

# Everett Interpretation and Quantum Concept of Consciousness

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## ABSTRACT

Subjective aspects of quantum mechanics (QM) are most radically expressed in the Everett's interpretation (EI) of QM which suggests coexisting macroscopically distinct configurations of the world in the form of a superposition of the (quasi-)classical state vectors. The components of such a superposition are often verbally denoted as "Everett's worlds", hence the name "Many-Worlds Interpretation" (MWI) for EI. Explicit accounting the correlation of each classical configuration of the world with the corresponding state of an observer's mind yields the so-called "Many-Minds interpretation" (MMI). This is maximum that may be done in the context of EI if the restriction by pure physics is implied. In the author's "Extended Everett Concept" (EEC) the observer's consciousness is defined in the spirit of psycho-physical parallelism, i.e., as going beyond pure physics. As a consequence, according to EEC, an observer, if he/she weakens or turns off his/her consciousness (perception), obtains the ability of super-intuition (obtaining seemingly unavailable information) and even of controlling the subjective reality (a picture of classical reality as it will be subjectively perceived). This may be interpreted as a realization of the Jung's "collective unconscious" as well as an explanation of the mystical elements in Oriental philosophies, world religions and deep psychological practices.

**Key Words:** Everett's interpretation; quantum concept of consciousness; psycho-physical parallelism

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## 1. Introduction

Everett's interpretation (EI) of quantum mechanics (QM) is an utter manifestation of the subjective aspect which is inherent in this extraordinary science (Everett, 1957). Yet there are versions of EI which differ in their formulations and statuses. We shall consider the versions which are called Many-Worlds Interpretation (MWI) (DeWitt, 1973), Many-Minds Interpretation (MMI) (Zeh, 1970; 2012) and Extended Everett Concept (EEC) (Menskii, 2005; 2007; Mensky, 2010). It will be argued that the status of the interpretation radically differs in the latter case.

EEC, contrary to MWI and MMI, goes beyond pure physics in the spirit of psycho-physical parallelism. Indeed, the notion of

consciousness is defined as an element that is additional to physics (although it is defined in the physical terms). As a result, contrary to MWI and MMI, *EEC is falsifiable*, since it may be verified *by observations of human consciousness*.

This is unusual since the conventional methodology of physics accepts verification of theories only with the help of instrumental experiments. From the conservative viewpoint, the verification by observing the phenomenon of consciousness is not objective. Therefore, such observations may be called 'verification' only if the meaning of the term is extended. This means extending of the methodology.

If the notion of the verification is actually extended in this way, a lot of *evidences of EEC may be found in the spiritual sphere of knowledge* (Oriental philosophies, world religions and deep psychological practices). As a result, a much closer unification of the material and spiritual spheres of knowledge are achieved.

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## Quantum measurements and alternative classical realities

The necessity of EI becomes evident from the analysis of a quantum measurement. Let some measurement distinguish between the states  $\{|\psi_i\rangle|i=1,2,\dots\}$  of a measured quantum system. Then the interaction of this system with the measuring device brings the initial state of this device  $|\Phi_0\rangle$  to one of the states  $\{|\Phi_j\rangle|j=1,2,\dots\}$  corresponding to the system's states. If the initial state of the measured system is  $|\psi_i\rangle$ , and the evolution of the measured system and the measuring device is presented by a linear unitary operator  $U$ , then the result of the interaction is given by the following evident equation:

$$U|\psi_i\rangle|\Phi_0\rangle=|\psi_i\rangle|\Phi_i\rangle \quad (1)$$

Generally, the initial state of the measured system can be a superposition (linear combination) of the characteristic states  $\{|\psi_i\rangle|i=1,2,\dots\}$ , say  $|\psi\rangle=\sum_i c_i |\psi_i\rangle$ . According to our intuitive idea of the measurement (and according to the so-called Copenhagen interpretation of QM) the result of the measurement must be one of the states  $\{|\psi_i\rangle|\Phi_i\rangle|i=1,2,\dots\}$ . However, the operator  $U$  is linear, and, due to its linearity and Eq.1, we have to present the interaction of the measuring system with the device as follows:

$$U\left(\sum_i c_i |\psi_i\rangle\right)|\Phi_0\rangle=\sum_i c_i |\psi_i\rangle|\Phi_i\rangle \quad (2)$$

This result is *counterintuitive* because we intuitively expect that the measured system and the measuring device must be after the measurement in one of the characteristic states  $\{|\psi_i\rangle|\Phi_i\rangle|i=1,2,\dots\}$  but not in the state of their superposition. Moreover, the state in the right hand side of Eq.2 is counterintuitive by itself, since it denotes the state in which macroscopically distinct states of the (macroscopic) device coexist (in the form of a superposition) that intuitively seems impossible. Nevertheless, Eq.2 is a direct consequence of the linearity of quantum evolution, the very important feature of QM. Therefore, this equation, expressing the essence of EI (and its counterintuitive features), is unavoidable.

