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QUANTUM IMMORTALITY AND QUANTUM SUICIDE

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The purpose of this paper is to define the meanings of the terms 'quantum immortality' and 'quantum suicide' and to describe their most likely consequences in terms of quantum physics. The most common misconceptions connected with quantum immortality have been described. The probability of eternal agony of a subject, as a consequence of quantum immortality, has been considered and a conclusion about its insignificance has been made.

Key words: *quantum immortality, quantum suicide, immortality, quantum mechanics*

The idea of immortality has been stirring the minds of both ordinary people and philosophers for more than a hundred years. Dozens of science fiction writers wrote about it and each of us has at least once imagined what it would be like to become immortal, has speculated about whether it is the highest good, or the cruelest curse of all. For a long time immortality remained something not even theoretically possible, until the middle of the 20th century, when the world was presented with the concept of "quantum immortality".

This concept comes to us from such a fascinating and unexplored world of quantum physics. This section of scientific knowledge, due to the difficulty of mastering it, remains shrouded in mystery for many, which leads to the fact that despite the fairly widespread familiarity of such terms as: "quantum immortality" and "quantum suicide", a lot of misconceptions hang around them. Most people consider them very superficially, which leads to their misinterpretation.

The purpose of this paper is to shed light on the real meaning of the term "quantum immortality". Describe all its most probable consequences and possible outcomes in terms of quantum mechanics.

Before discussing the main topic, it is necessary to understand that the quantum world, or as it is also called, the microcosm, operates according to laws that differ significantly from the laws of physics that we are familiar with. The most striking and widely known example of this is the fact that, depending on the conditions, light can behave either as a wave or as a particle.

Jesper Meijerink in his work "The Immortal Possibility of Quantum Suicide" gives the following example and explanation: "Heisenberg's uncertainty principle says: "The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa." Imagine this, you are in a big room and in the back of the room you've placed a green laser. You are firing it down towards the front of the room through a narrow slit. This particular slit can be adjusted to make it more narrow or wider and the laser is than projected on a screen behind the narrow slit, so what do you think will happen once you narrow the slit? Obviously, the laser spot on the screen will get narrower and narrower. And if you stop there you will never realize that the Uncertainty Principle is at work. But once you keep going something different will happen. Because once you make the slit even narrower the spot starts to spread out instead of getting narrower. … Heisenberg's Uncertainty Principle is normally written as

$\Delta X \Delta P \geq H \div 4\pi$. *In this formula X is the position of a particle and P is the momentum of that particle. … But why do the particles veer to the left and right once we narrow the slit even more? That's because the narrow slit affects the way the photons move. This is described in this formula with delta P. Because once delta X is so small that it won't be greater or equal to H divided by four Pi anymore, delta P will go up for the formula to make sense."[Meijerink, 2019]*

As we see it, the behavior of objects in the subatomic world can seem completely counter-intuitive to an outside observer. For this reason, it is virtually impossible to observe and investigate these objects without external interference, which leads to an unavoidable change in their state. Which is why all quantum theories and their proofs are given only in a form of mental experiment

After all of the above, we can move on to a discussion of quantum suicide. What is quantum suicide? Jacques Mallah in his paper "Many-Worlds Interpretations Can Not Imply 'Quantum Immortality'" gives following definition: *"The QS thought experiment has been described as 'Schrödinger's Cat from the point of view of the cat', but the best known version is Tegmark's, which involves a 'quantum gun'. This gun is used to play Russian Roulette, but instead of a 'classical' mechanism, a quantum measurement is used to determine whether the gun fires. In a single-world interpretation, there is some known probability that the gun will fire, say 50%. If it does, the experimenter dies; if not, he survives unharmed. In the Many Worlds Interpretation, both outcomes occur. There is no randomness involved; instead, there is 'branching' of the wavefunction. In this case, each of the two 'branches' has a total squared amplitude that is half as much of that of the original 'trunk' (which itself was some 'branch' of the universal wavefunction).*"[Mallah, 2009]

Thus, "quantum suicide" is a mental experiment in the course of which, if the Many Worlds Interpretation theory is to be believed, the universe splits into two parallel "branches", in one of which the experimenter dies and in the second one stays alive.

