = Z_1 + vT_1; \qquad \eta = T_2$





(a) Soliton-like envelope of the grating amplitude.

Schemetic image of localized grating corresponding to envelope 1 in the case of strong energy transfer.