## EI is Unavoidable

Macroscopic systems are conventionally considered as classical (not quantum) systems. Therefore, the existence of superposition of macroscopically distinct states (following from Eq.2) may be formulated as coexistence of distinct classical realities which usually are meant to be excluding each other, alternative in respect to each other. For brevity we shall speak of *coexistence of alternative classical realities*, or simply *coexistence of alternatives*.

Eq.2 is obtained because we treated the measuring device as a quantum system despite that this device is a macroscopic system. However, this is of course justified. Indeed, every system is in fact quantum. Macroscopic systems are quantum too, although in many situations they may be approximately considered as classical. The situation of quantum measurement is an important example when the *quantum features of even macroscopic systems cannot be neglected*.

Hugh Everett was the first physicist who firmly stated that linearity of QM must be recognized even in the situation of quantum measurements (Everett, 1957). The direct consequence of this assumption is the EI of QM and the recognition that generically the state of the quantum world may be a *superposition of alternative classical realities*. For further analysis we shall illustrate this statement by the following equation:

$$|\Psi\rangle=\sum_i c_i |\Psi_i\rangle \quad (3)$$

where  $|\Psi\rangle$  is a state of the world and  $|\Psi_i\rangle$  are macroscopically distinct quasiclassical states of the world, or *alternative classical realities* (*alternatives* for brevity).

## Extension of EI is Falsifiable

It is not evident that the specific kind of subjectivity which is expressed in the form of EI, can be confirmed by observations. Hence, it is questionable, whether EI is falsifiable. In fact, it is not falsifiable (can be neither confirmed nor disproved) by the conventional physical experiments (with the help of measuring instruments). However, we shall argue that the version of EI which is called Extended Everett Concept (EEC) may be confirmed (and in fact is confirmed) by *observations of the phenomenon of consciousness that reveals extraordinary*



relations between objective and subjective aspects of (quantum) reality (Menskii, 2005; 2007; Mensky, 2010).

EEC differs from the original EI in that consciousness is defined in EEC as the separation of alternatives (this will be clarified later on, see Sect. 3). As a result, EEC predicts that weakening (or, in the limit, turning off) consciousness opens access to the quantum reality as a whole, while the full consciousness has access to classical projections of the reality separately from each other (creating an illusion that only a single projection exists).<sup>2</sup>

It is important to take into account that in EEC we always mean only the simplest (primitive, but also most deep) meaning of the word “consciousness”, or “personal consciousness” as distinguishing between the conscious and unconscious states of mind. Many different aspects and functions which are usually denoted by the term “consciousness” (such as self-consciousness and various processes performed in the conscious state) are beyond the limits of “our” meaning of the term “consciousness”. Usage of this term in such a narrow understanding is typical in quantum physics, where the physicists discussed from the very beginning what was “*consciousness of an observer*”.

EI is a necessary part of QM, while EEC goes beyond QM. EEC is formulated mostly in the verbal form (although is illustrated with mathematical formulas, see Sect.4) and includes important consequences for philosophy and psychology. However, EEC goes beyond QM in a minimal way, since all its consequences are derived from *a sole logical element which is added to EI*: the definition of consciousness. This, together with numerous confirmations of EEC by the facts from psychological practices, makes EEC plausible. In the result of the whole discourse, we have much more wide idea of the subjective aspect of QM, leading to a much deeper connection between material and spiritual spheres of knowledge.

<sup>2</sup>To describe the relations between all essential elements of EEC in a more clear way, we shall introduce later three different terms concerning consciousness. The usual form of consciousness of an observer will be called *personal consciousness*, while the direct access to quantum reality (not connected with certain persons) will be denoted as *super-knowledge*. At last, *super-consciousness* will denote the ability to bring a part of information from the super-knowledge into the personal consciousness. Yet, in most cases we shall simplify terminology, using the term consciousness in the meaning of personal consciousness.



## 2. MWI and MMI: EI restricted by pure physics

EI can be neither proved nor disproved with the aid of usual physical experiments (instrumental measurements). The reason is that such experiments are analyzed only in terms of probabilities of different outputs, but the formulas for these probabilities are the same in all interpretations of QM. Therefore, the original form of EI is not falsifiable, as well as those modifications of it which remain in the scope of pure physics (at least of the conventional physics of restricted systems).<sup>3</sup>

### “Many worlds”: misleading term

The components  $|\Psi_i\rangle$  of the superposition (Eq.3) require some verbal interpretation. Bryce DeWitt offered (1973) to call them “Everett's worlds”. Each observer is presented in each of these worlds by a “clone”, or “twin”, which is observing the corresponding classical picture of the quantum world. This is why the term *Many-Worlds Interpretation* (MWI) became customary for EI. However, this terminology (although conceivable) turned out to be misleading. The term “many worlds” evoked an image of many real (“physical”) worlds which exist simultaneously (say, beside each other). Actually only a single physical world exists, but this world is quantum, so that many *classical projections* of this world *coexist* in the form of components  $|\Psi_i\rangle$  of the superposition (Eq.3).