Consequently, if this theory is true, then each of us is an immortal being in our own subjective universe. At first glance, this sounds like a perfect development, but if you look closely, you will see that this idea has one significant flaw. The theory of "quantum immortality" says that the experimenter remains alive, but the question about his physical state remains open, because it is quite possible the situation in which the gun went off, but the wound was not fatal.

Sayantan Gupta states following about that outcome in his paper "Survey of Quantum Suicide or Quantum Immortality": *"The "quantum suicide" thing really just says that your experience always continues, that there's always a next-moment. You are "a conscious perspective having a particular experience", currently a being-a-person-in-a-world experience, moment by moment. That consciousness cannot end. The theory doesn't specify the content of any next-moment though.*"[Gupta, 2016]

Therefore, "quantum immortality" can lead not to eternal and happy life, but to endless sufferings. István Aranyosi in his paper "SHOULD WE FEAR QUANTUM TORMENT?" gives the following quote from David Lewis: "*… David Lewis argues that: A terrifying corollary has gone unmentioned. As well as lifeand-death branchings, there may be life-and-life branchings such that you suffer harm on some branches and not on others. In some of these branchings, the harm branches get the lion's share of the total*

intensity. The intensity rule applies, so you should predominantly expect to find yourself harmed. As you survive deadly danger over and over again, you should also expect to suffer repeated harms. You should expect to lose your loved ones, your eyes and limbs, your mental powers, and your health.

What Lewis refers to as the intensity rule is that one should distribute expectations over branches according to their intensities in a way that would match the predictions of quantum mechanics regarding the observational outcomes of collapses, i.e. in a way to match Born's Rule. Once the death branches have been eliminated from the space of possible outcomes, we should subjectively expect to live forever, given that all branchings are life-and-life branchings, but given that all these branchings happen in the vicinity of death, we should expect to be predominantly harmed, since being harmed in life-threatening situations is very probable, hence it gets the lion's share of the total intensity of possible survival scenarios. We should, therefore, expect something like eternal torment. This is Lewis's terrifying corollary, and he expresses a genuine personal concern for his own future at the end of his article."[Aranyosi, 2012]

And what comes out of it? If the multiverse theory is true, are we all doomed to eternal suffering in the worst possible way? Not necessarily. If we view human "death" as oblivion, then this means that the death of the individual does not occur at the moment of the biological death of the organism, but rather at the moment of the loss of self-consciousness: "'*Death is oblivion', as Lewis puts it. So the variable that is responsible for both the new event space (lacking death branches) and for the high likelihood of future suffering within that space is consciousness, not life as such. The experience of suffering requires a minimal level of selfawareness and various cognitive functions. Life, on the other hand, can also be lived in coma or in a persistent vegetative state. Coma is understood in medical science as a state with no consciousness whatsoever and from which the patient cannot be aroused, whereas the vegetative state is 'absence of responsiveness and awareness due to overwhelming dysfunction of the cerebral hemispheres, with sufficient sparing of the diencephalon and brain stem to preserve autonomic and motor reflexes and sleep-wake cycles. Patients may have complex reflexes, including eye movements, yawning, and involuntary movements to noxious stimuli but show no awareness of self or environment'. Lewis's description of the torment you should expect refers to surviving with enough of you to sustain life, not to surviving with enough of you to sustain self-awareness;… Yet, in the argument for quantum immortality it is not life per se, but consciousness or self-awareness that plays a role; a branch containing an eternal life in a vegetative state or in coma is no different from one containing death*." [Aranyosi, 2012]

From this we can conclude that eternal suffering in a state of approaching death is not a possible scenario, since in most cases of biological death the loss of self-consciousness precedes it, and as we have already found out the individual should not get into the situation of loss of self-consciousness in the first place: *"Statistically, most cases of death are preceded by a process of dying. The process involves brain death at the future end, but brain death is always preceded by states of unconsciousness. This is true even of deaths that are considered sudden, like death from cardio-respiratory arrest. There is a brief temporal interval in which the victim is not conscious. Other times death is preceded by a longer period of coma or by coma followed by a vegetative state. These can last from a few seconds to several years*." [Aranyosi, 2012]

