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QUESTION OF CONSCIOUSNESS: TO QUANTUM MECHANICS FOR THE ANSWERS

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The article looks at the possible role of measurement in a quantum-mechanical description of physical reality. The widely spread interpretations of quantum phenomena are considered as indicating an apparent connection between conscious processes (such as observation) and the properties of the microcosm. The reasons for discrepancies between the results of observations of the microcosm and macrocosm and the potential association of consciousness with these reasons are closely investigated. This connection can be interpreted in the sense that the probable requirement for a complete understanding of quantum theory is an adequate description of consciousness within this theory and that the correct theory of consciousness should include a quantum-mechanical theoretical apparatus. The author draws conclusions about the current state of the "measuring" problem and its relationship with consciousness.

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1. Introduction

This article investigates the current ideas about the possible impact of conscious observation on reality in the context of quantum mechanics, a subdiscipline which is yet to be named according to the conventional meanings of quantum theory and quantum physics. The best hypotheses about the relationship (or lack of it) between observation and reality are discussed in the article. The conclusion summarizes the current state of the issue. The current analysis also identifies the difficulties in this issue in the context of epistemology.

Conscious observation is to a certain extent an important element of quantum mechanics. However it is not reflected in the theory as it includes no mathematical description of consciousness. Accordingly the following statement is proposed: quantum theory is incomplete in the sense that its description of acts of observation do not include the perception of reality (the term “observation” presumes rational activities itself). The specificity of quantum mechanics in its relation to consciousness lies in that unlike other sciences during the process of observation it makes reality to choose a specific configuration on a micro level. According to the Heisenberg indeterminacy principle this can be interpreted as follows: the entire observation (the measuring device) brings imminent disturbances into the quantum reality. This observer participation leads to a failure in the simultaneous measurement of the position and velocity of the components. Further, every following observation provides different results. Third, the world turns out to behave differently when being observed and when not. While quantum reality is not observed, it is described by Schrödinger equations; when the measurement has been carried out, the quantum mechanical equations are no longer applicable and classical physics which describe the macrocosm, come into effect. This meaning - the influence of conscious observation on the description of reality and its particular configuration - states the fundamental difference between quantum mechanics and classical physics.

In classical physics the properties of reality do not depend on the presence or absence of observation. The same applies to the relations with the properties of reality occurring in quantum physics but only until the very moment when this reality is being observed by conscious viewers. This is the theme which is discussed in this article – the rational consciousness.

Mathematician and physicist Roger Penrose (Penrose, 1991, p. 145) called quantum mechanics a “mystical” theory because of the strange link between reality and the presence or absence of our observation at a particular time. There are various philosophical interpretations of this mysterious quantum-mechanical phenomenon which have all grown from the lack of any explanation of this fact in quantum mechanics itself.

2. Some interpretation problems

Certain preliminary epistemological details need to be pointed out. The most complete representation for modern physical theories is in mathematical form. This fact precludes attempts to speak about the quantum physics using natural language. Natural language completely lacks the equivalent concepts to express the mathematical abstractions which are necessary for an accurate description. A more serious problem is how the philosophy of modern physics (and all the natural sciences) is applicable in such cases. Is it possible at all? Is it presumed that philosophy should be mathematical, i.e. should operate using the language of mathematics? If so is this still philosophy? For example, Koyré describes Newton and Einstein as outstanding philosopher-metaphysicians (Koyré, 1985, p. 24) and at the same time claims philosophy to be the forebear of science and to serve as its basis. In this case, the term "philosophy" loses its preciseness.

Galileo maintained a radical position on the connection between nature, philosophy and mathematics. He states that the book of nature is written in the language of mathematics. Many mathematicians, such as Penrose, claim mathematical objects (geometric, mathematical concepts and theories) actually exist and to be the only true reality (Penrose, 1991, pp. 96-97; Penrose, 2004, pp. 12-13). Penrose repeatedly calls himself a Platonist and argues that mathematical objects exist objectively outside of time and space, initially in the world of ideas, and they represent the truth. To be more accurate, the mathematical objects piece out the world of ideas. For this reason a scientist does not invent them but discovers them. Some Platonic dialogues ("The Republic", "Timaeus", "Epinomis") clearly state mathematical entities to be parts of the ideal world, meaning they are intelligible. For example, Plato's "The Republic" contains the concept of the perfect quadrangle (Plato, 2007, 510d), Plato's "Epinomis" considers same according to numbers (Plato, 2007, 977d, 978c). He stated numbers to be ideal essences and that leads mathematics as their operator to be the supreme science. Here the famous Pythagorean "Everything is the number" is also applicable (curiously, according to Jonathan Barnes (Barnes, 2006, p. 21), there is no convincing evidence that Pythagoras was actually interested in mathematics.)