### “Many minds”: correlation of an observer with the external world

More adequate is the term *Many-Minds Interpretation* (MMI) that refers to the entanglement (quantum correlation)

$$|\Psi_i\rangle = |\Psi'_i\rangle |\chi_i\rangle \quad (4)$$

between the state of an observer  $|\chi_i\rangle$  and the state  $|\Psi'_i\rangle$  of the part of the world which is external in respect to this observer (Zeh, 1970; 2012).<sup>4</sup> In this wording, each classical

<sup>3</sup>There are indications that some version of EI which is falsifiable (may be essentially equivalent to EEC) might be formulated in terms of physics provided that the physics includes the whole world as one of the systems, see later Sect. 5.

<sup>4</sup>More precisely,  $|\chi_i\rangle$  is the state of the brain of the observer (or even certain material system in the brain which is responsible for the reflection of the state of the world) and  $|\Psi'_i\rangle$  the state of the external world (in respect to the brain or its subsystem), including therefore the observer's body (but excluding the brain itself or its part).

projection  $|\Psi_i\rangle$  of the quantum world is associated with the corresponding state of the observer's mind, hence the term MMI.

### MWI and MMI are not falsifiable by measurements

The formulation of EI as MWI or MMI seems to be maximum that can be done if EI is treated as a conception in pure physics, *i.e.*, as a formulation in terms belonging to QM and containing nothing beyond this area of physics. The rules for calculating probabilities of various quantum processes and of outputs of various measurements in both these interpretations of QM are the same as in the conventional Copenhagen interpretation. Therefore, EI, if it is understood at the level of MWI or MMI, is not falsifiable with the aid of the usual physical experiments.

However, the scope of the phenomena which are embraced by EI, is greatly enlarged, and EI becomes falsifiable, if this interpretation is properly extended. Namely, a specific definition of the concept of consciousness (which is formulated in physical terms but does not belong in fact to pure physics) should be added to the original form of EI. Let us consider such an extension, called EEC.

### 3. Extended Everett Concept (EEC)

In the Extended Everett Concept (EEC), the concept of consciousness is defined in such a way that it turns out to belong both to physics (material sphere) and psychology (spiritual sphere). An unexpected consequence of this definition is that turning off what is called consciousness creates a specific state, called super-consciousness, which provides an access to the alternative states of the world. This is manifested as the phenomena that are usually treated as being mystical (therefore, contradicting to natural science).

It is evident from the above said, that EEC goes beyond the pure physics. Yet this concept proves not to contradict to physics. Instead, it unites physics and psychology in a natural way, providing the explanation of such elements of spiritual doctrines (world religions and Oriental philosophies) as well as of advanced psychological practices, which are often treated as contradicting to science.

### 3.1 Definition of consciousness

#### EI: Alternatives are separated in consciousness

The many-worlds formulation of EI is in fact misleading. Instead, one may say that the *alternative classical realities*  $|\Psi_i\rangle$  of Eq.3 are *separated in consciousness* (Menskii, 2005). This means that the perception of each alternative is independent of the perception of the rest of alternatives. Therefore, the observer who subjectively perceives one of the alternatives, obtains an *illusion that no other alternatives exist*.

The notion of *the alternatives' separation* seems especially natural in the framework of the many-minds formulation of EI. Indeed, as a consequence of Eqs.3-4, the state of the observer (or the observer's brain) is a mixture of the alternatives, which is presented by the following density matrix (we suggest that the states  $\Psi'_i$  are orthogonal)

$$\rho = \sum_i |c_i|^2 |\chi_i\rangle\langle\chi_i|. \quad (5)$$

In this formula the alternatives (more precisely, their reflections in the observer's state  $\rho$ ) appear as excluding each other, *i.e.*, separated (in verbal presentation they should be connected by the logical operation "excluding OR"). Therefore, the alternatives' images in the state of an observer are separated. This is quite parallel to the verbal formulation "*alternatives are separated in consciousness*" because the very notion 'consciousness' presupposes an observer (a person) (Panov, 2001).

Up to now our consideration of EI was restricted by the limits of pure physics. Now we take a step outwards from the pure physics, that gives entirely new possibilities.

#### EEC: Alternatives' separation is consciousness

Let us do now the key step leading to Extended Everett Concept (EEC). Instead of the statement that "alternatives are separated in consciousness" (which is characteristic of the original form of EI, although slightly reformulated) we shall accept the statement

EEC: *Separation of alternatives is consciousness.*

This statement (a definition of the notion 'consciousness') results in essential consequences, that distinguish EEC from EI.



Before discussing these consequences, let us make some preliminary remarks.

- This definition *simplifies logical structure of the theory* since it contains one primary notion ('separation' = 'consciousness') instead of two of them ('separation' and 'consciousness').

- Thus defined consciousness *cannot be reduced to (conventional) physics*. However, it is *in accordance with the logical structure of quantum physics* and is characterized by an important feature of the latter (the separation of alternatives).

- By this definition, the notion of consciousness is introduced into the theory in the spirit of *psycho-physical parallelism*. The final theoretical scheme (EEC) goes beyond the limits of pure physics (although in the minimal way). This is why verbal formulations are important in it. Yet we shall discuss in Sect. 4 the special role of quantum mathematical formalism for clarifying specific notions in EEC.

