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On the place of subjectivity in quantum theory

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(Dated: February 25, 2019)

I argue that the presence of subjective, qualitative consciousness in our world is - at first sight maybe surprisingly - related with ontological complexities surrounding measurement in quantum theory. Both issues can be cleared up by a suitable redefinition of the notion of observer - by equipping them with subjective ontology and waving goodbye to the global one, covering "the whole reality".

I. INTRODUCTION

The problem of subjectivity, or the problem of mind and body, is well established in philosophy. The literature devoted to it is abundant, however, it is also highly differentiated regarding quality. With a bit of luck, one may find brilliant observations there, supported by careful and detailed analysis. At the same time, the topic belongs to those unfortunate ones on which so many so vague publications appeared (another one would be the quantum measurement problem). To make the situation more complicated - it seems so hopelessly difficult for many science-oriented researchers to contrast it with the physical knowledge about the world that they simply deny the problem's existence. I do my best to approach the issue seriously here, by being neither too philosophical, nor too conservative about it. The resulting perspective is quite original, I guess.

To formulate the problem as sharply as possible, I take its source, i.e. subjective consciousness [12], not as *awareness*, not as merely *a state of neuronal tissue* investigated in a well-equipped lab, or any other aspect of a more or less avoiding approach, but as a set of qualitative, apparently physically irreducible entities, usually called *qualia*. That is maybe a bit simplistic, since the structure of consciousness is immensely rich, but it is not the functional side that causes the problem - it is the material. Moreover, taking functional aspects of consciousness into account can completely obscure the main point.

That there indeed is a subjective qualitative aspect of our lives which cannot be ignored was noted perhaps in an uncountable number of publications. If I were to choose some standard - and contemporary at the same time - references, these would be a classic paper "What is it like to be a bat?" [1] by Thomas Nagel, and "The Conscious Mind" [2], a book by David Chalmers, where he referred to *the hard problem of consciousness*.

Perhaps the most serious issue with qualia is that they do not seem to go well with current physics. Adding non-physical layers by hand at this point is, in my opinion, not the best way out, since it introduces more complications than the subjective-objective relation itself. I believe that the right path to follow is to look for unused space in conceptual structure of current physical theories. One of the pillars of modern physics, the quantum theory, is known to offer a significant supply of this resource, a few serious philosophical puzzles included. Below I argue that one of them, the measurement problem, shares very much with the issue of subjectivity, being related to some of the most fundamental physical notions - observation.

There are lots of good arguments in favor of irreducibility of qualia (see, for instance, [2]), there is one good for their reducibility - that physics demands it. So far, there have been numerous discussions related to the former ones, but perhaps none conclusive. Building on them is a risky game - it is easy to drown in an ocean of nuances. It is not my intention to ignore all that has been done so far [13], but it seems much easier to start from scratch, especially for the reader. The same is true for interpretations of the quantum formalism - I do not describe any of the standard ones here.

I begin by briefly recalling why existence of subjectivity poses a problem for our current physicalistic understanding of the world. I then switch to a review of canonical arguments *contra* reductionism. Next, I elaborate a bit on our notion of existence, arguing that it actually does not point that much at what it is usually assumed to - i.e. entities inhabiting an objective reality. I then show how this is related to the problem of other minds and how it allows for an approximate-only physical reductionism, something what quantum mechanics seems to have been whispering about from its very beginning [8]. Finally, I discuss how all this is connected with conceptual problems related to observation and measurement in quantum theory, known for containing a strange mixture of ontology and epistemology.

II. WHY SUBJECTIVITY IS A PROBLEM

Assuming intuitive, objective Newtonian physics, as is usually done in consciousness research, the main problem with subjectivity and qualia is that their role

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is at best unclear. Qualitative point of view seems physically redundant, since brain behavior apparently explains everything there is to explain about functioning of the mechanism of perception. Why would there need to be some strange impression of greenness in the world if there already exists a physically well-behaved network of neurons?

If one insists that existence of qualia is in some sense natural, the only reasonable way out seems to be proving their physical reducibility to neuronal functions. This, however, is in no way more feasible than explaining why they exist at all - there is a kind of *explanatory gap* here (the very term goes back to [3]). The problem is that whenever one tries or is somehow forced to *explain* qualia in terms of any established or even imaginable physical machinery, they sooner or later start to look inconceivable - instead of a bridge between the canonical domain of physical theories and the habitat of qualia, one encounters a conceptual void.