However, one detail indicated by Gaidenko is very important: numbers belong to the ideal world and exist as the only intelligible particular and spaceless ideas, but geometric objects by contrast have a different existence (Gaydenko, 2012, pp. 127-128). Geometric figures depend on space and therefore must exist between the sensible and the ideal worlds. This difficulty appears with objects such as a Mandelbrot set: a pure mathematical abstraction which can nevertheless be represented in graphical form and is regarded as a geometric object. The same situation occurs with a Riemann sphere, the vector sum according to the parallelogram rule, the geometrical representation of complex numbers (with the axes of the real and imaginary numbers), and the Hilbertian space. Thus, many intelligible mathematical entities can be spatially represented, which means they have analogies in the sensible world. Further, Plato's world of ideas is not identical to the world of mathematical objects: for example, Penrose's attitude to the existence of bed-idea is still not clear (Plato, 2007, 597a). These observations in this context are intended to try to limit the idea of the "ideal" essence of mathematical entities in order to preserve their connection with observable reality, but on the other hand the role of mathematical review is important in this research considering the probable connection between concepts of computability (algorithm, resolvability) with the action of consciousness. Moreover, such mathematical concepts as complex numbers are also significant for estimating quantum probabilities – they are "absolutely fundamental to the structure of quantum physics" (Penrose, 1991, p. 236). A complex number has the form a + ib, where a and b are the real numbers, and i is the square root of -1. Real number specifics lies in their presentability as nonterminating decimals and that the set of real numbers is greater than the set of rational numbers and is not countable. Such advanced mathematical developments in relation to the needs of physics is of spectacular value. However, there are different points of view (Greene, 2000, pp. 259-262).

3. Specific features of quantum physics

Quantum mechanics in contrast to classical physics conducts studies on microcosmic phenomena. The specificity ("nonclassicality") resides in its perception of the microcosm as arranged in a fundamentally different way than the macrocosm, although the latter seems to be "composed" of the elements of the first. The reason for such peculiarity lies in the wave-particle duality: atomic components act both as particles and as waves. In other words, the correct description of reality is possible only using two contradictory classical concepts. This, the Bohr complementarity principle, is a distinguishing characteristic of quantum mechanics. This phenomenon was experimentally confirmed through the famous double-slit experiment where a single particle created a wave interference pattern showing the wave behavior of elementary particles. This appears when one emitted particle passes through two slits at once thus being the wave. However if a detector is installed near the one of the slits the interference pattern does not take place and the particle behaves as a particle. This experiment could lead us to the conclusion that the reason for conflict with our intuition lies in the fact that particles and fields are not fundamental concepts so there is there is a more fundamental component to explain the experiment properly. Another interpretation is that the microcosm is really regulated by such rules so the interference occurs when there is no exact certitude which slit the particle is going to pass through and vice versa.

There are also later versions of the double-slit experiment: an experiment with a laser beam splitter which splits the laser beam (emitting one photon at regular intervals) into two beams. The basics stay the same: if a detector is installed the photon behaves like a particle, if not, as a wave. The distance between the two paths can reach many light years[3].

The passage of a single particle when a detector is present, through one slit or the other is determined by the classical method of probabilities. There are two alternative paths, and the probability of path A + the probability of path B = 1. However, when a detector is not present the interference pattern results from the sum of two alternative paths (their superposition) so complex numbers are additionally used here as coefficients of the alternative paths which are added (A + iB). In other words, quantum mechanics states that the alternatives for the action of the object are determined by the superposition of these alternative ways with complex factors. The only problem for such a statement is the lack of the examples in the macrocosm. For instance, it is difficult to imagine the situation when Socrates is seen in all the possible alternatives: when he has already taken the poison, and when he has not, being in different places and performing all the different actions that he could perform at the same time. Instead only one Socrates is seen. The real meaning of the complex coefficients in such situations and their influence on the visible macrocosm are not completely clear. Despite the empirical confirmability why are quantum mechanical “actions” not noticeable at a macrocosmic level?

