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Preface

Quantum optics was born in the first years of the 20th century. The first papers leading to further ideas of quanta of light were presented by Max Planck and Albert Einstein. Their pioneering papers laid the foundations for the theory of quantum optics. However, one should remember that for the birth of the formal theory of quantisation of light, the development of quantum mechanics was necessary. Interestingly, the word ’photon’ appeared for the first time in a paper by a Gilbert Lewis, a chemist, in 1926 and was later used by P.A.M. Dirac, a physicist, the next year. The modern sense of the term quantum optics was established in 1956 when Hanbury Brown and Twiss built the intensity interferometr and performed their famous experiment in which correlations between two light beams were measured. Although the results of their experiment could be explained on the basis of the classical theory of light, with some quantum component to the process of photodetection, their result is commonly accepted as the beginning of the modern quantum optics era. The next milestone in the development of quantum optics was the invention of laser in 1960. The physical properties of the light generated by lasers were considerably different from those characterising the light generated by classical thermal sources. This fact was a great impulse leading to further development of quantum optics’ ideas. The first of them were presented in the fundamental papers written by Glauber, describing new states of light quantum coherent states. From that moment we observe a tremendous growth of interest in the investigation on the quantum nature of light and its interaction with matter. We can mention such problems and effects as photon bunching and antibunching effects, problems related to the Heisenberg uncertainty relation, for instance the squeezing of light, phase effects in quantum optics and others. At the end of the 20th century new, fundamental ideas arose and the quantum information theory became one of the most intriguing trends in modern physics. This fact led to theoretical in their deepest sense as well as practical new developments in the field of quantum optics. For instance, optical methods have been designed for the use in quantum computing, quantum cryptography and quantum communication devices. Moreover, we observe a huge progress in methods applying trapped single ions and atoms. Such ”single atom experiments” gave huge momentum to the advances in various branches in modern physics and technology. What is worth mentioning, recent theoretical and experimental achievements in quantum optical research inspired by the quantum information theory made it possible to answer the fundamental questions related to the understanding of the quantum nature of the physical world and *vice versa*, solutions to problems appearing in the field of quantum and atomic optics has affected technology, leading to a new quantum technological revolution.

Although this book is devoted to various problems related to the contemporary quantum optics, this volume is assumed to be the first part of a series of books devoted to the problems related to various branches of physics and their practical applications The intention of the editor and authors of the papers presented here is to give the reader insight into the topics of physics that are in the mainstream of current investigation. We hope that the forthcoming volumes will cover the subjects that are in the focus of interest of a broad group of students and researchers concerned not only with physics but also with other natural sciences.

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