**EEC is falsifiable**

At first glance the definition of consciousness accepted in EEC does not differ radically from what is accepted in MWI and MMI. However, an impact of the new definition is fundamentally different. It becomes evident if, taking the definition of consciousness in EEC as a basis, we ask yourselves *what happens if consciousness is turned off or weakened* (for example in sleeping, trance or meditation).

The answer is evident. According to EEC, consciousness is nothing else as the separation of alternatives. Therefore, the absence of consciousness means the absence of the separation. If (in this state of mind) the alternatives are not separated, then *all alternatives (or at least some of them) are somehow accessed altogether, without separating them from each other*. In this state of mind, the observer overcomes the illusion that there is only one classic picture of the world.

This gives greater information of the world than when the alternatives are accessed independently from each other. For example, in this state of mind the alternatives can be compared with each other, and the preferable alternative can be singled out. Returning to the state of full consciousness, one may conserve some of the information thus obtained, and

make use of it to improve the quality of life (sometimes even to provide survival).

This means that a special state on the border of consciousness have unusual features, not available to the full consciousness. The ability arising at the border of consciousness may be called *super-consciousness*. This conclusion is made in the framework of EEC. Therefore, *EEC is falsifiable by observing the phenomena of consciousness and super-consciousness*.

Complicated relations between consciousness and super-consciousness may be briefly commented as follows:

- The states of mind which are called "consciousness" (illustrated by Eq.5) and "the absence of consciousness" (Eq.3), may be interpreted correspondingly as *perception* and *pure existence*.<sup>5</sup>
- In the state *at the border between perception and pure existence*, a part of the information about the world which is accessed in the pure existence (Eq.3) may be added to the information which is available by consciousness (Eq.5).
- Subjectively this transformation of the information is perceived as obtaining information "from nowhere". As a matter of fact, *the classical information* is extracted in this case from *the quantum information*.
- This phenomenon, predicted in EEC, may be considered as a quantum explanation of the conception of *the collective unconscious* of Carl G. Jung.

The following table illustrates these relations:

Consciousness	perception	information
absence of consciousness	existence	quantum information

Therefore, super-consciousness is the ability to transfer (a part of) quantum information into classical information.

<sup>5</sup>Later on (in Sect. 4.1) we shall apply for them also the terms *personal consciousness* and *super-knowledge*.



### 3.2 Consequences

The main point of the abilities arising as a consequence of EEC is that a sort of *super-information* may be obtained in contact between consciousness and the state of mind when consciousness is absent (weakened). Super-information may be understood as such information about our (quantum) world which is not available from the experience of a person in the conscious state, but needs turning to the pure existence. The regime of interaction between consciousness (perception) on the one hand and the absence of consciousness (pure existence) on the other hand, may be called *super-consciousness*. Let us make more concrete what can be the contents of super-information which can be achieved in the regime of super-consciousness.

#### Super-intuition

The quantum state (vector  $|\Psi\rangle$  in Eq.3) of the world contains immeasurably more information than a single alternative  $|\Psi_i\rangle$ . First, because  $|\Psi\rangle$  includes every  $|\Psi_i\rangle$ , with any  $i$ . Secondly, because evolution of the quantum state  $|\Psi\rangle$  is deterministic, so that all times in quantum world are in fact equal in rights. Therefore, present time for this state is not distinguished from any other time, and the information contained in  $|\Psi\rangle$  refers to all times.

Access to this information provided by super-consciousness, should look as a conclusion having no grounds (but being true), as the information coming “from nowhere” (yet being genuine). This capability, as it is predicted by EEC, may be called *super-intuition*. This is a sort of a direct vision of the truth, because the information is obtained in this case not by calculation or reasoning, but as a direct observing the quantum reality.

Scientific insights, in the most important cases (such as discoveries of new paradigms) are examples of super-intuition. Great scientists (among them Einstein) wrote that the most important enlightenments came to them as spontaneous guesses as if “from nowhere”, however accompanied by the complete confidence in their correctness.

Beside the scientific insights, even the successful guesses in the everyday life may be examples of super-intuition. The advice to take counsel of one's pillow (to postpone a decision

until the morning) may be recognition of the fact that a guess must be better on the morning, after the consciousness, during the night sleep, will get super-information with the help of super-consciousness.

#### Control of (subjective) reality

EEC predicts not only the ability of direct vision of truth, but also ability to control subjective reality. Strange as it may seem, insights, with dipping into the future, may lead to the control of subjective reality, *i.e.*, to the choice of the preferable classical alternative.

Indeed, let super-consciousness have got a glimpse of the future, chose those alternatives in the future which are preferable, and took the picture of one of the preferable alternatives back into the conscious state. This alternative obtains then another status. It is now not a possible choice in the future, but a part of the present reality. The knowledge of the future alternative becomes the present reality. Such a knowledge implies that just this alternative will happen in the future with certainty.<sup>6</sup>

Thus, according to EEC, people can in principle control their future (of course, in the limits, which are actually feasible, *i.e.*, possible according to the natural laws). It is quite probable that we do control our future permanently, some of us more often than the others.<sup>7</sup>

Let some event may objectively happen (is feasible according to the natural laws), but with very small probability. Let it actually happens. Then it looks as a miracle. Why can this happen? First of all, it may happen accidentally, as a pure chance. Secondly, according to EEC, this may be perceived by someone due to his/her control of his/her subjective reality. In the last case such event may be called a *probabilistic miracle*.

