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Epistemological Analysis of Discrete Physical Reality

© Oleg Orestovich Feygin

Institute of Scientific & Technological Researches
Ukrainian Academy of Sciences
Kharkov, Ukraine

Contact to author: fond@online.kharkiv.com

Epistemological analysis, the basic method used in synthetic gnosiology and its application to discrete temporalogy, provides revealing new aspects of the world surrounding us. The conceptual system is explored as an ontological premise of logic: discretization →quantum chronophysics→cosmology. The methodology of theoretical physics is represented here through fundamental universal principles of physical quantization in particles and processes. A system of metascientific concepts, including the nomenclature, "temporally physical reality" is accordingly expanded. A universal physical pattern of the world is explored in conceptual fashion. The fundamental hypothesis whereby discrete chrono-physical space is seen to underly objective reality is also is considered.

The concept of a discrete physical reality as quantum aspect of the objective world allows us to identify an extensive set of separate problem as components of an enclosing reality [1,4]. Considering that the Universe represents a complete set of hierarchically bound systems with relevant structural plants, we shall set the task of clearing them up and present new temporal properties through coordination and subordination. In theoretical physics and the evolution of qantum mechanics, objects were staticized. Passage from atomic to subnuclear in a perfect vacuum has evolved into complicated questions regarding the existence of separate virtual microformations. Their further systematization and substructurization has demanded the introduction of innovative heuristic models of discrete physical reality [2,3].

Following the gnosiology of a common philosophical base, we perceive that the mathematics of the discrete theory of quantum effects (together with some formal recipes,) have been constructed earlier than the relevant physical concepts. The analytical methods of a logically consistent quantum mechanics was used to solve the problems of atomic physics, but the physical explanation of it was not quite clear. Considering the logic development of relativistic principles, a quantum chronophysics based on separate conceptual positions of discrete temporalogy is considered. We accept aspects of relativism in quantum chronodynamic with the introduction of a special class of temporal frames of reference [7,8]. Model structurization of relativistic quantum chronodynamic /RQCD/ is accompanied by a build-up of a group of specific transformations of symmetry, defining the basic regularities in the development of continual-temporal envelopes /CTE/ in physical space [9]. A particular innovation here is the temporal methodology in the review of traditional quantum representations of the fundamental CPT - theorem in the metric Minkowski universe [11].

In classical relativistic mechanics, particles of zero mass propelled with the velocity of light are considered. In pre - chronoquantum representations [1 - 5], the following relationship features the energy of such particles:

E = p c = p l(h) / h(t), h(t) h(e) ν ~ m [l(h) / h(t)]^2, m ~ h(e) / c(h)^2; (1)

where p - impulse; c - velocity of light; l(h) - Planck length; h(t) - chronoquantum; ν - frequency. The use of two fundamental stationary values - Planck length and the chronoquantum temporal gap corresponds to a metric velocity of spatial phase passages - c(h). It naturally defines an upper bound for any physical velocities of material plants. It is necessary to note that in formula (1), major assumptions regarding the identification of velocities of distributions of electromagnetic interactions and metric phase passages are made. Unfortunately, the shortage of direct experimental data does not allow inclusion of other physical processes (for example, a gravitational interaction), that are commensurable with the expansion of the metric of space.

We shall consider that relation (1) is basically valid for the energy and impulse of electromagnetic waves in radiation. The quantized eigentones of an electromagnetic field also give the population of its component quanta.

In a chronoquantum limit from relation (1), the analog for one of the variants of Einstein's formula for relativistic quantum plants follows. The detailed analysis of the given relation shows [6], that in an ultrarelativistic case, the distinction between a corpuscular substance and a field to become ambiguous. The statement of such qualitatively new properties of microscopic objects demands special methods in their description, including exterior and interior frames of references concerning the sequence of CTE. Thus, at atomic plants undular or corpuscular properties [10] are identified.

In a relativistic approximation, the common wave equation maintains the aspect:

$$i\, h(e)\, \Delta\psi[h(t)] = <H[h(t),h(e)]>\psi, \quad (2)$$

where $<H[h(t), h(e)]>$ - fashions a Hamiltonian. For equation (2) the canonical Lorentz transformation laws, (the symmetric concerning time and coordinates) should be valid. Hence, the relativistic invariance of expression (2) will be determined by a content of the Hamiltonian in the passage from relativistic to quantum mechanics. To such a passage, there are correspondingly conventional inputs to the operational equations:

$$E \Rightarrow i\, h(t)\, h(e)\, d / dt \Rightarrow i\, h(e)\, \Delta[h(t)],\quad p = - i\, h(e)\, h(t)\, d / dr \Rightarrow - i\, h(e)\, h(t)\, \Delta[l(h)] \Rightarrow - i\, h(e) / \Delta[c(h)],$$
$$E = \{[c(h)\, p]^2 + m^2\, c(h)^4\}^{0,5}. \quad (3)$$