Let us take a look at some thought experiments making this statement more evident. My review of claims against reducibility of phenomenal consciousness to brain behavior follows a short orthodox list. There is a well-known argument about logical possibility of philosophical zombies [2], there is an old one about inverted qualitative spectrum [4, 5], there is also the story of Mary the super-scientist [6], and the one already mentioned - the "what is it like to be" argument [1]. I report them very briefly, just to define a point of reference - in case the reader had doubts about their soundness, I strongly encourage them to go through the literature collected in [2].

A. Philosophical zombies

The reasoning behind zombies is the most direct one on the list about what I mentioned at the beginning of this section - that qualia seem completely redundant in the light of brain functions. It is conceivable, so the argument goes, that there exist physically identical copies of us without any kind of subjective, qualitative consciousness - no sensations, no feelings etc. If one admits that behavior of neurons is enough to explain the functioning of perception, which I accept here beyond any doubt, this mere observation seems to prove that qualia do not play any role at all.

B. Inverted spectrum

The spectrum argument is in a sense very much similar to the story of zombies. Here, however, a subjective phenomenal perception and a brain are contrasted with an identical brain, but a consciousness with altered qualia, specifically inverted color spectrum. Since occurrence of such a scenario in the real world seems conceivable, it is natural to ask: how are qualia related to physics, if in principle there is a many-to-one relation between them?

C. Mary the super-scientist

This one often goes under the name of the knowledge argument. Imagine a lab, organized in such a way that a scientist occupying it for a lifetime - Mary by convention - perceives everything monochromatically. At the same time, she is a world-class specialist regarding human vision and physics of light. Technically, she knows in great detail what happens in a human brain when light of a given wavelength (say red) impinges on a healthy human eye. Yet, as the reasoning goes, she still does not know in what way a red quale is different from the monochromatic ones she is familiar with.

D. What is it like to be

This is perhaps the easiest of the arguments from the list to capture, making it a very powerful one - if imagining other people's qualia might seem conceivable, at least to a zeroth approximation, it is almost certainly impossible in the case of bat's sonar. It encourages one to think that there is an indispensable element of subjectivity in our world, since objective science cannot reach all of reality.

Each of these arguments seems quite plausible - there is certainly a fair amount of qualitative subjectivity in us. On the other hand, however, there is physics with an apparently different attitude. In the light of current scientific knowledge it would be unnatural to assume that consciousness is something more than just a physical structure. What a scientist usually does at this point is questioning the common sense and assuming that somehow, in more or less distant future, qualia will be explained by neuroscience. With such attitude, however, it is easy to reach a - ridiculous from an intuitive point of view - conclusion that qualia are just an illusion.

The two positions, each one seemingly correct, have been competing for a long time in the literature. Pushing argumentation in any of these directions, however, is not likely to give any real progress. In such a paradoxical situation what might help is a redefinition of a basic notion quietly assumed to be valid. Two such notions emerge very naturally in the present context: *reductionism*, because qualia seem irreducible, and *observation*, since the qualitative is the subjective at the same time. In some sense fortunately, exactly the same two notions cause problems in current physics. Reductionism - because no matter how many elementary quantum objects one glues together, Newtonian physics (or the classical limit of the quantum formalism) is not reached by this procedure alone [8], observation - because the mysterious *jump* from quantum fuzziness to sharply defined physical quantities (the famous collapse of the quantum state) seems to be present only in one's consciousness. Let us start with the latter one, but before we do that -

let us take a closer look at the concept of existence. Its reconsideration turns out to be crucial for making sense of qualia and for coping with measurement in our fundamental physics.