Notice that the actual observation of even quite improbable (but feasible) event

<sup>6</sup>A mechanism for the control of the (subjective) reality may be described as an operation of postcorrection (Mensky, 2007 and see also Sect. 4.1). This operation consists of dipping into the future, singling out the preferable alternative in the future, and selecting (projecting on) such state of the world in the present which provides the preferable alternative in the future.

<sup>7</sup>Notice that this issue is not as simple as it seems. If someone likes some alternative but does not believe that it is conceivable for him/her, then he/she cannot actually provide, with the help of his/her super-consciousness, that just this alternative will be perceived.



does not contradict to the conventional theory because the probability of this event is non-zero. Moreover, even if any finite series of low-probability events happens, this also can be explained by the natural laws because the probability of the whole series of these events is non-zero.

However, if anyone is keen for some event to happen and believes it should happen, and if later on he/she observes that this event really happens, then psychologically it is very difficult for him/her to think that this is a simple coincidence. This is an example showing why strange phenomena in the sphere of consciousness, which are predicted by EEC, cannot be unambiguously attributed to the material or to the spiritual sphere. In fact, they belong to both. According to EEC, the whole sphere of consciousness belongs to the material as well as to the spiritual spheres, providing the smooth connection of these spheres.

It is necessary to make two remarks about practical aspect of the strange (“mystical”) phenomena in the sphere of consciousness.

- According to EEC, every person possesses abilities of super-intuition and of controlling his/her subjective reality, but only rare people have these abilities on a significant level, either due to special training or as given at birth.

- The scientific insight due to super-intuition can come only to someone who has thoroughly analyzed the problem with the help of the usual rational methods. Therefore, this insight not only does not exclude hard work by the usual methods, but rather presupposes it.

### **Synchronicities of Carl Jung**

The strange phenomenon that has been analyzed by Carl Gustav Jung and called *synchronicity*, is an example of probabilistic miracles. Jung spoke of a synchronicity in case if a series of events happen which are connected with each other through some idea or word, but have no material cause to happen simultaneously. This looks as a specific miracle, and it may be explained as a probabilistic miracle (Mensky, 2012).

### **3.3 Problem of methodology**

The conventional scientific methodology is inapplicable for theories of the type of EEC.



Indeed, theory of this type can be neither proved nor disproved with the aid of the usual instrumental experiments which are, according to the conventional physical methodology, the only way for verifying theories. In our case we need another methodology, which would recognize events in the sphere of consciousness as acceptable for verifying one or another theory of consciousness. How a novel methodology can be justified?

Roger Penrose claims in his “The Emperor's New Mind” (1989) that 1. scientific discoveries are made as scientific enlightenments, 2. at the moment of the enlightenment, the scientist is convinced of the truth of the revelation, and 3. this confidence is always confirmed.

This means that the conventional scientific methodology is not applicable at the moment of a discovery, which is the key element of scientific progress. A great discovery cannot be made if the scientist makes use of only conventional rational procedures of research and rational criteria of truth.<sup>8</sup> The discovery is performed spontaneously, and its genuineness or falseness is determined at the moment of discovery with the aid of another criterion - “the super-conscious confidence in the truth”.

The facts from biographies of great scientists evidence that 1) the super-conscious methodology is more efficient at the key stages of scientific research than the conventional rational methodology, and 2) the super-conscious criterion of truth is absolutely reliable at these stages.

Penrose concludes that it is hardly possible to understand the phenomenon of consciousness if not appealing to QM for explaining this phenomenon. In later papers by Penrose and Hameroff (1995) a concrete scheme of such an explanation is suggested. Roughly speaking, this is a hypothesis that brain (or rather some structure in brain) works as a quantum computer.

Our point of view is that this hypothesis is not sufficient for explaining the phenomena that have to be explained, and that it is necessary to go beyond physics. EEC is an

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<sup>8</sup>Of course, rational instruments of analysis are used before the discovery and after it, for its final formulation and inclusion into the body of the theory.

attempt to outline a road-map for solving this exciting problem.<sup>9</sup>

#### 4. Conceptual-mathematical parallelism EI and mathematics of QM

Extended Everett Concept (EEC) includes not only purely physical elements, but also the definition of consciousness which in fact goes beyond physics. This is why significant statements in EEC have verbal formulations. However, these statements may somehow be illustrated with mathematical formulas characteristic for QM. Such illustrations may hint how future complete theory might be constructed, even if this theory cannot just now be completed. One may also think that, vice versa, principal mathematical instruments of QM must have their conceptual realizations in quantum theory of consciousness and super-consciousness.

We shall recall here the main points of the parallels between the notions appearing in *quantum concept of consciousness* on the one hand and *the quantum-mechanical formulas* - on the other.

