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Concepts of Chronoquantum Decoherence

Oleg O. Feygin
fond@online.kharkiv.com

Various temporal aspects of the phenomenon decoherence conditions of quantum microobjects and their macrosystems are considered. An attempt at chronoquantum interpretation of process decoherence is done in view of its new role in the quantum theory of measurements and quantum computer science. The general principles of theory decoherence are compared with quantum localization in studying various types of spontaneous interactions between microsystems and their quantum environment based on an example modelling of a multislot-hole interference to the subsequent reduction of a condition of the system. The temporal scale of the quantum phenomena is analyzed in process decoherence, in particular the phenomenology of quantum chronodigitizations. Concepts for decisions in the problematic quantum arrow of time, and interpretations of quantummechanical representations are logically deduced.

The experimental paradigm of decoherence is based on the analysis of a multislot-hole interference at which quantum particles overcome a diaphragm with several apertures and are fixed on the screen, giving some distribution of probabilities of points to its surfaces. In classical physics, a similar distribution is calculated by multiplication of the probability of passage through each aperture and a conditional probability of fixing with the subsequent summation for all beams. In the quantum case for total probability to be entered, an additional component of the particles, which are passing through all apertures depends on the wave. Hence, the quantum condition of a microparticle is not reduced to the description of the wave which is passing through an individual aperture, even in view of an uncertainty in the probability of localization [1].

However, the situation changes for the modified multislot-hole interference for detection in the plane of a diaphragm since the measurement of a pulse of feedback from the diaphragm makes coordinates uncertain. Probability and spontaneity change a component of interference on interaction with the quantum environment on a distant diaphragm - the screen. In this case interference is not observed, since the microparticle is confused with the quantum environment, and the phase ratio between components is determined by the overall system: particle + environment. The last physical phenomenon also is the subject of a study of the theory of decoherence, including the concept of joint histories. Thus, the semantics contend decoherence is an abstract mathematical formalism, the component under their entry conditions is determined by the requirement of quantum probabilities for a wave, according to the standard classical formulas for the reduction of a wave package [2,3].

The theory of quantum chronophysics studies the dynamics of spontaneous quantum interactions in a temporal scale of characteristic time. In models of such interactions, various aspects show a suppression of interference depending on the speed and duration of the processes, in the considered system and its environment near the borders of the allocated chronoquantum [4,5]. The environment aspires to be united with the system and to suppress interference between the allocated discrete set of conditions behind the borders of the chronoquantum. Stability of these allocated conditions is determined by the quantum time of interaction with the environment and while the system is confused with the environment, the conditions between which interference is suppressed, there appear conditions with the least time of interaction with the environment. Thus, chrono - decoherence generates an effective selection of quantum conditions, as some generalization of the formalism of quantum mechanics for switching classically observable sizes.

The time stability of chronoquantum results in an opportunity to identifiy a wave as a component of microobjects for some chronoquantum time interval, and it allows speaking of timeless spatial trajectories for the allocated conditions in the evolution of the reduced systems.

In case of connection with decoherence interactions in the form of a joint estimation of the approached values of coordinates and a pulse, the allocated conditions obviously are chronolocated Schrödinger waves. In this case, trajectories at the level of a component (a trajectory of the allocated conditions) can be approximated by correspondingly classical trajectories. From the point of view of quantum chronophysics it is possible to explain that the allocated conditions as wave packets are located by coordinates and a pulse. In the current, chronoquantum are confused with the environment with a corresponding disregard for Schrödinger's equation. Here a future problem is the construction of a phenomenological macroquantum interaction of any system with its environment. It is an exacting requirement that detailed physical research finds for what typical macroquantum systems is the absence of chronoquantum properties, and we can take whatever common conclusions are derived from studying the individual phenomena of tunneling, superconductivity and superfluidity [7].