III. THE NOTIONS OF EXISTENCE AND OBSERVATION

In the context of a given state of subjective consciousness, *to exist* is perhaps the most fundamental notion I have (forgive me, please, this egocentrism - with first-person perspective it is easier to maintain clarity of the following). Yet, it is not necessarily obvious what it actually refers to. Not going too much into details for the moment, let me adopt a variant closest to my instantaneous subjective experience. Intuitively then, its scope are objects I see in my private visual space, thoughts I have, my other sensations, feelings etc. The term "experience" is not accidental, since what I most privately treat as existence is actually *an experience of existence*. These two are indistinguishable for entities like thoughts and feelings, but it is a bit more complex with spatial objects. Here, I visually experience only some parts of an object, *imagining* that the rest exists hidden from my sight. I can cure that, however, by acknowledging the latter existence to be in fact an extrapolation of the mentioned experience of existence (this is quite easily verified by intuition). I recognize, thus, that in fact the experience comes first - it captures the essence of being, while the other, a bit more general, notion of existence is only its derivative, living in imagination.

Going on, it is easy to notice that, taken as such, existence goes away together with consciousness - if I die, my sense of existence of my surroundings, inhabiting my consciousness, is sure to disappear. Now, if I demand that content of consciousness is to be completely encoded in brain behavior through an isomorphism, an immediate conclusion is that this existence has to be, for lack of better words, a kind of "thought", for only then can it be a part of the neural mechanism [14]. I conclude that I do not experience objective existence of entities living *outside* consciousness, I just have "thoughts" that something exists (more correctly - I have experiences of existence), and this something exists *inside* my consciousness. To give an illustration in the visual space - if I see a 300-kilogram piggy, on the edge of sanity, charging in my direction, because I hold a bucket with food, this piggy exists for me at most in my subjective visual consciousness.

Nevertheless, I tend to give the notion of existence an objective character. This manifests itself in two contexts. Firstly, there is a generalization of the one involving the difference between existence and experience of existence, mentioned above. If I close my eyes, then imagine - in an appropriate way - time evolution of an object I was looking at the moment before and open them again, my imagination will match the new state of this object. Because of that, I can very easily construct a world objective in character, still quite clearly made of qualia, which I experience and explore everyday. Let us ascribe to it, for an obvious reason, *existence-even-when-I-do-not-look*. The other, stronger in a sense, context arises if I admit phenomena which seem to turn the simple world constructed in the previous sentences into a conceptual model of an "outer", "real" and independent one, in which consciousness is immersed. These can be a loss of awareness, a damage or inherent limit of senses etc. - everything that forces me to rely heavily on my more or less abstract imagination. If I am fluent enough in using the latter and have enough time, I can obtain in this way a conceptual structure that is traditionally described by Newtonian physics (we will switch to quantum theory later on, when it is needed). One should be careful, though, in promoting this construction to a model of reality, as it is usually done. In accordance with our discussion, the existence of, for instance, objects living in space created by my visual imagination from primitive sensory data is only a derivative of the notion of subjective experience of existence, not a world's existence *per se*. For the common sense this extrapolation is not necessarily harmful, whereas it prohibits proper understanding of subjective consciousness, as will become clear until I finish my argumentation.

The above can be compressed in the following way. In its cleanest form, existence for me is *de facto* the *subjective experience of existence*. The latter applies to entities *given* in real time, like a sensation of a uniform visual field, of a sound, like a thought, a feeling etc. This experience can be imagined, and in such form it is what I usually call *existence*. In other words, all the meanings of the word "existence" I can think of are derived from imagined experience of existence with more or less effort. Two possible contexts come here to mind immediately. The first one - when I complicate a bit the visual field by introducing spatial objects. Since I can have a visual sensation of only a side of an object, the (experience of) existence of others is imagined. This is what I called existence-even-when-I-do-not-look. The second context arises if I try to introduce a world completely *independent* of my consciousness (in the previous case it was not so - the unseen sides of objects were potentially in my visual field). Or, if I try to define an ontology outside my consciousness. This seems risky for I can easily verify that I model existence in this outer world on my *subjective experience of existence*. Thus, I give up the idea and agree to treat what I thought would be an external ontology (our physical model of the world) as an elaborate conceptual structure still only inhabiting my imagination.

From now on, let us call the hypothetical "true", "real", "external" to consciousness (and possibly also objective) ontology *physical*, while the one from the above conceptual model either *quasi-objective* or *subjective physical*.