Before proceeding let us briefly recall the quantum mechanical method of probability. Since the particle acts as a wave the probability of its location in a particular place can be determined by the amplitude. Mathematically, this probability amplitude is made up of each and every alternative path multiplied by a complex number. The highest probability of locating the particle is at the moment of the upper crest, the least, at the lower one. However, the particle could also be detected at lower crests despite the low probability. This implies that theoretically there are many possible locations of a particle. But it is impossible to find the location of a particle before it is observed. Standard quantum mechanics states it to be wherever it could be, so its location is described by superposition. In other words, before the exact observation the particle has no specific location. Such assertions are in contradiction with our intuition and the observations of the everyday world. The act of observation “forces” the particle to locate in particular place while it has been everywhere before and has been described as acting exactly as the wave function. In fact, the act of observation switches the quantum level to the classical. In mathematics, this is the same as drawing the squared value of quantum complex amplitude module – a simple procedure performed in the Argand subspace using the Pythagorean theorem. This manipulation of the squared absolute value of quantum complex amplitude in physics is

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[3] It hasn't been done experimentally.

called the collapse of the wave function. This resolves itself into the very moment of the recording of the position of the particle, a single wave crest remains and the others “collapse” to zero. This makes it appear that our observation makes the particle select a specific location, and the quantum mechanical laws cease to describe its position.

Classical physics is deterministic: if the location and velocity of an object is clear its original and final locations can be predicted, although the actual situation is more complicated as the interaction of more than two particles causes difficulties. In quantum mechanics it is incorrect to claim a particle is located in a particular place at a particular time due to Heisenberg indeterminacy principle which states that the location and velocity are impossible to measure simultaneously. The more precisely we state velocity of the particle, the less clear its location is for our observation, and vice versa. For example, if a probability wave has the same grade amplitudes and wavelengths the particle velocity has been defined correctly. This means the observation act (wave function collapse) to locate the particle in any place results in equal probability because of the equal squares modules at any wave area. So the particle location is completely undetermined. The situation when the “wavepackage” has been specified is appropriate in quantum mechanics: when location and velocity are limited to a specific range and, therefore, are only approximately determined.

The Schrödinger equation describes the time evolution of a quantum system. Its form is not important here, but the absence of measurement in its structure is critical. The equation in this regard describes the world being deterministic: the evolution of the wave function as a superposition of probabilities is predictable, but indeterminacy arises with any attempt to locate the particle (or define its velocity) so there is a switching of the quantum level to the classical. This indeterminacy arises due to the choice of the microcosmic components being observed. So the Schrödinger equation in not applicable here as the cause of the wave function collapse. Schrödinger himself was not pleased with the absence of a correspondence between the modeling of the quantum mechanical world and what is observed in reality. The macrocosm has no superposition. His “Schrödinger’s cat” thought experiment and its many modifications are widely known. The modification of this equation which is applicable to this research will be described further.

4. The measurement problem

Let’s imagine Socrates sitting with a vial of poison instead of the cat. Then assume that no one is around him to observe his actions. Schrödinger’s original thought experiment is based on the role of subatomic particles described by a wave function effects which directly influence the cat’s condition as a superposition of alive and dead. However, quantum mechanics does not include the statements on the differences between macrocosmic and microcosmic patterns (moreover, all the objects of macrocosm are made up of elementary particles[4]). So if Socrates has no observer (that is, there is no "measuring" process), then his condition is described as a superposition of possible alternatives - in other words, he has drunk the poison and died and he has not drunk it and is still alive. For the Athenian citizens waiting outside (and also for quantum mechanics) Socrates is simultaneously both alive and dead. At the very moment of anyone entering the room, Socrates chooses a specific condition - either alive or dead, but no one ever sees him both alive and dead. With the help of probability factors we could state the Socrates superposition as being not just the sum of the two conditions but the presumption of all possible complex combinations – and they are all different. For example this could be represented as follows: the state vector of Socrates being 16% dead and 84% alive is possible. However, entering the room observer will never see such a condition. As a result of the wave function collapse which the observer provokes by the recognition of what is going on in the room, Socrates appears to be either fully alive or completely dead. But this does not turn out to be the core problem. The problem is what Socrates feels about it himself. Obviously, he perceives nothing of the kind (no complex superposition of his conditions). He is self-aware when alive and, supposedly, is not when dead. This means that the reality is different depending on the observer. As Socrates measures his condition by himself, he surely knows that he does not fit into Schrödinger equation and that he is clearly alive. For those who are outside and cannot see him, Socrates is a complex superposition of dead and alive conditions and can be described by Schrödinger equation. There seems to be no contradiction in the case of Socrates being dead and having no recognition of what is happening anymore, but is there? For outside observers he is still dead + alive, that is why it can not be generally stated that Socrates has died.

