

Focus Issue: Quantum structures in nonlinear optics and atomic physics

Introduction

Homogeneous, periodic, quasiperiodic, irregular and disordered spatial structures have been at the heart of scientific interest and research for a long time and in many disciplines as diverse as chemistry, physics, biology and morphology. Some recent, spectacular achievements in experimental quantum optics have, however, made it possible to study quantum effects in a variety of spatial structures. The main aim of this Focus Issue is to present some of the most recent theoretical, numerical and experimental progresses in the area of Quantum Structures, i.e. spatial structures that display quantum features. A short background overview of Quantum Structures is provided at the beginning of this Focus Issue, in which individual authors' works are specifically commented.

In brief, we can say that the articles can be catalogued into two main areas of research interest in Quantum Structures: quantum effects in spatial structures in nonlinear optics, and in atomic physics.

Spatial structures are a common feature when diffraction is coupled to optical nonlinearities. Several articles provide a series of superb examples of optical patterns and study quantum spatial correlations both theoretically and numerically. New experimental results on quantum spatial correlations in the process of spontaneous parametric down-conversion are also presented.

On the atomic physics side, equally interesting findings are reported. For example, normal modes of oscillation in a chain of trapped calcium ions are identified, and an experimental study of spatial diffusion of a single ion in a one-dimensional optical lattice is presented.

We hope that the reading of this Focus Issue of Optics Express will communicate the feelings of novelty and beauty that we experience when studying quantum structures. This topic of research is new and fertile and we expect it to attract a growing number of young researchers in the near future.

We take advantage of this occasion to thank all the contributors to this Focus Issue of Optics Express for the outstanding quality of their papers. Special thanks go to Joe Eberly for the invitation and his interest in this venture. Last but not least, we thank the editorial office of Optics Express and in particular Deborah Herrin and Jennifer Martin for their help and incommensurable patience.

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