Let us now take a look at consequences of the above reasoning for the notion of observer. Consciousness

is traditionally, i.e. if one treats quasi-objective as physical, thought to contain images of surrounding objects (particularly its visual part). Its ontological layer, it follows, should be considered common with an objective world - like it is for a mirror and objects it reflects. That is, an observer is traditionally convinced that their consciousness is *a part* of an objective world. Or, the traditional observer is able in some sense to reach outside their consciousness, since they logically separate perceived objects and their images. On a closer look, however, this ought to be at odds with the very definition of consciousness understood as a source of knowledge - for it should be the only thing at the disposal of an observer. If we now combine this with the argument from the previous paragraphs, we arrive at a conclusion that subjective consciousness itself should define ontology for an observer (perhaps an "observer" now). That is, due to their own nature, they should not be able to reach any kind of truly objective ontology, external to their consciousness.

Such a statement can seem quite problematic, however, at least for three reasons:

- physics is assumed to postulate a common ontology (if one completely ignores quantum peculiarities),
- we intuitively think there is an ontology to share between various observers,
- a situation with different notions of existence (pertaining to different agents) seems incomprehensible.

Despite a conflict with intuition, there is a way to proceed. Firstly, we need to agree, along the lines of what has been said so far, that none of us has access to physical ontology, whatever it might be. Secondly, we need to give each observer their own ontology, which they treat as true. It looks as if there was "real" physics - on the conceptual side very different from what we are used to, and unreachable for us - such strange that it was able to create a mind with an impression of existence. Agreed, this potentially produces a certain logical uneasiness - existence is on the one hand treated as artificial (it is not the physical one), on the other it has to be in some sense real (it is the only one an observer has). In order to avoid it, we have to redefine our *traditional* notion of physical ontology - it should now be taken as the subjective physical one, whereas its old location should be left blank. In other words, existence I have at my disposal is not a "true" existence of things in a reality completely independent of my consciousness, it is only created by my mind for its purposes.

Something like a common ontological layer is necessary in order for the notion of observation to be strictly applicable. If a theory lacks one, a single object cannot be connected with numerous observers, and room is left for each of them having their own object in their subjective perception. Why then do we have a tendency to construct a global ontology common to all observers? Why is there observation at all? The reason is precisely the mistaking of quasi-objective ontology for physical one. Such a misleading picture can arise only because my own consciousness has a "brainy" representation within itself - only this allows me to place all minds (through corresponding brains), including my own, on an equal footing, by introducing a global view. I am then easily inclined to think that me and other agents all have access to, or observe (specifically through subjective consciousness), the very same set of items - our surroundings. However, this can quickly collapse, because the global ontology I have just introduced is neither objective, nor "true" - it is quite easy for me to realize, if I recall the previous paragraphs, that it is actually *my* quasi-objective or subjective physical ontology. Thus, there is no common playground for different "observers", moreover - they never share objects between their ontologies (this point will be crucial later on, when we come to quantum theory). A consequence is that - in accordance with intuition - it does not make sense to ask about other people's or animals' qualia, for they belong to different ontologies. If they were to be compared, this could be possible only from the point of view of physical ontology, which we do not have access to.

To finish the story, we have to say a few more words about the status of quasi-objective ontology in brain. First of all, observe that in the picture at hand ontology within a given subjective consciousness, mapped to its brain through neural correlates, has to be completely different from the one of the brain itself, i.e. its building blocks. Neurons produce a notion of existence, but this existence is not about objects standing next to the brain - rather about virtual, internal to perception, objects created by itself, only correlated with the outer ones in the just constructed global view. In other words, not only an image occurs in perception - this image has also its own "abstract" or "artificial" ontology, having nothing to do with any ontology of neurons [15]. This is obvious if one translates the identification of existence with experience of existence through the mind-brain isomorphism.