Here the question arises: is there any reason to believe that consciousness is the essential part of observation? Is it possible, for example, to consider a mosquito flying in the room as an observer who provokes the collapse of the wave function? That may be, especially taking into account that otherwise the mosquito could not have bitten Socrates while described by a superposition of all possible states.

As mentioned above, some of problems of this kind did not satisfy Schrödinger and he believed that his equation cannot be applied to macrocosmic objects, such as, for instance, Socrates. However, this is only his private opinion and in quantum mechanics itself there are no valid grounds for not doing so. Contradictions may come from our perception, intuition and the way we recognize reality, but these are not scientific arguments (for more details refer to works by Paul Dirac (Dirac, 1978) and John Bell (Bell, 1987)).

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[4] Whatever their make up is, be it "strings" or "branes", does not effect the essence of the experiment.

What, then, are the legitimate criteria for the Schrödinger equation? Why should we accept it? For example, it includes questionable members of equation, the usage of which may be interpreted as a certain mathematical “trick” for the purpose of achieving the targeted results. Who decides that the equation is appropriate and applicable? It is natural to think it has been done by those rational beings who recognize the results of the equation’s implementation, and because the equation corresponds to the results of experiments demonstrating the nature of microcosm. Another answer is that our consciousness determines “legitimacy” following the criteria of our perception and of what we consider “reasonable” based on our experience, observations, etc. The first and second laws of thermodynamics, for instance, are considered axioms of physics. However, can we surely say that the evolution of the Universe will not turn backwards in some distant future because of the changes in entropy process, so that the entropy will be decreasing while the degree, on the contrary, will be increasing? This cannot be surely stated, and the same cannot be said about the conservation laws (refer to Koyré’s works on this issue (Koyré, 1985, p. 24)). But accepting these laws is in full correspondence with our mental intuition. There are plenty of other examples from the history of science. Einstein introduced the cosmological constant relying on the intuitive believe that the Universe can only have a steady state, which he later said was the greatest mistake in his life. On the same grounds, the grounds of reason, Aristotle, Hipparchus and Ptolemy considered the Earth to be the center of the Universe, and the Universe to be finite. Newton, however, did not even accept the possibility of gravity being a feature of objects themselves. In a certain sense Descartes’s statement “We cannot doubt our existence while we doubt, and this is the first knowledge we acquire when we philosophize in order” (Descartes, 1989, p. 316) has been further developed. But nothing prevented Zhuang Zhou from doubting, contrary to Descartes (and long before him) “whether Zhou is dreaming himself a butterfly or the butterfly is dreaming itself as Zhou” (Zhuangzi, 2013, p. 35). It really does seem to contradict reason, intuition, common sense. Nevertheless, in the history of philosophy, starting from antiquity, there has been a question: why should reason (or experience, as we understand it through our conscience) be considered a sufficient basis for claiming any truth? Heraclitus’s statement is very representative: “I know nothing of anything” (Muravev, 2012, p. 124)[5]. Such doubts are likely to have evolved over the course of time into Schopenhauer’s belief that the world is nothing more than our perception of it: “everything exists only for the subject” (Schopenhauer, 2011, p. 20). As shown by the examples from the field of physics, this problem troubles not only philosophers.

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[5] The “reconstruction” of fragments of Heraclitus carried out by S.N. Muravev was used for the current research. Having solid grounds for such supposing a number of researchers are skeptical of this reconstruction but this fact is not so important for this research. “Typical” viewpoints of ancient and later authors (of the Middle Ages and Modern Times) are cited in the article in order to emphasize the same continued relevance of knowledge and reality relation problem.