The operational sense of formulas (3) is obvious in view of relation (2):

$$<H[h(e),h(t)]> = c(h)\{<a>\, <p[h(e),h(t)]>\} + m\, c(h)^2\, <b>; \quad (4)$$

where $<a>$ and $<b>$ - operators, bound with the interior symmetries of microscopic objects and operating on their interior degrees of freedom. Hence, it is possible to say that exterior symmetries of quantum plants will be exhausted by symmetries of physical space and time, and operating functionals $<a>$ and $<b>$ are bound to the interior moment and antimap of a quantum microsystem. In RQCD the sense of the given operators will be supplemented by new degrees of freedom of localization in CTE. Then the relativistic wave equation for quantum microscopic plants will have the following discrete shape:

$$i\, h(e)\, \Delta\psi[h(t)] = \{c(h)\{<a>\, <p[h(e),h(t)]>\} + m\, c(h)^2\, <b>\}\psi,\quad \psi = \Psi\{\psi[h(t)], \psi[h(e)], \psi[s(1)], \psi[s(2)], \psi[s(3)]\}; \quad (5)$$

where $\psi[s(1)]$, $\psi[s(2)]$ and $\psi[s(3)]$ - components, bound with charge, the exterior and interior symmetry of quantum microscopic objects. Equations (5) satisfy one of main principles of a chronoquantum superposition of states of localized microscopic objects in the next CTE [6 - 9]. At the relevant passage from chronoquantum representation of the equation of Dirac to nonrelativistic Schrödinger equations and model representations of the ultrarelativistic, a field convergence will be replaced by methods of quantization of fields and annihilation processes.

Major factors defining world lines of microscopic objects in RQCD, are multiple acts of localizations on some strictly sequential CTE [10-11]. Thus, a unique role will be displayed with various symmetries of microparticles, in particular, antiidentity; the quantum permutable symmetry linking a spin with statistics of states and a relativistic kinematic symmetry, based on Lorentz transformation laws. Classical permutation - kinematic symmetries represent rotational displacements of the four-dimensional frame changing the direction of an axis of time in the mathematical representation. In the outcome, there is a group of fundamental statements, components of analog CPT - theorems, defining the sequence of operations of a reversion of time T, a specular reflection of space P and charge conjugation C to the equations of quantum chronodynamic. In a conventional sense, completeness of a group of symmetries reflects particular physical properties of the quantum particle. Therefore, presence of a zero rest mass reduces in solutions of equation (9) without P - symmetries. It can mean that in a progression to the limit, substance - field appearing on the chronoquantum boundary of CTE in Minkowski's metric space will be significally nonsymmetric. It is inapplicable to particles with a nonzero rest mass since in the fixed relative frame of reference all directions in space are equivalent.

It is necessary to note here that there are particular didactic inconsistencies between quantum mechanics referring property P - parities to interior symmetries of microparticles and RQCD, linking it with properties of metric space. Classical quantum-theoretical representations contain comparisons to exterior symmetries of continuous transformations of space and time. Thus discrete operations P - and T - transformations refer to interior symmetries of quantum plants. In RQCD, in application of CPT - theorems, separation of exterior and interior symmetries is clearly the conditional. Basic here is the T - transformation, bound through a temporally variant of CPT - theorems with other symmetries. Thus, the traditional separation of represented symmetries of exterior - existential and interior - topological is not quite justified.

In canonical quantum theory, any improvement of the preceding observations will not change the unique prediction of the outcome of measurement. Traditionally, it is considered an expression of some law of nature, a wave-corpuscle dualism of microscopic objects. On the other hand, axiomatic RQCD allows a classical determinism based on new shapes in the principle of causality. In itself, it means allocation of quantum mechanical probabilities in a series of measurements for the interior observer and localization when choosing CTE. Hence, the probability character of quantum mechanical properties of atomic plants does not at all exclude determinism from the point of view of discrete chronophysics.

The dual wave-corpuscle nature of quantum microscopic objects is displayed in the electrodynamics of multicomponent statistical collectives. The ensemble of quantum particles in relativistic electrodynamics together with the kinetics and dynamics of chronoquantums make a logical circuit of developmental representations. Their further conceptualization and adequate reinterpretation is possible in the classical boundaries of a quantum mechanics, relativity theory, physics of microcosms and vacuum, and relativistic cosmology.

