Subjective Universe

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Abstract

We show that, using quantum theory, the subjective experience including that of observing the representation of the universe, i.e., not the universe itself, is all that exists. This is called the 'Subjective Universe'.

1 Subjectivity: the ultimate limit of physics

Scientific laws are derived based on what we observe or experience. Even experiments, as objective as they may seem, are what we subjectively experience. Physical laws provide us not with the law of physical systems, such as the Moon or elementary particles etc., but the way their characteristics or representations are observed or experienced. That is, subjectivity is the ultimate and unavoidable limit of physics.

Let us outline aspects which the completely subjective physics theory should possess. - The ultimate theory should describe the physical system which we observe not as an objectively existing entity, but with the subjective representation in relation to the observation. By the subjective representation of the physical system, we mean the characteristics of the physical system that can be observed. The theory should contain the following two main variables:

1. **Subjective representation of the physical system**
2. **Reference frame in observing the subjective representation of the physical system**

The ultimate theory should describe the subjective experience with these two variables. It is noted that the variable, the subjective representation of the physical system, does not imply the existence of the physical system. All it represents is the subjective representation of the physical system, not the physical system itself.

When the ultimate subjective theory is said to describe only the subjective experience, it seems to yield an impression that the theory will not be able to reveal the objective reality of the universe but only the limited subjective experience. Surprisingly, we will show that it is only the subjective experience that exists, not the universe itself. That is, *the universe does not exist! Only the subjective experience does!*

2 Quantum theory reaching the subjectivity limit

The subjective limit had not been a major concern in classical physics. However, after centuries of continuous efforts and remarkable advancement, physicists began to reach this ultimate limit and subjectivity *finally* started to matter. With the development of quantum theory, the observation or measurement aspect began to be seen as an integral part of the theory. Many people have viewed subjectivity in quantum theory as a sign of incompleteness of the theory. However, quantum theory being subjective at the fundamental level shows the theory has started to reach the furthest limit physics could offer.

Let us consider the *standard* axioms of quantum theory which can be stated as follows:

Axiom 1: A state vector is complete description of a physical system.

Axiom 2: An observable is a property of a physical system that can be measured.

Axiom 3: A state vector is measured with respect to the observable. The measurement outcome is probabilistic and its average value corresponds to the expectation value.

Axiom 4: Time evolution of quantum dynamics is unitary through two equivalent approaches, namely the Schrödinger and the Heisenberg pictures.

Let us review the first and the third axioms in more detail. Using the notation of quantum computation, let us consider a case when the state vector is a qubit with emphasis on its subjective nature. When the qubit is measured and its outcome turns out to be ± 1, the actual qubit state may not be ± 1 but something else. That is, what the result really means is that the qubit 'as it is measured' has the outcome of ± 1. In other words, the result yields to describe the subjective observation of the qubit state turning out to be ± 1. It does not say anything about the objective state or the existence of the physical system being represented through the qubit. When we put the first and the third axioms together, a state vector is a complete description of a physical system within the limit which measurement is able to reveal. That is, a state vector is a subjective representation of a physical system.

When we consider the state vector describing the universe, the same logic applies. When the state vector for the universe is measured and a certain outcome is obtained, it may not actually correspond to the objective state of the universe. What the result really implies is that the state of the universe 'as it is observed' has that particular outcome. That is, it only describes the subjective experience of the observing the state of the universe to be that outcome. It does not reveal the objective representation or the existence of the universe.

If the first and the third axioms show that the state vector is complete within the limit of observation, this in fact requires another main variable.

Let us consider the case of a qubit. - When the qubit is measured with a certain observable, say z-direction in the Bloch sphere notation, the outcome is ± 1. That is, the z-direction is serving the role of the frame of reference when the measurement is performed. The second and the third axioms show that the observables to be considered as the frame of reference when describing the subjective experience of observing the state vector. If we consider the state vector of the universe, we can see that the corresponding observable should be the frame of reference for observing the state vector of the universe.

Therefore, we can see that the first three axioms of quantum theory fit the criteria of the ultimate theory outlined in the previous section with two main variables as follows,

1. **Subjective representation of the physical system:** the state vector of the universe.

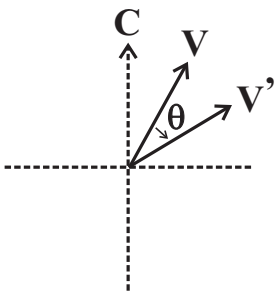
2. **Reference frame in observing the subjective representation of the physical system**: the observable for the state vector of the universe.

3 Subjective Reality

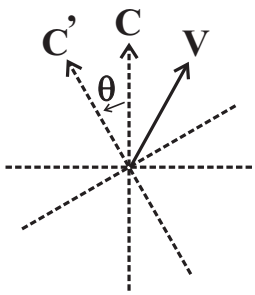
When the ultimate physics theory is said to be subjective, it seems discouraging that it will not be able to reveal the truth about the objective representation of the universe outside of the limited subjective experience, let alone the existence of the universe. However, unlike this common perception of subjectivity, we wish to show that the subjective experience is all that exists. That is, we will show why the subjective experience including that of observing the representation of the universe, i.e., not the universe itself, is all that exists. Therefore, there is no reason to be disappointed by the limitation of the ultimate theory, since that limited subjective experience is all that exists! We wish to show this using the fourth axiom of quantum theory, i.e., the unitary evolution.