The history of misconceptions proves that reasonable grounds (as in statements like, “this is false beyond any reasonable doubt” and vice versa) rely on intuition, the character of which is determined by the knowledge that people have in a particular cultural-historical period. For example, the proof of God’s existence by Thomas Aquinas seemed true as it completely satisfied the mental intuition of educated people of that time. However, with the development of knowledge and ideas, gaining experience with the appearance of new philosophic concepts, Thomas’s proof started to loose its intuitive obviousness.

There is also a counter-example: the counterintuitive principles of quantum mechanics outlined above were developed in the first half of the 20th century, but for the following generations of physicists these principles may have already become intuitive. However, this does not mean that intellectual intuition is unreliable. The discovery and understanding of the laws of nature and the embodiment of this knowledge in technology testifies to the contrary.

5. Interpretations of the measurement problem

Cognitive problems which originate from quantum mechanics have various interpretations and solutions. Let us consider some particular examples.

1. According to Bohr, the very problem of measuring operations as an attempt to explain why the rules of physics change during the transition from the micro to the macro level has never been a problem. There is no point in describing anything that is not possible for experimental observation. One should only work with something that exists, without raising senseless questions that have no answers. In other words, there is no reality rather than the one described by science.

2. A different point of view, derived from Heisenberg’s ideas, which appeals to our consciousness is that the wave function is not real. It only reflects human understanding of reality and cannot be considered an objective phenomenon. Consequently, the wave function collapse means a change of understanding.

3. David Bohm (Bohm, 1983, p. 369) like Einstein (Pais, 2005, pp. 454-457) has deterministic views on reality. According to him, particles in fact take certain positions and have certain velocities regardless of whether we can observe them or not. However, in accordance with the indeterminacy principle we cannot be aware of both simultaneously. Bohm’s theory challenges Bohr’s complementarity principle, meaning that instead of wave-particle duality it postulates separate existence of particles and their waves. This approach is also known as the “hidden variable” theory. Therefore, our knowledge of reality has its limits, but reality itself has objective features irrespective of our awareness (or whether or not we are observing it).

4. The fourth approach, probably the most unconventional, belongs to a group of scientists (Bell, 1987, p. 201) who have taken into account the possibility of altering the Schrödinger equation in such a manner that it would still “work” (technically, it is a kind of a mathematical “trick”). The idea of this innovation is that the wave function sooner or later collapses by itself with no interference from an observer. But this hardly ever happens - approximately once in a billion years for every particle. This infrequency guarantees no evident contradictions with the conventional quantum-mechanical representation of the world. And this is also an advantage, as the records of quantum-mechanics are extremely precise, otherwise contradictions would appear. Thus, from time to time particles, so to say, measure themselves, but their whole development up to this improbable event is described by a standard wave function. In this way the new theory explains the principal divergence between the behaviors of the microcosm and the macrocosm: as macrocosmic objects consist of a multitude of elementary particles, the function collapse of separate particles constantly happens within them. This process causes a peculiar chain reaction (determined by the “tangling” of all the wave functions) which makes the functions of other particles collapse. As the result, a macrocosmic object always takes a certain position and has a certain velocity (though subjected to reservations even in the macrocosm) and is not observed as a complex superposition of all possible conditions. Such an approach is rather attractive, because it removes the mystical halo around quantum-mechanics (as well as Bohm’s theory) eliminating the magical role of consciousness in the interception of reality.

However, it should be noted that all these approaches are only interpretations of reality and there is no experimental proof for any of them.

5. The next theory is known as quantum decoherence (Greene, 2004, pp. 209-212). Simply, the visual environment and its influence on objects makes these objects choose certain configurations, which are observed. The Schrödinger equation can be applied not only to the microcosm but also to the macrocosm considering that objects in the real world are not isolated, but exposed to an outer influence from for example fields or elementary particles. And though from the macroscopic point of view this influence is insignificant, in reality it is sufficient to disturb the coherence of a macro object. This influence on the wave function, which describes the development of the microcosm over the course of time, suppresses interference. It means that the visual world “takes measurements” by itself and the human with conscious observation is unnecessary. However there is a different point of view: Penrose makes an interesting observation concerning decoherence. His point is that decoherence brings us back to the matter of consciousness and implicitly suggests the acceptance of the multiverse hypotheses (Penrose, 2004, p. 1031).