The interference between the located conditions of macroscopical objects is suppressed at chronoquantum distances and forces us to assume what exact macroscopical objects actually and appear to us as the located conditions. It closely is connected with the classical problem of measurement since we do not notice all the bases of conditions of the device to obtain various results. Quantummechanical systems are described by mathematical wave objects (vectors) which can form superpositions. Evolution in time, as required by the Schrödinger equation, maintains such superpositions.

As an example, it is possible to consider a quantummechanical system described by the superposition of two set conditions (for example, backs +1/2 and -1/2). Interaction of such microsystems with the measuring device which reacts to these two conditions, results in some final quantum condition. This condition will be the sum of components, one where the device is connected to a value, (which it will be registered) a back = +1/2. In the other case the device is connected to a value, (which, also, it will be registered) a back =-1/2. The problem will be that if we can admit the idea of the microscopic system described as a similar superposition we cannot even imagine the sense of the compound device and электрона, described in a similar way.

Now, what occurs, if we include decoherence in the description? Decoherence advises us among other things, that there is a large number of interactions in which differently located conditions of macroscopical systems contact various conditions of their environment. In particular, differently located conditions of macroscopical systems can represent conditions of a vector of conditions of the device recording various values of a back electron. By virtue of the same argument, the electron structure, the device and environment will represent the sum of the condition adequate for an environment connected with the device showing a value +1/2 for back, and a condition adequate{answering} to an environment, connected with the device showing value-1/2 for back. So, we again cannot imagine what all this means for the compound system described in such a superposition.

Irrespective of whether or not we involve decoherence, we come to the following choice: The compound system is not described by a superposition similar to a Schrödinger equation (which then requires updating), or it is described, but then we should understand what it means, by givin a suitable interpretation to quantum mechanics. Thus, decoherence as such does not decide a problem of measurement if it is not connected to a suitable interpretation of the wave function. Although it is valid as we can see, decoherence can be best understood in terms of the interpretation of a multiworld paradigm.

Decoherence does not show the dynamic evolution of a new interpretation of the wave function which would contradict the Schrödinger equation. At the same time, it reveals the important dynamic effects inherent in evolution of the Schrödinger equation, and can contribute to the formation of probable interpretations of the wave function. From an intuitive point of view, if the environment proves to be a set of measurements of coordinates, the problem of measurement should be considered more widely and should also include these spontaneously occurring measurements.

As is well-known, the located conditions of macroscopical objects blur very slowly during Schrödinger evolution (i.e. if there are no interactions), however the situation becomes other if there are interactions with an environment. Though various components which contact an environment are located by unpredictable images, collectively they can result in dispersal with many orders of higher amplitude. It means that the condition of object and environment can be represented by the superposition of a huge number of well-located members, every one with a slightly different coordinate but which in the sum blur at macroscopic distances, even in case of objects with which we deal on a daily basis.

Taking into account that those ordinary macroscopic objects are exposed, in particular, to interactions resulting from decoherence, it generates a question - whether quantum mechanics can explain events in the daily world even outside of the problem of measurement in the exact sense of the word. Problems are simplified if something coordinates with something else, or something is in opposition to something else. It is more difficult to solve problems of complications with measuring device and measuring gauges. To discuss a problem of measurement without taking into account decoherence (in full) can be insufficient. That is well illustrated by some versions of modelling interpretation. It allows us to assume that chronoquantum decoherence can explain the occurrences of the daily world in the evaluation of the located reality of our Universe. It is natural that at a level and on macro intervals, a component of chronoquantum description of a phenomenon decoherence can show classical aspects.