##### 4.1 Quantum reality and classical alternatives

###### Pure existence, or quantum reality

Combining equations (3) and (4), we obtain the following formula for the state of the world which can be interpreted as *pure existence*, or *quantum reality*:

$$|\Psi\rangle = \sum_i c_i |\Psi_i\rangle = \sum_i c_i |\Psi'_i\rangle |\chi_i\rangle \quad (\text{existence}). \quad (6)$$

The notion of existence, in the context of Everett's interpretation, includes all alternative classical pictures  $|\Psi_i\rangle$  of the world (classical alternatives) taken together (in superposition, *i.e.*, as coexisting). The superposition  $|\Psi\rangle$  is an objective description of the state of the world.

For the aim of the analysis the alternative  $|\Psi_i\rangle$  from the point of view of the given observer, we may present this alternative as the correlation of the corresponding state of the observer<sup>10</sup>  $|\chi_i\rangle$  with the corresponding

state  $|\Psi'_i\rangle$  of the external (in respect to this observer) world.<sup>11</sup>

When the classical alternatives are considered as composing the quantum reality (existence) of the world, they are treated 1) on equal terms and 2) without separation between them, *i.e.*, in their unity. This wholeness of the quantum world provides what can be called *super-knowledge*. Super-knowledge is the access to the enormous data base, which is not completely available if the alternatives are separated (for example, because the separation excludes comparing the alternatives with each other). Only super-knowledge makes possible the action of super-consciousness.

###### Perception, or personal consciousness, as the reflection of the world

According to Eq.5, with the state of the world expressed by Eq.6, the subsystem which is called "the observer" (arbitrarily chosen but fixed in our consideration) is described by the density matrix

$$\rho = \sum_i |c_i|^2 |\chi_i\rangle\langle\chi_i| \quad (\text{perception}) \quad (7)$$

Since the observer constitutes only a part of the world (as it is seen from Eq.6), his/her state cannot be presented by a state vector. Instead, it should be presented by a density matrix, namely, as it is made in Eq.7.

This density matrix (unambiguously obtained from the state vector (Eq.6) includes all the alternative states of the observer (corresponding to the alternative classical pictures of the external world). However, now these alternatives are taken not in their unity, they are separated (are connected by the logical operation "excluding OR"). Eq.7 may be interpreted as presenting *perception* of the external world by the observer.<sup>12</sup> If the

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the world. Then the state of the rest of the observer's body is included in the external world and presented by the vector  $|\Psi'_i\rangle$ .

<sup>11</sup>In fact, each  $|\Psi_i\rangle$  is not a classical picture of the world, but a sum of classical pictures,

$|\Psi_i\rangle = \sum_{\alpha} a_{\alpha i} |\Psi_{\alpha i}\rangle = \left( \sum_{\alpha} a_{\alpha i} |\Psi'_{\alpha i}\rangle \right) \cdot |\Psi''_i\rangle |\chi_i\rangle$ , with  $|\Psi''_i\rangle$  being the state of the vicinity of the observer. The observer can directly perceive this vicinity, the result of this perceiving is the observer's state  $|\chi_i\rangle$ .

<sup>12</sup>Decoherence of an observer expressed by Eq.7 is evidently in agreement with the definition of consciousness as the separation of the alternatives (see Panov, 2001). This is a point in which EEC is similar to MMI (see Zeh 1970; 2012 and Sect. 2). However, the

<sup>9</sup>Penrose insisted in (2004) that the EI may be seriously discussed only after theory of consciousness is created. We think, vice versa that EI may serve as a key element for creating theory of consciousness.

<sup>10</sup>More precisely,  $|\chi_i\rangle$  may be the state of a part of the observer's brain, namely the part which is responsible for reflecting the state of





observer, in his subjective experience, is perceiving the  $i$ th alternative, he/she is perceiving none of the alternatives  $i'$ ,  $i' \neq i$ .

Thus, the form of the observer's state (Eq.7) is inevitably separated. This is in accord with the definition of consciousness which is accepted in EEC, but this is not equivalent to this definition. Eq.7 only demonstrates the natural character of EEC in the context of both QM and the intuitive concept of consciousness.

If the observer subjectively perceives the picture  $|\chi_i\rangle$  of the world, then, due to quantum correlation between the observer and the external world, the corresponding state of the whole world is  $|\Psi_i\rangle = |\Psi'_i\rangle |\chi_i\rangle$ . This, however, is not an objectively existing state of the world. The latter is a superposition of such states, Eq.3, with all values of the index  $i$  included.<sup>13</sup>

### Personal consciousness and super-knowledge

The components of the mixture (Eq.7) exclude each other (are connected by the logical operation “excluding OR”). This is in accord with the formulation of EI which claims that the alternatives are separated in consciousness (see Sect. 3.1). In the framework of EEC we make the next step and claim that this separation of the alternative pictures  $|\chi_i\rangle$  of the world (as they are given by the brain of a certain observer) is the *personal consciousness* of this observer.

However, the access to one of the components (say,  $|\chi_i\rangle$ ) does not exclude the access (of another nature, not in the framework of personal consciousness) to the others.

Moreover, the Eq.6 hints that the access may exist to all components  $|\Psi_i\rangle$  together, therefore, to the quantum state  $|\Psi\rangle$  of the world as a whole. This access cannot be of course referred to a certain observer. The access of this type is not what we usually call “consciousness”. This should be something

that has nothing in common with the well known images created by our personal consciousness.

