Control of pattern formation in a single feedback system by photonic lattices
Nicolas Marsal, Delphine Wolfersberger, Marc Sciamanna, Germano Montemezzani, Dragomir Neshev

To cite this version:
Nicolas Marsal, Delphine Wolfersberger, Marc Sciamanna, Germano Montemezzani, Dragomir Neshev. Control of pattern formation in a single feedback system by photonic lattices. A Future In Light, Mar 2009, Metz, France. hal-00437584

HAL Id: hal-00437584
https://hal-supelec.archives-ouvertes.fr/hal-00437584
Submitted on 1 Dec 2009

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
**Control of Pattern Formation in a Single Feedback System By Photonic Lattices**

Nicolas Marsal¹, Delphine Wolfersberger¹, Marc Sciamanna¹, Germano Montemezzani¹, Dragomir Neshev²

¹Lab. Matériaux Optiques, Photonique et Systèmes
Université Paul Verlaine and Supelec, Metz, France

²Nonlinear Physics Centre, Research School of Physical Sciences and Engineering,
Australian National University, Canberra, Australia

Email: nicolas.marsal@metz.supelec.fr

**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 BaTiO₃ 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.](image)

**References**