It is very tempting now to ask where does "we" come from, since the subjective is naturally limited to "me". How is it possible for me to talk with someone else about their subjective consciousness if I cannot verify its existence? It makes sense simply because I do not need qualia of another person in order to talk about their subjective consciousness - it is represented in my consciousness through their brain, or through a virtual world created by their neural network. It is there that I can find a correlate of - artificial for me - existence of some subjective entity inhabiting someone else's perception and consciousness. Whatever (empirically correct) they say about their qualia is reflected in behavior of their brain, it thus becomes obvious that it does not matter if I have access to these qualia. They can be "inverted", for instance, and this still would not matter for anything in my understanding of the world, my communication with

these agents and so on. It is like other brains defined my point of view on other people's minds - if they appear to me as brains, not as sets of their qualia, so be it. In the end, these brains are only parts of my subjective ontology, not a true physical one. In the same manner, it is also meaningless to ask if one can ascribe qualia to other physical entities than brains. "We" is thus something present only in each quasi-objective or even-when-I-do-not-look ontology. As a side remark, since we do not have access to physical ontology, the very notion of observation changes its meaning. We may call ourselves observers only because each subjective perception is represented within itself as surrounded by something it apparently mirrors (or is correlated with in certain manner, to be precise).

This is a good moment to consider physical reducibility of qualia. The problem can be formulated both in terms of a possible physical ontology, as well as a subjective physical one. As for the first option - qualia cannot be reducible to any real physical ontology simply because we do not have access to it, i.e. we cannot formulate any elaborate arguments with the help of it. As for the second one, recall that brain does not recognize objects around it as elements of ontology - it does so for mental constructions living inside perception, which are mental mirrors of these objects. Thus, my own perception, which is my consciousness seen inside itself, seems to define a "false" ontology, which I will never agree to identify with the subjective one - my proper, fundamental ontology. Put differently, in order for the reduction to take place I would have to consider my own subjective ontology artificial. That is a strong reason to reject reducibility of subjective perception to brain behavior - what one can hope for at most is a functional isomorphism between the two.

IV. CONSEQUENCES FOR PHYSICS

Such a substantial change in understanding of ontology must have serious conceptual implications for physics. Fortunately, it turns out that it rather fixes existing problems than causes new ones.

A. Relation with physical reductionism

Quantum theory is known very well to have arisen in order to explain behavior of atoms and elementary particles - in other words, to make physical reductionism more solid than it used to be before. Some time ago I argued [8] that the need to introduce the collapse of the quantum state signals a problem exactly with reductionism. However contradictory these two approaches might seem, it is not difficult to reconcile them.

If I take an appropriate number of elementary quantum objects and glue them in order to form atoms, then molecules, then more complicated pieces of matter, I expect to obtain, in the end, a classical macroscopic object. This never happens by itself, as indicated by the quantum formalism - I need to apply the collapse at some point in order for the big object to gain definite properties [16]. Adopting a top-down approach, one might say that the smaller the constituents of matter, encountered on subsequent layers of material organization, the less well-defined they are in terms of ontological definiteness - as if the ontology was gradually dissolving (to be precise, what is dissolving is the Newtonian quasi-objective one). As a consequence, quantum theory is defined by its classical limit [7], not the other way round, as one might expect.

An ontology defined on the macroscopic level, like the one constructed inside subjective perception, is exactly the missing part of the picture. The well-defined, top level is governed by objective, observer-independent classical physics, while the remote, quantum one is in principle allowed to be ontologically deformed, for nothing is in fact built on top of it - reductionism in terms of Hilbert space can be defined only *relative* to the classical level, which is established independently. In other words, we have subspaces for quantum particles because we observe quantum particles while being on the macroscopic level. The classical world is thus only quasi-reductionistic - its reductionism is apparent, albeit quite convincing on the macrolevel.

Such deformation, or dissolving, is conceivable if one accepts that subjective ontology is not a physical one (recall how we defined the term "physical" above). One could imagine a situation in which it was, for instance, somehow emergent, but this emergence was not visible in consciousness due to its being (forever) insensitive to a "deeper level".

B. The measurement problem

The measurement problem is closely related with the notion of observer. Its standard formulation, however, exposes a difficulty arising when we want to treat measurement as an ordinary interaction, engineered by us to extract information about an object.