6. The Schrödinger equation cannot be applied to conscious creatures (Jenő Wigner's concept (Wigner, 1983 pp. 168-182)) meaning that it describes reality objectively only while it is not perceived by the observers in the relative proximity. According to Penrose, this leads to paradoxes (Penrose, 1991, pp. 294-295). Although these phenomena are considered to be paradoxes only because they are objectionable from the point of view of reasonableness. Assuming that in the universe there are other conscious observers the wave function collapse would represent a different portrait of the same region of space to different observers (as at the moment of observation various characteristics of reality are set randomly). Let us assume that a researcher takes measurements of a microcosmic phenomenon, for example, the axial direction of an electron spin. After taking measurements he informs another researcher who is not observing anything of the results in order for the second to record them. But can such results be objective? It is highly probable (in the quantum-mechanical sense) that a second observer would get a completely different result under the same conditions because of the random nature of the microcosm at the moment of the collapse of the wave function. Is it worth speaking about objective reality in this case if it is different depending not only on whether it is being observed or not, but also on who is observing it?

7. John Wheeler (Wheeler, 1983, pp. 182-217) suggested an even more radical concept. As reality chooses a particular alternative only as a result of conscious observation, the whole evolution of the universe up to the moment when consciousness formed obtains fixed specific values only after the formation of consciousness. This is a very interesting theory especially because it leads to further questions on such issues as: what it does mean "to observe the past" in the quantum-mechanical sense if we are speaking about the human history, of course, rather than the observation of the extra-terrestrial universe. In the latter case we literally see the past. But even if we understand it this way, complexities arise. A photon traveling for many light years from a different galaxy (in an experimental case with a beam splitter) causes an interference pattern on Earth. This means, that for many years its condition has been described by a wave function and it was "smeared out" all over the universe , which is a great many alternatives. But with a detector installed the interference disappears, thus all throughout history the photon had a particular trajectory. If the detector is absent – the interference remains. It seems that the past is changing in relation to the act of observation, history is being rewritten. From a mathematical point of view this fact does not create any paradox. The paradox is a result of a philosophical interpretation.

8. John Wheeler's student Hugh Everett (Everett, 1983, pp. 315-324) proposed probably the most popular interpretation of the quantum theory in mass culture - the idea of parallel universes (often called the multiverse interpretation). The core of Everett's concept is that is no

collapse of wave function and the Schrödinger equation describes reality in a most complete way. All possible alternatives of the wave function have their realizations, but each of them does so in a separate parallel universe. It means that a variety of additional universes constantly appears with all possible combinations of alternative events. This interpretation simplifies the problem of measurement and seems to lessen the mystical role of consciousness in the evolution of the universe. However, if there is such a variety of universes and their number keeps growing, why do we recognize ourselves only in one particular universe and are not aware of the others? As an objection, it is likely that we do recognize ourselves in all the universes, but in each independently. This ruins the intuitive concept of the unity of consciousness, the idea of self-identification: how can we be sure that these are "us" in the parallel universes, if each of our doppelgangers has a different consciousness?

Another problem is experimental evidence for the existence of parallel universes. Finding such evidence is very problematic for obvious reasons. Still some physicists, for instance Alexander Guts (Guts, 2004, pp. 320-325) and David Deutsch, believe that such a test is possible with the help of so-called "shadow particles". Describing the interference of a photon, Deutsch suggests that interference is determined by the influence of "shadow photons" - invisible particles that prove the existence of innumerable parallel universes where these photons do exist (Deutsch, 1987, pp. 43-45).