We wish to consider the unitary evolution of a qubit and an observable in the $x-z$-plane of the Bloch sphere. The first case of quantum dynamics is when the state vector, $\mathbf{V}$, is rotated unitarily by θ, and the second case is when the reference frame, $\mathbf{C}$, is rotated into the opposite direction by the same amount (Fig. 1). In both instances, the measurements would yield the same outcome. That is, both cases describe the identical experience. The first case corresponds to the Schrödinger picture and the second to the Heisenberg picture of quantum theory. Note that if we consider the qubit to be a pure state, then the qubit is disentangled from the rest of the state vector and is possible to treat the unitary evolution of the qubit with respect to the observable (as in Fig. 1) as a completely closed and independent system.

In the above, we have considered the case of the unitary evolution of the state vector $\mathbf{V}$ with respect to the reference frame $\mathbf{C}$. In the Schrödinger picture, it is the representation of the physical system that is rotated, and in the Heisenberg picture, it is the reference frame that is rotated into the opposite direction. Let us now consider one special case of the general unitary evolution of $\mathbf{V}$ with

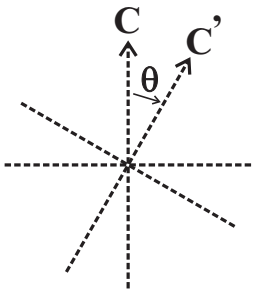


(a) Schrödinger picture

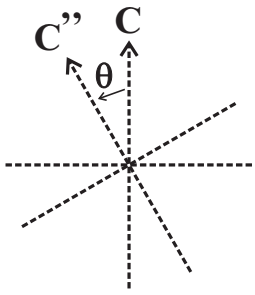


(b) Heisenberg picture

Figure 1: In the Schrödinger picture, it is the state vector, **V**, that is rotated clockwise by θ while the observable **C** remains still. On the other hand, in the Heisenberg picture, the reference frame is rotated counterclockwise by the same amount and the state vector is not changed. Both pictures describe the identical experience.



(a) Schrödinger picture



(b) Heisenberg picture

Figure 2: In the Schrödinger picture, **C**, being the state vector, is rotated clockwise. In the Heisenberg picture, the same vector, being the reference frame, is rotated by $-\theta$. In both pictures, they do not yield the same experience.

respect to **C**, i.e., when it is the reference frame **C** that is unitarily evolving. This corresponds to the case when the coordinate vector **C** itself is evolving as the state vector.

As discussed, the fourth axiom of quantum theory provides two approaches for its dynamics. In the Schrödinger picture, the coordinate **C** is unitarily rotated clockwise because it is serving the role of the state vector. However, in the Heisenberg picture, **C** is an observable which is rotated counterclockwise. Therefore, one can see that the two approaches do not yield the same experience, i.e., **C** is rotated into two different outcomes (see Fig. 2) [1]. However, the question arises, if such a thing, i.e., the reference frame evolving as a state vector, in fact is observed. Surprisingly, such phenomenon is experienced! For example, we are able to experience choosing or changing a basis when measurement is performed on a qubit. However, we could still experience choosing or changing a basis when there is no measurement to be performed at all. This unique experience of observing our own reference frame exists only in consciousness, a phenomenon known as reflexive self-consciousness [2].

The problem shown above (see Fig. 2) arises because the two picture formulation of quantum dynamics in the fourth axiom have an underlying assumption about the existence of the physical system and consider the physical system is observed in terms of the relative difference between the reference frame and the state of the physical system. Therefore, in order to resolve the inconsistency shown above, as in Fig. 2, we have to abandon this assumption about the existence of the physical system. For example, in the language of the qubit transformation we just considered, it is not that a physical system which is in the state **V** exists and is being observed in terms of the relative difference between **V** and the reference frame **C**. Instead, it is only the experience of observing the representation **V** itself that exists, rather than the physical system that is being represented by **V**. If we assume this, then there is no problem when we consider the transformation of the observable alone. This is because it is the experience that exists and the observation is not considered as the result of the relative difference which necessarily fails when considering the observation of the reference frame itself. If we consider the state vector of the universe, then the above argument leads to the conclusion that it is not that the universe which is in a certain state vector exists and is observed in terms of the relative difference between the state vector of the universe and the reference frame. Instead, it is only the subjective experience of observing the state of the universe that exists, not the universe itself. Therefore, we may define the existence as follows:

Existence $\equiv$ Subjective experience including that of observing the state of the universe, but not the universe itself.

This we are calling the 'Subjective Universe'.

We are used to associating objectivity with realism and subjectivity with partiality or unrealism. Unlike this common perception, the 'Subjective Universe' derived above is suggesting that the real existence is completely subjective, i.e., the subjective realism.

References

[1] D. Song, Unsolvability of the halting problem in quantum dynamcis, Int. J. Theor. Phys. **47**, 1785 (2008).

[2] E. Halliday, Reflexive self-consciousness. United Kingdom: The Melchisedec press, (1989).