Let me give a simple illustration (for an introduction to the formalism of quantum theory and its description of measurement the reader is referred to [9]). Consider states $|s_i\rangle$ of a quantum system S and states $|a_j\rangle$ of a measuring apparatus A, with a "ready" state, $|a_0\rangle$. If A can measure S, then there exists a unitary operator U with the following property:

$$|s_i\rangle|a_0\rangle \xrightarrow{U} |s_i\rangle|a_i\rangle \tag{1}$$

(for every i). From the linearity of U we have:

$$\Big(\sum_i \alpha_i|s_i\rangle\Big)|a_0\rangle \xrightarrow{U} \sum_i \alpha_i|s_i\rangle|a_i\rangle. \tag{2}$$

Since measurement should be an interaction like any other (these are unitary for isolated quantum systems), we should be able to stop at this point. It is far

from clear, however, that one can treat the right-hand side of (2) ontologically as a result of measurement - neither the apparatus, nor the object is in a definite state. Only after performing an appropriate projection,

$$\sum_i \alpha_i |s_i\rangle|a_i\rangle \xrightarrow{P_j} |s_j\rangle|a_j\rangle, \tag{3}$$

can one finish the whole procedure. When exactly to apply P_j in an experiment and what kind of phenomenon it corresponds to is not indicated by quantum theory.

Moreover, quantum measurement involves *creation* rather than uncovering of properties. The reason is that quantum superposition, from which measurement picks an option, is not the same as statistical mixture. This is perhaps most lucid in the famous double-slit experiment where lack of measurement allows for quantum interference. Overall, it is as if measurement was in part pushed from the domain of epistemology to the ontological one.

What is considered a measuring apparatus in the above scenario is not precisely defined - it can be a bunch of particles, large enough to be on the edge of the macrolevel, but also an enormous piece of laboratory gear. Thus, the cut (as Heisenberg would say) between the quantum and the classical can be freely shifted over a wide range. Nothing prevents us, in principle, from including human observer as the last element of the measuring chain (this was done by von Neumann [10] and Wigner [11] long time ago, but in a different context). Now, this is exactly what is needed to relate the measurement problem with the whole reasoning of this paper. As soon as the influence of the measured (or rather "measured") object arrives to my brain, I can connect the quantum formalism with a particular state of my subjective perception by neural correlates and pick the right element of the quantum superposition [17]. The reason why we have to wait until the brain is included in the process is that quantum theory does not allow us to use the objective, classical existence strictly. That forces us to make predictions for the only well-defined layer there is left, i.e. direct consciousness and its derivatives from imagination. An impatient researcher could actually locate the cut a bit earlier, already when the signal reaches the macroscopic level, and before the observer is included, because mechanisms like decoherence allow it *for practical purposes*, or - because quasi-objectivity and approximate reductionism are "saturated" enough at this earlier stage. In principle, however, this is not correct, since our physics is not fundamentally, strictly reductionistic in the ontological sense.

C. Wigner's friend

The above problem can be given a different face, as in the "Wigner's friend" thought experiment [11]. Assume we have two measurement processes. The first one, as above, includes a measured quantum object and an observer (it is crucial to have a human this time). Imagine now that we treat them as an isolated quantum system (close them in a hermetic room) and include an external human observer in the picture - this would be the second measurement process. From the point of view of the first observer, the state of the measured quantum object may be perfectly definite, while for the second one the whole system inside the room may be in a quantum superposition. One can now ask, loosely speaking, who is right regarding the state of the object, for it is different in the two cases (in the latter one a pure state for this object is not defined, since it is entangled with its measuring apparatus). This paradox is very well explained by the assumption that each observer has their own ontology. If both of them are not physical, but subjectively physical, meaning the observers do not share objects between their ontologies, such a difference in points of view is perfectly acceptable - for, in the light of the previous sections, our physics is distributed over different subjective ontologies. Of course, after opening the room, the external observer would have to apply the collapse. This would, however, just put both observers into agreement verifiable by them from their minds [18].

V. CONCLUDING REMARKS

Objective ontology, accompanied by observation, is certainly a very natural ingredient of our view of physics. Nevertheless, this notion is based on a convenient modification of the quasi-objective one, which is purely a domain of our subjective sensory data and imagination - our notion of existence is only a derivative of a subjective state that might be called "experience of existence". If we draw a conclusion that there really are some objects outside subjective consciousness in any sense, it is only because we introduce by hand a "true", global ontology and *identify* the subjective with brain behavior, what forces us to consider physical surroundings of the mind. Contrary to this picture, however, one actually never claims existence of one's consciousness. If I say "my consciousness exists" it means "a visual content exists" or "a set of auditory sensations exists" - it is a statement about something inside consciousness. We never consider existence of consciousness as a whole (this would be the "true" physical existence), but concentrate on the one which points at its content or a theoretical model.