9. Mikhail Mensky suggests an even more challenging approach. Accepting Everett's idea he disagrees with the conclusion that the role of consciousness in the objective shaping of reality reduces to zero. He claims, on the contrary, that consciousness is responsible for the choice of alternatives. Then he goes even further stating that the choice of alternatives between parallel universes is consciousness - consciousness is what separates the alternatives (Mensky, 2011 p. 108). In addition his interpretation preserves the idea of an objective visual world - the world of all quantum superpositions - while he believes that it is the consciousness that carries out the subjective separation of the alternatives. However, a human being is capable of perceiving this objective world, the world of quantum superpositions, when he is unconscious: in a trance, while dreaming or meditating. Mensky believes that his concept can explain such wide-ranging phenomena as clairvoyance, telepathy and other supernatural abilities. In an unconscious state a person has the ability (or rather, chances to have the ability) of "superintuition" which is a direct vision of truth. Perceiving all the universes in their superposition an individual acknowledges all probabilities and their realizations. One of the last chapters of Mensky's book is titled "Why a quantum concept of consciousness turned out to be successful". In order to avoid misunderstanding we should emphasize that this is not true. Mensky's quantum concept of consciousness is not at all successful if we understand "success" to be accepted by the academic

community. At least, it is so in this Universe. Mensky's ideas are purely speculative and "facts" about all-possible wonders provided by him as examples are unfalsifiable.

Mensky pays special attention to the fact that Pauli, one of the founders of quantum physics, cooperated with Carl Jung on the issue of the role of consciousness (and the unconscious) in physics, but he states that the results of this cooperation have never been published. However, it is only partially true. Pauli and Jung published the work "The Interpretation of Nature and the Psyche" (Pauli, W., Jung, C.J., 1955). The aim of Pauli's research was to analyze the influence of archetypes on Keppler's ideas. Jung's research at the same time was devoted to the theory of synchronicity which is used for the explanation of mystical super-abilities that are so attractive to Mensky.

There is an opinion that Everett's theory violates the parsimony principle which is a part of the "real" world. Still this is not a strong argument. This point comes directly from subjective perception of "how things should be" based on mental intuition. Another criteria of a "proper" theory popular among physicists and mathematicians is aesthetics (Penrose, 2004, pp. 22-23). Moreover, it is quite often these criteria that determine the choice of approach or initial data, but the objectivity of choice is not under consideration.

10. Another point of view on measurement relates to the nature of observers. Is it necessary to have consciousness through the observation process for the collapse of the wave function? Obviously, such a question lacks confirmation. Thus, the following hypothesis is stated: the macrocosm is as observed because it is constantly being "measured" by different observers, for example, by animals (or bacteria)[6].

6. Some conclusions

Let us draw some conclusions about observations in quantum mechanics or, in this context, on the interpretations of the origins of the differences in the microcosm and macrocosm. By reference to the interpretations above the question may be formulated as follows: what is the role of conscious observation in quantum processes and it is necessary for the observer to be conscious? These questions also can be given this way: do quantum processes have any impact on the process of conscious observation? Is it possible to view the brain as a quantum computer that carries out calculations which are reduced to what we call consciousness? If the brain is considered to be a version of a typical computer, then consciousness is actually a program that set the algorithms of calculations (recall Turing machine) and is accordingly the algorithm itself. This is how the brain deals with calculable tasks. However, Kurt Goedel's famous theorem is applicable here: there are always problems that cannot be solved algorithmically. Such problems

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[6] This section is innovative to a certain extent and has not yet been studied in the science literature.

can be solved in theory, but the existent algorithms are useless for the purpose. If we accept that consciousness is a program containing algorithms and is an algorithm itself, we have to admit that there are numerous problems which can not be solved by consciousness. Another problem, described by John Searle (Searle, 1980), is that such a program will lack true understanding of the calculations it is performing so it is still not analogous to consciousness. Thus, the human mind and consciousness cannot be regarded as a typical computer with appropriate software. Despite this, Deutsch (Deutsch, 1987, pp. 238, 337) has claimed that the brain is a computer operating on the basis of classical physics, i.e. it does not follow the rules of quantum mechanics. However, according to Deutsch, consciousness necessarily functions on the acceptance that copies of us exist in parallel universes (ibid, p. 339). Regarding the multiverse, the human brain turns into a cross-functional computer intricately avoiding the problem of insolvability.