Such an access to the “super-information” about the whole quantum world should be non-personified. Previously we referred to this situation as “the pure existence”. In order to underline that it is connected with the access to the information of the world, we can make use of the term *super-knowledge*.

Existence of this deepest level of consciousness corresponds to the ancient conception of *microcosm*. It is supported by the experience of Buddhists and Indian yogis who experience, in the state of the deepest meditation, a special state in which they are aware of neither bodies, nor thoughts, and only *the sensation of pure self* remains, without any concrete attributes. The experience shows that this Self is perceived as being identical to God, or to the whole world.

The way in which the usual personal consciousness may obtain access to super-information (or to super-knowledge), is referred to as super-consciousness. It is interesting that, according to experience of the Oriental spiritual practices, the super-consciousness may be present even without full meditation, on the back of the usual perception of the environment. This may indicate that *super-knowledge always exists*. It is usually hidden by the too high level of the information supplied by personal consciousness, but it becomes available, even on the background of this “noise”, due to the special training or because of the special abilities of the observer.

### 4.2 Subjectiveness Everett's scenarios as subjective experiences

It is interesting to consider, in the framework of thus outlined *conceptual-mathematical parallelism*, other mathematical instruments exploited in QM. One of these instruments is formalism of *restricted path integrals*, or *quantum corridors* (Mensky, 1993). Each quantum corridor (restricted path integral) is a bundle of Feynman paths. This mathematical object may be interpreted in EEC as an Everett's scenario, *i.e.*, a chain of alternatives, one for each time moment. The Everett's scenario (and therefore quantum corridor)

definition of consciousness and the phenomenon of super-consciousness in EEC goes far beyond the original EI as well as its version MMI.

<sup>13</sup>This superposition is “non-separated” and impersonal (does not refer to any certain observer) and presents what can be called *super-knowledge*. The super-information (necessary for super-intuition) can be extracted (with the help of super-consciousness) only from this whole superposition.



may present a subjective experience of an observer as it is traced in the march of time. This interpretation has been considered in (Mensky, 2010). There are new interesting aspects in this issue, but we shall discuss them elsewhere.

### Amplitudes and probabilities in EEC

In QM both probability amplitudes and probabilities are exploited. In EEC, the transition from probability amplitudes to probabilities is connected with subjectivity, *i.e.*, with the selection of a single variant of classical reality that is subjectively perceived.

- The set of all possible potential events (alternatives) is associated with a superposition Eq.3, the coefficients of the superposition are probability amplitudes.

- Selecting a specific alternative as what is actually perceived, is characterized by the probability that is equal to the square modulus of the corresponding amplitude. This is a probability of the corresponding subjective experience.

- If the alternative is selected by super-consciousness as a preferable one, it is also characterized by a probability, but in this case the probability is different. It depends on the criteria of preferences (Mensky, 2011). This is a deeper level of subjectivity.

### Amplitudes and probabilities in case of an Everett's scenario

Consider an example of the situation described by Everett's scenarios, or quantum corridors. Let, for the given initial state  $\rho_0$  at time  $t=0$ , the set of events (that are found to be preferable) in the future ( $t=T$ ), is fixed in the sense of postcorrection (see footnote 6), but these preferable future alternatives may be achieved along various scenarios enumerated by an index  $\alpha$ . Each of these scenarios is characterized with a partial evolution operator  $U_\alpha$ . In these conditions, the density matrix presenting possible state at time  $t=T$  is

$$\rho_T = \sum_{\alpha} U_{\alpha} \rho_0 U_{\alpha}^{\dagger}, \quad \text{tr}(\rho_T) = 1.$$

Then

$$p_{\alpha} = \text{tr}(U_{\alpha} \rho_0 U_{\alpha}^{\dagger})$$

is a probability that the scenario  $\alpha$  will be realized (subjectively perceived).

### 4.3 Selection Projecting in consciousness and postcorrection in super-consciousness

The very important role in quantum concept of consciousness and super-consciousness is played by the mathematical operation which is called projection.<sup>14</sup> The conceptions of selection, preference and subjectivity are connected with this operation (Mensky, 2011). Simplifying, we can think of projection as transition from a wider set of classical alternatives to a narrower set of them.

#### Free will and providence

One and the same mathematical operation, projection, may present essentially different concepts and phenomena in theory of consciousness:

- *Free will* is an arbitrary selection of the preferable alternatives (in the simplest case this is a selection of one of two alternatives). Characteristic feature for the notion of free will is that the selection (projecting) is made on the basis of *logical analysis* (in some cases - computing) which lead to the conclusion about the preferable alternatives.

- In contrast to this, super-intuition (particularly, in the framework of postcorrection, see footnote 6) is a selection (projecting) which is made on the basis of *super-information*, obtained by the irrational, transcendent way.

In case of super-intuition and especially in case of post-correction, we deal with a sort of *backward causality* when the final state of the evolution (or some features of this state) is selected rather than the initial state. This differs from the natural causal law of evolution by reversal of time: evolution leads to the goal which is predetermined, therefore it depends on the future rather than on the past. In a sense, consideration of super-consciousness along with consciousness restores symmetry in respect to the time reversal.

