Journal of Optics B: Quantum and Semiclassical Optics

EDITORIAL

Squeezed states and uncertainty relations

EDITORIAL

Squeezed states and uncertainty relations

Guest Editors

Octavio Castaños
Institute of Nuclear Science, UNAM, Mexico

Rocio Jauregue-Renaud
Institute of Physics, UNAM, Mexico

Young S Kim
University of Maryland, College Park, USA

Margarita A Man'ko
P N Lebedev Physical Institute, Moscow, Russia

Hector Moya-Cessa
INAOE, Coordinación de Optica, Puebla, Mexico

This special issue of *Journal of Optics B: Quantum and Semiclassical Optics* is composed mainly of extended versions of talks and papers presented at the Eighth International Conference on Squeezed States and Uncertainty Relations held in Puebla, Mexico on 9–13 June 2003. The Conference was hosted by Instituto de Astrofísica, Óptica y Electrónica, and the Universidad Nacional Autónoma de México.

This series of meetings began at the University of Maryland, College Park, USA, in March 1991. The second and third workshops were organized by the Lebedev Physical Institute in Moscow, Russia, in 1992 and by the University of Maryland Baltimore County, USA, in 1993, respectively. Afterwards, it was decided that the workshop series should be held every two years. Thus the fourth meeting took place at the University of Shanxi in China and was supported by the International Union of Pure and Applied Physics (IUPAP). The next three meetings in 1997, 1999 and 2001 were held in Lake Balatonfüred, Hungary, in Naples, Italy, and in Boston, USA, respectively. All of them were sponsored by IUPAP. The ninth workshop will take place in Besançon, France, in 2005.

The conference has now become one of the major international meetings on quantum optics and the foundations of quantum mechanics, where most of the active research groups throughout the world present their new results. Accordingly this conference has been able to align itself to the current trend in quantum optics and quantum mechanics.

The Puebla meeting covered most extensively the following areas: quantum measurements, quantum computing and information theory, trapped atoms and degenerate gases, and the generation and characterization of quantum states of light. The meeting also covered squeeze-like transformations in areas other than quantum optics, such as atomic physics, nuclear physics, statistical physics and relativity, as well as optical devices. There were many new participants at this meeting, particularly from Latin American countries including, of course, Mexico.

There were many talks on the subjects traditionally covered in this conference series, including quantum fluctuations, different forms of squeezing, unlike kinds of nonclassical states of light, and distinct representations of the quantum superposition principle, such as even and odd coherent states. The entanglement phenomenon, frequently in the form of the EPR paradox, is responsible for the main advantages of quantum engineering compared with classical methods. Even though entanglement has been known since the early days of quantum mechanics, its properties, such as the most appropriate entanglement measures, are still under current investigation. The phenomena of dissipations and decoherence of the initial pure states are very important because the fast decoherence can destroy all the advantages of quantum processes in teleportation, quantum computing and image processing. Due to this, methods of controlling the decoherence, such as by the use of different kinds of nonlinearities and deformations, are also under study. From the very beginning of quantum mechanics, the uncertainty relations were basic inequalities distinguishing the classical and quantum worlds.

Among the theoretical methods for quantum optics and quantum mechanics, this conference covered phase space and group representations, such as the Wigner and probability distribution functions, which provide an alternative approach to the Schrödinger or Heisenberg picture. Different forms of probability representations of quantum states are important tools to be applied in studying various quantum phenomena, such as quantum interference, decoherence and quantum tomography. They have been established also as a very useful tool in all branches of classical optics. From the mathematical point of view, it is well known that the coherent and squeezed states are representations of the Lorentz group. It was noted throughout the conference that another form of the Lorentz group, namely, the 2×2 representation of the SL(2,c) group, is becoming more prominent while providing the mathematical basis for the Poincaré sphere, entanglement, qubits and decoherence, as well as classical ray optics traditionally based on 2×2 'ABCD' matrices.

The contributions of this special issue cover the most recent trends in all areas of quantum optics and the foundations of quantum mechanics.