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EDITORIAL

Squeeze transformation and optics after Einstein

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With this special issue, *Journal of Optics B: Quantum and Semiclassical Optics* contributes to the celebration of the World Year of Physics held in recognition of five brilliant papers written by Albert Einstein in 1905. There is no need to explain to the readers of this journal the content and importance of these papers, which are cornerstones of modern physics. The 51 contributions in this special issue represent current trends in quantum optics—100 years after the concept of light quanta was introduced. At first glance, in his famous papers of 1905, Einstein treated quite independent subjects—special relativity, the nature and statistical properties of light, electrodynamics of moving bodies and Brownian motion. We now know that all these phenomena are deeply related, and these relations are clearly shown in many papers in this issue.

Most of the papers are based on the talks and poster contributions from participants of the 9th International Conference on Squeezed States and Uncertainty Relations (ICSSUR'05), which took place in Besançon, France, 2–6 May, 2005. This was the continuation of a series of meetings, originating with the first workshops organized by Professor Y S Kim at the University of Maryland, College Park, USA, in 1991 and by Professor V I Man'ko at the Lebedev Physical Institute, Moscow in 1992.

One of the main topics of ICSSUR'05 and this special issue is the theory and applications of squeezed states and their generalizations. At first glance, one could think that this subject has no relation to Einstein's papers. However, this is not true: the theory of squeezed states is deeply related to special relativity, as far as it is based on the representations of the Lorentz group (see the paper by Kim Y S and Noz M E, S458–S467), which also links the current concepts of entanglement and decoherence with Lorentz-covariance. Besides, studies of the different quantum states of light imply, after all, the study of photon (or photo-electron) statistics and fluctuations of the electromagnetic field, whose importance was first emphasized by Einstein in 1905.

The squeezed states can also be considered as a generalization of the concept of coherent states, which turned out to be one of the most important theoretical tools for solving the numerous problems of quantum optics. It seems highly symbolical that the printed version of this special issue will appear in the same month when one of the prominent creators of the theory of coherent states and modern quantum optics—Professor Roy J Glauber—will receive his Nobel Prize in Stockholm. ICSSUR'05 was opened by the invited talk of R J Glauber, 'What makes a quantum jump?', and we take great pleasure in congratulating him on this well deserved award. We are sure that all participants of ICSSUR'05 and all readers of this special issue share our feelings. Two other Nobel Prize winners of 2005—Professor J L Hall and Professor T W Hänsch—also made great contributions to quantum optics. In particular, in 1986, J L Hall with collaborators, performed the first experiments on the generation of squeezed states by parametric down conversion, having obtained squeezing at the 50% level (Wu L A, Kimble H J, Hall J L and Wu H 1986 *Phys. Rev. Lett.* **57** 2520).

Another area, which has attracted the attention of many researchers in the past decade and which is well represented in this special issue, is related to the problems of quantum correlations, entanglement and quantum nonlocality. It is also connected with the name of Einstein due to his famous 'EPR' paper of 1935

written together with Podolsky and Rosen. For several decades this was an area of ‘thought experiments’ only, but now this field is becoming a new part of physics, known as ‘quantum information’. The reader can find several papers which introduce new concepts in this area, such as applications of the Galois algebras and discrete Wigner functions. Solutions of different problems of the interaction between light and matter (which also take their origin in Einstein’s paper of 1905), stationary and nonstationary Casimir effect, decoherence, new forms of uncertainty relations and their experimental verification, etc, can also be found in this issue. Many other contributions will be published in another special issue of the *International Journal of Modern Physics B* entitled ‘Quantum Information in Modern Optics’.

This special issue is also the last issue of *Journal of Optics B: Quantum and Semiclassical Optics*. For the past 15 years this journal and its predecessors—*Quantum Optics* and *Quantum and Semiclassical Optics*—gained great respect among the quantum optics community. Many breakthrough papers were published in its pages during this period (see, for example, Schrade G, Man’ko V I, Schleich W P and Glauber R J 1995 Wigner Functions in the Paul trap *Quantum Semiclass. Opt.* **7** 307). Since 1999, *Journal of Optics B: Quantum and Semiclassical Optics* has published a special issue for each ICSSUR meeting. This is the fourth issue of this series. We would like to thank Institute of Physics Publishing and the staff of *Journal of Optics B: Quantum and Semiclassical Optics* for providing the opportunity to pursue this programme, hoping that such a cooperation will continue in the future. We would also like to thank the many colleagues, who served as referees and whose efforts helped immensely in the preparation of this issue at such a high standard. The 10th ICSSUR conference will be organized for 2007 in Bradford, UK, by Professor A Vourdas. We invite readers to join us in two years.