Here there is a general question; whether valid results of chronoquantum decoherence of the alternative World can be used for an explanation of occurrence of a complete classical picture of environmental Reality. In fact, a phenomenologically adequate description should include an explanation of such kinematic and dynamic properties as macroscopic localization in classical approximation. It is necessary to note, that there are cases for which the classical description has no suitable phenomenology, even applied to macroscopic systems (for example, macroquantum tunneling, superconductivity and superfluidity). Accordingly, it is possible to specify quantum measurements for which classical aspects of the daily world are only kinematic parameters (the fixed values of a vector of conditions) while dynamic aspects appear extremely nonclassical. Somewhat the daily world is the classical world as Bor has assumed by way of description, first of all, chronoquantum phenomena which in themselves appear investigations of decoherence. The question of an explanation of the daily world becomes a question of whether it is possible to deduce from chronoquantum physics the conditions necessary for creation of preconditions and realization in the practice of a substantiation of quantum mechanics, and, thus, to close a logical circle. In such a general statement the given question is, obviously, too difficult for the answer and dependent on how far the physical program of chrono - decoherence can be applied.

The majority of modern approaches to an explanation of a reduction of a wave package consist in updating derivations of the Schrödinger equation. Frequently the given constructions proceed from the requirement of suppression of the display of superpositions of various classical conditions or their expressed metastability. Intuitively it seems that such approaches will be coordinated a little with decoherence although they try to describe the effect of suppression in accuracy of the same superpositions which participate in reduction and chronoquantum decoherence.

In a background, Neumann has offered an absurd idealistic idea that the consciousness of the observer is somehow connected by what he has named Process I, Alternately, this idea is known as a postulate on a collapse or a projective postulate which, in the monography he has placed level with the Schrödinger equation (Process II in its terminology). There is some duality of position in the Neumann background. On the one hand it protected the positivistic point of view about our consciousness which lets us know that with the collapse of a wave function, there is specified a phenomenological representation of process I. On the other hand, it suggests, formally, that the consciousness plays some causal role in the display of a collapse. In this case Process I is a physical process, completely level with Process II. In any case interpretation of the Neumann background idealistically is also unproductive by nature and connects the intensity of final prelegends (which we is realized we feel) in accuracy with the where and when Process I is used for modelling the evolution of a quantum system. It is frequently mentioned as a mobility of border between the subject and object.

In the given interpretation the reduction of a wave function can occur, when the particle gets on the screen or when the screen blackens or when the automatic print of the result is done, or at hit on our retina or in an optic nerve or when the information acts in our consciousness. Before and after a collapse, the evolution of the system is described by the Schrödinger equation. Neumann wrongly shows a background, that all these models are equivalent. It could not be predicted in what place these occur. So the collapse is ostensibly connected to consciousness, in view of the practice of application of a projective postulate on many earlier (and more practical) stages of the description.

What, however, has resulted Neumann background in a conclusion of so absurd result? Probably an assumption of the absence of interference among various components of a wave function. Really, if the interference took place, the duration of a collapse would influence the final statistics. This is exactly the same as in the case of an experiment with two slits (the collapse occurs behind slits or on the screen).

No less steadfast attention is deserved by the known theory of a spontaneous collapse. In it is shown that the material particle spontaneously tests localization so that during the causal moments of time, there is a collapse in the form used for the description of an estimation of position at measurement. In the initial model, the collapse occurs independently for each particle, and in later models, frequency for each particle is identified according to its weight, then the resulting frequency of a collapse is connected to the density of weight.

Thus, formally the effect of a spontaneous collapse appears the same as in some decoherence models, at least for one particle. However, there exist certain differences. So, we have a trivial collapse instead of a suppression of interference and the spontaneous collapse occurs without any interaction between the system and the environment. During a time in the theory of chrono – decoherence, suppression of an interference is usually carried out through interaction with an environment at chronoquantum distance.

Can standard decoherence be used in chronoquantum theory? The situation can appear rather complex when the interaction generating decoherence is not connected mainly to measurement of coordinate position (and for example, instead of it, superconducting currents) because a collapse and decoherence can actually be different events. But when the basic interaction resulting in decoherence is also connected to measurement of position, the answer is reduced to a quantitative comparison. If the collapse occurs faster in the superposition of the component, it has no time for increase, and thus the theory of chronoquantum reduction of a wave package covers classical phenomena. On the contrary, if in decoherence the mechanism of a collapse can find suitable structures for the reduction of wave function, it will be carried out faster. Thus, it is represented, that chrono - decoherence plays a part and in theories of spontaneous collapse.

