The PROBLEM of ELECTRON and SUPERLUMINAL SIGNALS

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PREFACE

In the monograph the results of the long-term researches of the author on the central problem of quantum electrodynamics (QED) - the problem of electron are presented. The new formulation of QED is developed based on the notion of electron as an open self-organizing system. It is shown that the own field of electron, in view of spatial expansion of the particle, is capable to transfer signals with superluminal velocity. The conclusion about the possibility of superluminal transfer of information follows with necessity from the laws of electrodynamics and is in the complete conformity with the special theory of relativity (STR).

The modern means of communication (radio communication, television, radiolocation) are based on the use of electromagnetic waves, and consequently at the moment the velocity of transfer of the information is limited by that of light in vacuum, which is considered as the greatest possible velocity of transfer of a signal existing in nature. A radically different way of transfer of a signal is shown by our researches to be possible - not with the help of electromagnetic waves but by means of the own field of electrically charged particles, which has that advantage over the usual one that it allows to transfer the information with velocity considerably exceeding velocity of light in vacuum, and under conditions when the signal transfer by usual methods is complicated (for example, the transfer of a signal through various obstacles).

The approach developed in the work is based on the physical idea that the own field generated by electron is inseparable from the particle and, therefore, is its constituent. The ability of electron to create the own field is considered as a physical property intrinsically inherent in the particle. This idea is realized at the modern mathematical level, within the framework of Lagrange's and Hamilton's formalisms of quantum field theory, by including the property mentioned above in the definition of the particle.

The QED formulation developed in the book represents a synthesis of the standard quantum electrodynamics and the ideas of the theory of self-organization of physical systems. The physical mechanism of self-organization consists in the back action of the own field created by electron upon the same electron (self-action) and is described with the help of a model of open system.

The theory considered fits the fundamental principles of symmetry, gives the correct dimensions and Balmer's spectrum of the hydrogen atom, the intrinsic moment of electron and does not result in serious difficulties of the standard QED formulation - the divergence of self-energy and the failure of theory to explain the stability of electron.

The fundamental dynamic equation of electron derived from the action principle is a generalization of the Dirac equation to the case of the self-organizing electron. The solutions to this equation are indicative of the soliton nature of electron and allow one to determine the internal energy, dimensions, and geometric shape of the particle in different quantum states. On the basis of fundamental equations, the quantum models of electron and hydrogen atom are considered, and internal energy spectra of particles are evaluated. It is shown that the energy spectrum of electron is discrete and of hydrogen atom is of a zoned structure.

Detailed investigation of physical properties of the self-field of electron is carried out. The characteristic feature of this field is that a vortex field is separated from the Coulomb one when the particle moves uniformly and rectilinearly. This field does not submit to the wave-corpuscular duality; it is of a purely classical nature and cannot be reduced to the set of photons. When electron moves with acceleration, it radiates electromagnetic waves, representing a flow of quanta of light - photons driven with velocity of light. Thus, in the general case the vortex electromagnetic field, created by a driven particle, consists of two components - the vortex self-field, not reducing to a flow of photons, and electromagnetic waves representing a set of photons.

The special role played in nature by the self-field of charged particle is that it endows the physical environment produced by it with the properties of an absolutely solid body. Due to this, the environment created by electron gains the capacity to instantaneously transfer a signal (information) related to a perturbation to arbitrarily large distances, not causing at the same time the flow of particles from the source of perturbation to the receiver of signal.

The basic possibility of the superluminal transfer of information follows from the fact that the charged self-acting particles become extended objects and, therefore, events, separated by space-like intervals, cease to be physically independent, i.e. they can influence each other.

The physical mechanism of superluminal transfer of a signal with the help of the own field of electron consists in the following. Apart from the region of main localization, whose dimensions are of the order of Bohr radius (for the ground state of particle), the wave function of electron has a tail extending to infinity. The oscillations happening in the region of main

localization are immediately transmitted via the tail to any distances and excite oscillations of electric and magnetic fields at each point of space. Due to this all the universe instantaneously "learns" about a physical event occurring at some point.

The necessity of existence of the physical mechanism of instantaneous signaling follows from the most general considerations. As the self-field of electron is inseparable from the particle, the electron and its self-field should be considered as a single physical system. In view of the long-range character of the self-field, this system fills in the whole space. In order that such a system be stable, a physical mechanism, connecting its parts in a unit, should exist. The instantaneous transfer of information with the help of standing waves of matter forming the own field of electron is, apparently, such a mechanism.

It is noted that the causal relationship between two events is a problem of dynamics which cannot be solved in principle on the basis of purely kinematic reasons. The conclusion about the impossibility of superluminal signals does not follow from STR and is an additional hypothesis contradicting STR. It is shown that the points of view of the observers, located in various inertial reference frames, on an event, occurring at some spatial-temporary point, can be essentially different. This effect called the phenomenon of relativity of physical processes is a consequence of some peculiarities of geometry of space-time associated with superluminal signals. It is indicative of a basic opportunity of prediction of some physical events (prediction of future events). We mean here strictly deterministic events that are not subject to casual influences.

According to the analysis conducted STR predicts the phenomenon of dynamic inhomogeneity of time: the course of time essentially depends upon the behaviour of a particle. The effect is of a local character: any physical effect on the particle results in the deformation of time (slowing down of the course of time or its acceleration) in that spatial region in which the particle is localized.

On the basis of results obtained a conclusion is drawn that in nature an universal principle works - the Principle of Self-Organization, which can be formulated as follows: any material object represents an open self-organizing system, the internal structures of which are formed in participation with the whole universe. Apparently, the Principle of Self-Organization, incorporated in nature as one of the integral properties of matter, operates the world and creates all its variety.

The monograph lays no claim to complete coverage of the investigations on the problem of electron and superluminal signals; it deals primarily with the results of investigations performed for the last few years by the author of the book as well as by his colleagues and pupils - Ju. Arep'ev, I. Belousov, Ran Yangqiang and others. For this reason the references given in the book are also incomplete and reflect only the interests of the author.

The book is addressed to scientists, post-graduate students, students and all those who are interested in the newest development of quantum electrodynamics and in the applications of new physical ideas for practical purposes.