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Ginzburg-Landau equation for dynamical four-wave mixing in gain nonlinear media with relaxation

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We consider the dynamical degenerate four-wave mixing (FWM) model in a cubic nonlinear medium including both the time relaxation of the induced nonlinearity and the nonlocal coupling. The initial ten-dimensional FWM system can be rewritten as a three-variable intrinsic system (namely the intensity pattern, the amplitude of the nonlinearity and the total net gain) which is very close to the pumped Maxwell-Bloch system. In the case of a purely nonlocal response the initial system reduces to a real damped sine-Gordon (SG) equation. We obtain a new solution of this equation in the form of a sech function with a time-dependent coefficient. By applying the reductive perturbation method to this damped SG equation, we obtain exactly the cubic complex Ginzburg Landau equation (CGL3), but with a time dependence in the loss/gain coefficient. The CGL3 describes the properties of the spatially localized interference pattern formed by the FWM.

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