The question of suitability for an experimental check of the theory is connected to its chronoquantum collapse. Really, chronoquantum decoherence can be used also in the approaches which have been not connected to a collapse, such, as the theory of the pilot wave. Then in all cases when decoherence occurs faster than a collapse, it is interpreted as obvious display of a reduction. At the same time it can be interpreted as a standard suppression of interference. And only in cases in which the theory of chronoquantum collapse predicts a reduction, and the system is blocked from decoherence can this last be used for an experimental check of the theory of reduction.

So, decoherence is required for certain efforts to make possible the generalized conclusions based on studying only time models. On the other hand, by way of an explanation of occurrence of the classical World on the basis of chrono - decoherence, it is necessary to find out all probable consequences of its application. Direct application of suitable technical equipment for the resolution of classical trajectories at a level of a component was used for the resolution of chaotic trajectories in quantum mechanics. At first sight it seems, that the problem of quantum description of chaotic behaviour does not exist. Chaos, roughly speaking, is characterized as extreme sensitivity in the behaviour of system entry conditions, and the distance between trajectories for different entry conditions in time grows exponentially. As the evolution described by the Schrödinger equation, is unitary, it keeps all scalar products and all distances between vectors of quantum conditions. Thus, it can seem that close entry conditions result in trajectories which are in regular intervals are close during all moments of time so that chaotic movement is impossible. Unitarity is kept, because vectors of an environment to which various components are connected, are, and remain orthogonal: evolution a component as such remains non-material. Modelling gives a picture of quantum chaos in which various trajectories miss. Similarly, to crossing of trajectories in the Bom's theory, here provides behaviour at a level of a component which is qualitatively distinct from the behaviour deduced from the wave function of an isolated system.

Other claim of the importance of decoherence is connected to asymmetry of time, in particular with a question on, whether decoherence can explain a doubtless orientation of time in our classical world. This conclusion again appears one of which results in an orientation of time at a level of a component, and thus following a symmetric evolution in time at the level of a universal wave function (presumably with special entry conditions). So far as obvious, collapse really is the process directed to time. Decoherence will have a direct relation to the origin of this «quantum arrow of time».

In some last considerations, it is possible to comment on remarks that decoherence can explain such quantum phenomenon as *the detecting of a particle,* so the concept of a particle in the quantum theory of a field in itself appears an investigation of decoherence. It means, that in a category of fundamental concepts only fields are included, and particles appear a derivative design, in contrast to the usual logic of the procedure of secondary quantization. Thus, decoherence apparently provides further convincing arguments of a conceptual priority of fields before particles in the question of interpretation of the quantum theory of a field.

At last, it is possible to state the assumption, that chrono - decoherence can appear a useful component in theories of quantum gravitation. First, because in a suitable generalization of chronoquantum physical theory, decoherence, up to the full theory of quantum gravitation can result in suppression of interference between various classical spaces - time areas. Second, decoherence on chronoquantum distances in duration of processes and the phenomena could solve a so-called *problem of time* which arises as a fundamental riddle in the initial approach to quantum gravitation. This problem consists of a fundamental equation that is not dependent on time as in Schrödinger's equation, and does not contain time at all. Differently, the problem is extremely simple: whence there is time?

In the context of the chronoquantum theory it is possible to try to design various models in which the analogue of wave function will be displayed on the components divided by a quantum interval of localization on the environment of a continuum. Each of the given allocated subsystems, by virtue of standard quantum positions should satisfy full indepencence of the chronoquantum analogue of Schrödinger's equation. In this sense, chronoquantum decoherence appears not only a source of the reality of the world around us, but also forms a basis for a relational time. Accessible introduction to this concept and philosophical discussion of similar models is given in [6,7,8] where references to original works are also displayed.

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