#### Repeated selections lead to death?

Selection is always made to obtain the preferable variant from all existing variants, in

<sup>14</sup>projecting a linear space of state vectors onto some subspace.



order to improve the situation. However, this is achieved not as an arbitrary change of the state, but as projecting it, or as the transition from the wider to a narrower set of alternatives. Therefore, the set of the remaining alternatives becomes poorer after each act of selection. Selection reduces the possibilities for further selection. After many steps of selection, the further non-trivial selection may become almost impossible. It is reasonable to suppose that this may be a deep reason of why death of each individual organism is inevitable.

Of course, the “number of alternatives” which are available from the very beginning, is enormous, but in principle it has to be exhausted sooner or later.<sup>15</sup> The moment of exhausting of the choice (and inevitable death) is closer for the individual creatures<sup>16</sup> (or humans) because they select between very wide classes of alternatives, so that the number of classes is comparatively small. This moment is much further for big collectives of creatures (or people) and may become even infinite for life as a whole.

This may be an argument for the passive strategy of life, that suggests that the complete obedience to the providence is preferable in respect to the active selection of preferable alternatives according to the free will. If the preceding reasoning is valid, then the passive strategy lengthens life.

An example of this may be the choice of the comfort instead of the natural life conditions which are rather difficult. Almost permanent comfort became feasible in the civilized society, but finally this turned out to be unhealthy and led to many chronic diseases of modern humans.

## 5. Concluding remarks

We have discussed in various aspects the quantum concept of consciousness which results from the Extended Everett Concept (EEC) proposed by the author. Many details of this program has been published elsewhere, most details are in Mensky, 2010, so the discussion here was focused on the status of

this concept of consciousness and the prospects of its further development. Let us shortly recapitulate some of the main points of the discussion.

## Characteristic features of EEC

Subjective aspects in QM are expressed in EEC in the most radical way. As a result, EEC allows to explain mystical features of consciousness and to unify material and spiritual spheres of knowledge. EEC is applicable not only to the mind of a man, but to life in general. The characteristic feature of life (in fact, its definition) is that evolution of living systems is determined not only by causes, but also by goals (first of all the goal of survival). In the scope of physics, EEC sheds new light on the “three great problems”, in terminology of V.Ginzburg: interpretation of QM, reductionism (possibility to reduce life to physics) and irreversibility of time (Menskii, 2007).

Because of this wide coverage, EEC may seem speculative, and in a sense it is. However, this concept seems reliable because its radical conclusions follow from the only a single statement which is nothing else as an improvement of the notion “consciousness of an observer”. Yet, it should be underlined that EEC does not reduce spiritual, or psychic, sphere to quantum physics, but introduces the notion of consciousness in the spirit of psycho-physical parallelism. This approach is speculative from the pure physical viewpoint, and in any case it requires an extension of the conventional physical methodology.

## Further steps

Contrary to the original Everett's interpretation, EEC can be verified by observations, but only by observations of the work of consciousness rather than the usual (instrumental) physical experiments. Happily, the confirmations of this type can be “taken off the shelf”, namely borrowed from the experience of deep psychological practices. However, special psychological observations and measurements under full control are necessary for more convincing confirmation of EEC.<sup>17</sup>

Purely theoretical tasks also remain in EEC. For example, collective effects in theory

<sup>15</sup>Of course, the analysis has to be more rigorous (that is impossible here), particularly infinite series of selections may be possible for the infinite set of alternatives.

<sup>16</sup>In case of arbitrary living organisms, not necessarily people, this conclusion follows from the generalization of the theory (Mensky, 2010), where the notion of *classical reflection of the quantum reality* generalizes the notion of consciousness.

<sup>17</sup>Yet one should take into account that a certain subjective element will remain in any proof of EEC, and this follows from the very EEC (see Mensky, 2010).



of consciousness are not yet seriously considered, and they are of the first importance. Besides, it cannot be excluded that the future complete theory of consciousness, created on the basis of EEC, may be in the limits of pure physics. This is possible only if one considers in the framework of quantum physics not only the restricted systems (which have their environments and therefore subjected to decoherence) but also the whole world (which has no environment and therefore does not decohere). Nowadays only quantum cosmology includes the whole Universe as one of the quantum systems, and this theory is also not completed. It is not excluded that the further development of EEC has to include quantum cosmology. This would be parallel to the suggestion of Penrose (2004).

### Artificial intellect and consciousness

Theory of consciousness became very important now when the danger of uncontrolled artificial intellect is actively

discussed. According to EEC, no human-created machine can possess anything similar to super-intuition and super-consciousness. Comprehension due to super-intuition cannot be achieved by computers. This may be formulated in such a way.

Artificial intellect can be created, it has already been created and is constantly and rapidly improving, even with frightening acceleration. This is nothing else as a computer (a supercomputer). However, nothing similar to human (with his super-intuition and super-consciousness) can be artificially created (Mensky, 2010). From the other side, human-machine systems may be useful in order to benefit from the phenomenon of super-consciousness (Mensky, 2009).

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