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Summary

We investigate experimentally the possibility to control the pattern formation in a nonlinear photorefractive single feedback system by using a periodic photonic lattice.

Introduction

Periodic photonic structures enable novel possibilities for manipulation of the fundamental aspects of wave propagation including enhancement of optical nonlinearity and control of light emission. The interplay between nonlinearity, optical gain, and photonic bandgap structures gives rise to new physical phenomena on control of nonlinear dynamics and spatial pattern formation. This has inspired recent interest in dissipative discrete systems leading to the prediction of localized structures or bandgap manipulation of modulational instability [1]. In this work, we present the experimental observation of manipulation of modulational instability in a periodic nonlinear dissipative system.

Experiments

We use a setup based on a photorefractive $BaTiO_3$ crystal in a single feedback mirror configuration giving rise to hexagonal pattern formation [2] (Center of Fig: 1a). Additionally, we impose an optical lattice to induce photonic band-gap structure with variable parameters (see the two outer spots in Fig 1a, corresponding to the linear diffraction of the pattern beam on the lattice created inside the crystal). By varying the lattice strength and periodicity, we can induce patterns of different symmetry. Figure 1b shows how the far field hexagonal pattern switches to a « diagonal pattern » after the addition of the optical lattice. Additionally, the modulational instability can be suppressed when the position of the lattice bandgap coincides with the instability gain region (Fig: 1c). Finally, for a well-defined lattice periodicity, we can rotationally control the pattern in its transverse plane depending on the lattice orientation.

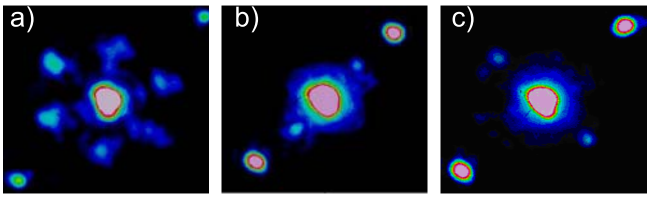

Fig 1. a) Observation in the far field of an hexagonal pattern in presence of a lattice inside the photorefractive crystal. b) Hexagonal pattern switching to a diagonal one for a well defined intensity ratio between the pattern beam and the lattice beam. c) Suppression of the modulational instability in the bandgap area of the lattice.

References

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