This means that each agent has their own ontology, either inaccessible by others (if it is looked upon as a set of qualia), or artificial for them (if it is seen as brain behavior). These ontologies do not share objects between themselves, but at the same time are not independent. Very loosely speaking, it is like a collection of different movies, with plots taking place in distinct worlds, but similar [19]. The usual location of the global ontology is, however, left empty.

Qualia are naturally not reducible to anything

"external" in such setting, for they belong to their own, separate reality in case of each consciousness. This *can be* treated as the price we pay for having perception (understood generally, as a mechanism, not as brain behavior) which is a higher-order structure in terms to which we do not have access.

Whereas for a random physicist claiming that the notion of observer is not well-defined in the scope of quantum theory is acceptable, questioning reductionism, even to a slightest degree, is automatically a heresy. The fact that this theory is so reliable on the practical side often leads people to ignore or ridicule its conceptual issues. On the other hand, more science-oriented researchers involved in philosophy of consciousness quite often do not have particular interest in physics, thus they know about reductionism what fellow scientists tell them - that it is "scientifically proven". For some of them things like qualia have to be strictly reducible to brain behavior, because "according to physics" everything has to be reducible to behavior of elementary particles. Well, physics has its own conceptual issues.

The reasoning presented in this paper touches the notion of physical reductionism only where experiment does not reach. This means that it is rather based on rearranging of some notions than interfering with formal structure of a physical theory and changing its predictions through that. Quantum theory is still what it used to be - reductionistic to exactly the same degree as before, but it has only been stressed that this reductionism should be understood relative to an independently (although not infinitely precisely) defined macroscopic level.

Of course, the role of the observer in quantum theory is now much more clear - everything in physics has to be related to an observer's consciousness, since it defines their ontology.

Let us finally comment on the meaning of this work's main conclusions in the light of existing points of view on consciousness. First of all, there is no problem of choice between monism and dualism - a partition into matter and mind comes in a different flavor. Qualia are fundamental elements of subjective ontology, and on them we build - with the help of imagination - an "objective" world (to a zeroth approximation it is the *given* spatio-temporal world together with "private" elements, like thoughts and feelings, to a first approximation - the world known from Newtonian physics, also living only in our imagination, and gradually dissolving in the microscopic realm). What we call matter then is a derivative of qualia in a sense. This implies that subjective consciousness is not built from a "separate material", and there is no need to consider its possible interactions with matter (interactionism, epiphenomenalism and so on).

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[7] S. L. Adler, "Quantum theory as an emergent phenomenon", Cambridge (2004)

[8] P. Witas, "An intuition behind quantum measurement", arXiv:1403.6701 (2014); some parts of the reasoning presented there are a bit outdated, but the one concerning reductionism supplements this paper very well;

[9] G. Auletta, "Foundations and Interpretation of Quantum Mechanics", World Scientific (2000)

[10] J. von Neumann, "Mathematische Grundlagen der Quantenmechanik", Springer (1932)

[11] E. Wigner, "Remarks on the mind-body question", in I. J. Good (ed.), "The Scientist Speculates", Heineman (1961)

[12] The terms "consciousness" and "mind" always mean "subjective consciousness" in the following, whereas "perception" used alone is always understood as a neuronal mechanism corresponding to consciousness through neural correlates.

[13] I apologize all serious thinkers in the field who happen to read this - a more complete paper, presenting my argumentation in an appropriate context, is on the way.

[14] In this paper I do not assume *identity* of subjective consciousness and brain behavior.

[15] Of course, the terms "abstract" and "artificial" should be contrasted only with quasi-objective ontology, not physical one.

[16] Some say that it is enough to include interaction of a given quantum object with environment in order to fix the situation. This is obviously *not* enough since the object together with its environment is still ill-defined.

[17] It does not mean that consciousness causes collapse!

[18] To be precise, one of them would be a mind, the other - a perception, since we cannot have a global view containing several minds.

[19] As in the preceding footnote, it is not possible to see a collection of such qualitative movies - there is always a need to distinguish one, from the point of view of which other ones are seen as brains.