Penrose, in turn, adheres to the point of view that consciousness is not a program and the brain is not a computer because there are certain insolvable problems. He insists that the very possibility of evaluating any algorithm's legitimacy means that consciousness is not algorithmic because this evaluation is not algorithmic (Penrose, 1991, pp. 411-413). Indeed, how do we decide which mathematical operation should be used, that a certain result is legitimate, how do we select and formulate criteria of truth? If there was an algorithm for making an algorithm which criterion of truth could be applied to this algorithm? Would they both be algorithmic? According to quantum mechanics this could be asked as follows: is the process of wave function collapse algorithmic or not? If not, which is likely to be true, it means that consciousness as an observer of reality can perform an uncomputable process and cannot be interpreted as a typical computer program. These considerations remain correct if we do not take into account the possible dualism of consciousness and body, meaning that conscious processes must be reduced to brain function. For example, Mensky holds a contrary opinion that consciousness is not a brain tool, but conversely, the brain is a tool of consciousness. The old question of the primacy between the body or the brain in the light of quantum mechanics is now modified and arises again: does the consciousness determine quantum reality or vice versa?

7. What is primary?

Penrose, in "The Road to Reality" 2004, while bonding quantum mechanics and consciousness, states that consciousness does not determine subjective observation and its results, but rather the physically real wave function collapse is responsible for the work of consciousness (Penrose, 2004, p. 1032). This corresponds with the Koyré statement that "the objective structure of existence defines the role and importance of our cognitive abilities" (Koyré, 1985, p. 21). Nor does Penrose consider the brain to be a quantum computer. He believes so for the simple reason that brain as a macroscopic object functions in full accordance with the rules of classical physics. But he also believes that in order to understand the phenomenon of consciousness completely quantum mechanics needs to be modified to connect to the general theory of relativity. Physicists having been trying for a long time but not in relation to the observation of the nature of consciousness[7]. It means that, according to Penrose, gravity plays an essential role in the problem of measurement. It is gravity that provides the objective reduction (the equivalent of wave function collapse) with which the macrocosm finds its realization and serves as the realization of quantum reality. A conscious observer is therefore unnecessary and consciousness does not determine reality. This approach to the problem of observation becomes possible within quantum mechanics only if certain alterations are brought into standard quantum theory (such as the approaches of Bohm, and Girardi, Rimini and Weber).

The quantum computer's applicability is worth speaking about only in terms of its increasing of calculation effectiveness (Penrose, 1991, p. 402). There are no grounds to suppose that the summing up of quantum probabilities is closer to the actual work of consciousness than classical calculations.

The followers of the viewpoint that an act of conscious observation itself is able to change the reality in quantum processes (that is, initiate a wave function collapse), sometimes provide the anthropic principle as an argument. According to this, the Universe is such, because of the presence of an observer. In other words, humans could not exist in a universe with different physical characteristics. It supposes the necessity of consciousness. This does not sound convincing. For instance, if we consider the fullness principle (see A. S. Karpenko (Karpenko, 2013, pp. 1508-1522) and (Karpenko, 2013, pp. 1660-1679)) and the law of sufficient reason, we can assume that all possible universes exist with their courses of nature, including our own, then the anthropic principle makes no sense and the presence of conscious observers only proves that all probabilities should be realized.

Generally, the question of the possible impact of conscious observation on the physical characteristics of reality, thus drawing the differences between the microcosm and macrocosm, still remains open. Its complexity is principal and was formulated by Zubov in a different way, "…how can we bridge physics and physiological psychology, which is to do something completely opposite to what Descartes's theories and all that followed did, which was separating physics from physiology?" (Zubov, 2006, p. 60). As has been shown, this to a greater extent depends on the interpretation which is sometimes not strictly scientific enough because of an absence of mathematical description of conscious observation in quantum theory.

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[7] It is commonly known that such a connection is required because quantum theory does not include a description of gravity.

From section 5 it can be concluded that solutions are usually purely intuitive without any empirical evidence. This situation brings us back to the speculative method. It may even be stated that the solution for the characteristics of reality, and knowledge, and the connection between the two has not come far since the pre-Socratic philosophy.

Nevertheless, this issue is very important and such a solution could possibly show the way to a proper understanding of quantum mechanics (and even the nature of consciousness).

But it is also possible that the answers will never be found at all, as the fundamental laws of nature may impose restrictions on the ability of cognition. This results from the concepts of the existence of hidden variables that cannot be calculated in accordance with the principle of Heisenberg. In this case, it would be fair to say that the possibilities of conscious observation of nature are limited by nature. And, therefore, consciousness is unable to know whether it affects the properties of the reality or not. As Heraclitus once said, “Nature likes to hide” (Muravev, 2012, p. 193).

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