An additional argument that eternal suffering is not an inalienable consequence of "quantum immortality" is the closest continuer theory of Robert Nozick which Bartlomiej A. Lenart expounded in his paper "Why We Shouldn't Pity Schrödinger's Kitty: Revisiting David Lewis' Worry About Quantum Immortality in a Branching Multiverse": *"Robert Nozick's closest continuer theory (CCT), however, may prove to be a source of comfort and peace of mind. On Nozick's account of personal identity, the application of the closest continuer schema to persons is heavily dependent on the self's self-defining nature. … Nozick claims that the self is a self-defining self; the self defines itself via self-ascribed dimensions. Each individual person is self-defining insofar as she identifies her closest continuers in accord with the dimensions chosen for the purpose of self-definition. … Self-definition entails that certain copies of an agent may be rejected by the agent and denied the status of closest continuer if they do not fit the agent's subjective metric as defined by the self-ascribed dimensions that constitute the metric. Cooper explains that the trans-world structure, which is the trans-world. self, excludes outliers. He gives the example of multiple copies in various nearby possible worlds flipping a coin while other copies refrain from the activity. All these copies constitute the same trans-world self (all belong to the same transworld structure), in virtue of being defined by the agent's metric (that is, they are unified by the metric and the self-ascribed dimensions). However, Cooper argues, that "not included are 'me-outliers' such as the person who, instead of flipping the coin or refraining from doing so, shoots everyone in sight. That's because that is not something I could have done". In other words, the trans-world structure (sharing a certain metric) cannot include a copy with a substantially distinct (or distorted) metric. This would imply that there are copies in the multiverse that are in many ways very similar (perhaps even, for most intents and purposes, almost identical), but do not count as an agent's closest continuers*." [Lenart, 2019]

That is, in theory, the individual can determine for himself which of his future versions represent him and which are alien to him. From the above it can be concluded that if a person possessing this ability can determine which of his future versions fits his subjective metrics, then he can just as well reject those variants of events which will harm him: *"If the agent's metric can exclude outliers, then, given the right metric (as determined by some appropriate dimensions), it can also exclude or prune off all the branches containing the decrepit copies of the agent*." [Lenart, 2019]

In addition, from this theory it can be inferred that an individual can independently interrupt his infinite cycle at the moment when none of his possible future versions will correspond to his subjective metrics: *"Another possibility is that the agent simply ceases to identify with future continuers altogether and thus, as a result, dies with the last remaining copy resembling her closely enough. … And since Nozick's closest continuer theory states that X is Y if Y is X's closest continuer and X is Y's closest predecessor, both relations, a closest continuer and a closest predecessor relation, ought to be required for proper trans-world identification, meaning that the absence of either one should be enough to prune the undesired branches*." [Lenart, 2019]

Conclusions:

1. A clear definition of the term "quantum immortality" was given.

2. Were considered all the most probable outcomes of "quantum suicide" and the resulting "quantum immortality"

3. It was shown why an outcome with endless physical sufferings, as a possible scenario for the development of events in the theory of many worlds interpretation, is unlikely

1. from all of the above, we can conclude that although the theory of "quantum immortality" does not deny possible moral suffering, due to the mortality of all people surrounding a particular individual, this does not mean that the subject will also receive critical physical harm if the many worlds interpretation is correct

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КВАНТОВЕ БЕЗСМЕРТЯ ТА КВАНТОВЕ САМОГУБСТВО

Метою цієї статті є визначення значень термінів «квантове безсмертя» та «квантове самогубство» та опис їх найбільш ймовірних наслідків з точки зору квантової фізики. Описано найпоширеніші помилки, пов'язані з квантовим безсмертям. Розглянуто ймовірність вічної агонії суб’єкта, як наслідку квантового безсмертя, і зроблено висновок щодо її незначності.

Ключові слова: *квантове безсмертя, квантове самогубство, безсмертя, квантова механіка*

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