The free electromagnetic field in chronoquantum theories supposes a relativistic representation for spectral resolution of stagnant electromagnetic waves. The vectorial potential of a field in an approximation of some continuous function of coordinates and for a separate CTE can look like time

$$\mathbf{A} = \sum[\mathbf{a} \exp(i\, \mathbf{k}\, \mathbf{r}) + \mathbf{a}^* \exp(-i\, \mathbf{k}\, \mathbf{r})],\ E = \text{const}(1)\, d\mathbf{A} / h(t),\ \mathbf{H} = \text{rot}\mathbf{A},\ \Delta\mathbf{A} = \text{const}(2)\, [d\mathbf{A} / h(t)]^2; \quad (6)$$

where **k, r** - undular and a radius vector. A population of vectors {**a**} comprises a discrete set for a free field with trivial relations

Then, formulas (2) gain an operational sense of action in an undular psi-function. Accordingly, a population of discrete field formations as a function of their number and time will feature the amplitude of states of similar relativistic quantum plants. In this case, one of the reduced shapes of a Schrödinger equation and its analog will define the association of a psi-function of time

$$i\, h\, d\psi / dt = \langle H\rangle\psi,\ i\, h(e)\, d\psi = \langle H\rangle\psi,\ \langle H\rangle = \text{const}(3) \int(\langle\mathbf{E}\rangle^2 + \langle\mathbf{H}\rangle^2)\, dV,\ E = \text{const}(3)\int(\mathbf{E}^2 + \mathbf{H}^2)\, dV; \quad (7)$$

where h(e) - an energy component of the quantum of an operation. The input equation (5) is invariant, being grounded on the relevant equations of electrodynamics. In canonical quantum electrodynamics, a solution of equations (5) determine the levels of an energy field structure. Dynamics of field states in many respects is defined by a nonzero level in the vacuum; an electromagnetic field. Subsequent excitation of the field is equivalent to the occurrence of quanta in an amount proportional to the level of excitation. Fields with high quantum numbers can be considered within the framework of classical quantum theory. In addition, permanent fields which are not represented in shape (4), being strictly localized, are in the limits of some chosen CTE.

Regularities in field delocalization allows reformulating a principle of causality with reference to appearances. According to the canonical positions of quantum mechanics, the wave function of an atomic system satisfies a wave equation which uniquely identifies it as an initial value of Schrödinger's equations. Thus, the law for modification of the probabilities expressed through a wave function is also defined.

In the RQCD case, key parameters of an electromagnetic field gain an aspect of the chronooperators operating on a psi-function of numbers of filling of quanta, defining a state of a field. Thus, the most adequate shape in RQCD is the application of a group of chronoquantum operators of localization and delocalization on a particular CTE. Review a situation typical of relativistic quantum theory; operators of the birth and the erasure of microparticles. A procedure of secondary quantization takes place and psi-operators act in the amplitude of states of the microscopic objects, being function of numbers of filling of charge carriers. In classical quantum electrodynamics, the essential moment is the input of a macroscopic limit for electromagnetic interactions. Similar interactions of charged microscopic objects with an electromagnetic field are featured by the following quantum mechanical expressions in operational representation

$$const(4) \int [A(i)\ j(i)]\ dV \rightarrow const(5) \int [\langle j(i) \rangle \langle A(i) \rangle]\ dV; \quad (8)$$

Here A(i) and j(i) - four-dimensional potentials and currents of charges. Formula (8) defines an operator of an electromagnetic interaction with an operator of quanta of an electromagnetic field - $\langle A(i) \rangle$ and an operator of a current of probability for charge carriers - $\langle j(i) \rangle$. The detailed analysis of an interaction of a field with its carriers shows that it should be featured by a set of Dirac's equations and operational Maxwell equations. A solution of this set of equations is a uniform function for amplitude of the state, depending on the quantum numbers of filling of carriers of electrocharges and quanta. Probabilities of localization in CTE of the given field structures are determined by the square-law shapes of the amplitude of a state. It follows that kinetic processes in electromagnetic fields can be considered transitional localizations from one CTE into another.

In a modern physics, the principle of causality is related not only to an impossibility of action in the past, but also to the existence of a speed limit for the operation; the velocity of light in free space. These requirements are discovered ine reflection and in RQCD. However, the severe directedness of a deflection of time is meaningful only for an interior observer and in an exterior frame of reference, objectively, there are all moments of the past and future as relevant to CTE. In turn, the maximum velocity of an operation in RQCD is compared to the velocity of the cosmological phase passage intensively dilating our Universe in the fashion of CTE. In connection with the existence of a speed limit of distribution, it is necessary to consider the problem of so-called "reductions of a wave packet". The given paradox will consist in a sudden change of wave functions at the modification of a probability distribution in a series of subsequent experiences. For conceptual means RQCD, it is reinterpreted as a localization on the next CTE and is interlinked to the presence of detailed macroanalogs in the classical quantum theory of a field.

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