MANY SIMPLE UNIVERSES OR ONLY A VERY COMPLEX ONE?

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ABSTRACT: Through the mental experiment that i suggest, it is possible to demonstrate that Hugh Everett's quantum interpretation, known as of the "many universes", is incongruent with the special theory of relativity.

Keywords: Everett, Deutsch, quantum robot, quantum memory.

In 1957, Hug Everett presented what perhaps may be the most original and daring interpretation of quantum physics: the theory of many universes or universes in scission. According to Everett, whenever a quantum system is in a superposition of, let us just say, 'N' quantum states, after the measure, the whole universe will split into 'N' copies, each containing a version of the measured reality, included the observers. In the simplest case that 'N' equals two, for example, the passing or not of a photon through a polarizer rotated forty five degrees with respect to the initial polarization plan of the photon, the universe will split into two almost equal copies, in one of which we shall have a photon trapped by the polarizer, and in the other one a photon having passed through it, and two identical observers, one in each universe, each of them thinking to be the only one and observing only one of the two versions of the quantum phenomenon.

In 1980, David Deutsch, a physicist from the department of astrophysics in Oxford, slightly changed the theory: according to Deutsch, the number of universes remains fixed, therefore it does not exist any bifurcation, but the universes are identical at the beginning and the "quantum leaps" differentiate them to a greater and greater extent, though occasionally (the exceptions) two different universes could become identical again and, consequently, superpose.

On the other hand, Deutsch observed at the beginning of the eighties that the other interpretations predict that, once the measure has been effected, every possible alternative reality disappears. However, Everett's interpretation predicts that all they have a real existence in parallel universes. From these considerations, he devised a new test that, briefly, consists of the following: We create an artificial observer (let us call it 'A') with a quantum memory unit. We present a quantum event (for example an atomic spin) with two possible result "a" or "b" to this observer. Later, we create a situation in which the two universes interact again, and the artificial observer would have to be able to detect it on "looking" again in its brain and to observe now an interference phenomenon of this one with itself, referred to the two possible situations: "a" and "b".

To observe this phenomenon, the quantum robot would have a special sensory organ which would, in essence, be another properly modified quantum memory unit.

(The reason why it is needed an artificial observer is that our brain is not "acute" enough to feel the quantum interference. And even though it is not possible to do it nowadays with an electronic brain either, it is foreseeable that it can be done in a not very distant future.)

Using this second quantum memory unit the artificial observer would filter -so to speak- the information contained in its first quantum memory unit, and keep in the first stage of the experiment only the information that he has attended one and only one of the two quantum phenomenon options, but without knowing, either it or any other observer, which of them it has been.

This way we get the phenomenon called wave function collapse, or wave package collapse, not to occur, as the information does not come out of the quantum realm (that is one of the reasons for using quantum memory units). On this point, all the quantum theory interpretations agree. Another point on which they agree is that at least when the information comes to the observer's mind, the irreversible wave function collapse occurs. At what point of the way leading from the quantum system to the observer's mind the collapse occurs is a target of discussion among the diverse interpretations. Bohr, for example, says that the collapse occurs when the information interacts with a thermodynamic object, but Bohr never presented a solid demonstration of that assertion, and, besides, he 'forgot' to specify when an object stops being a quantum one to become considered thermodynamic. In the end, the measuring instruments are made of atoms and therefore submitted to the rules of quantum physics. (In practice, we do not notice the effects in macroscopic instruments because such effects are slight. However, if quantum mechanics is a solid theory, the quantum effects must be present, being not important how large the instrument may be).

On the other hand, John Von Neumann managed to prove in a mathematical way in the thirties that when a quantum system connects to the measuring appliance it interacts with, they happen to be submitted as a whole to a superposition of quantum states and the final collapse only occurs when the information comes to a conscious observer's mind.

Luckily, this point is totally irrelevant for the experiment we are concerned, since our scenes are exclusively the two extremes, that is: subatomic level and observer's mind.

At the second stage of the experiment (as the information kept in that first quantum memory unit is erased) the artificial experimenter will observe with its sensory organ (second quantum memory unit), and whenever Everett's theory is right, an interference phenomenon caused in its brain by the two universes fusing together again.

On the contrary, if Everett's theory is untrue, and some of the alternative theories are right, or no one is, the mentioned phenomenon of superposition of quantum states will not occur.

The subject matter is not banal. It is not just a question of discriminating among academic aspects of different interpretations. The matter is profounder. If Everett's theory were right, the line of argument to be followed in order to understand our Universe would be marked by the strong anthropic principle. Our Universe would be only one more of the many Universes in Everett's macrospace, and the exquisite precision of its design (allowing life and, therefore, its contemplation) a lucky coincidence, though inevitable, among a vast number of universes risen by chance. Following this point of view, the complexity observed at a quantum level would not come from characteristic structure of our universe but from the interactions with parallel universes. The quantum indetermination would not be, after all, an intrinsic to the matter quality but the result of our incomplete knowledge about the initial state (we cannot observe -at least in a direct way- those other universes).

If on the contrary, this theory were untrue, we should focus our attention on the other interpretations, especially on the Copenhagen interpretations and on recent theories postulating the existence of hidden, non-local variables, being the most representative the "quantum potential", by David Bohm and Basil Hiley, which, in a way, takes up again the conceptual line followed by Louis de Broglie at the end of the twenties and the beginning of the thirties.

The Copenhagen interpretation 'replaces' Everett's universes and the macrospace with an entity called configuration or phase space, placed nobody knows where, on which the observer's mind would act (nobody knows how) to cause the wave function collapse of the observed system, and it would need, on the other hand, three independent dimensions to explain the existence and interactions of every particle of our universe; that is, the configuration or phase space would have as many dimensions as the triple of the total particles existing in the known universe. Taking into account that in our universe there exist at least -according to the latest estimates of the COBE- a minimal of fifty-thousand million galaxies, averaging one hundred thousand million stars a galaxy, it is easy to see that this theory (like Everett's) "provides" our universe with an enormous amount of unobservable metaphysical structure. Besides, to generate the wave function collapse of a system, the Copenhagen theory needs the collaboration of an external observer, being this one with his observation who gets the observed system out of the quantum indetermination.

But the question comes up at once: Who could generate -at least in theory- the wave function collapse of all the universe, included the observers?. It is obvious that from the viewpoint of the Copenhagen interpretation, there is no answer to such a question, as this interpretation -in contrast to Everett's- is incongruent with quantum cosmology.

Regarding the quantum potential by David Bohm and Basil Hiley, it can be said that, as the previous interpretations, it also 'provides' our Universe with a huge extradimensional luggage: it first proposes the existence of some non-local variables which could never be measured, that would instantaneously communicate somehow from a long distance, but they would do it without affecting the physical situation. And so that all this could be possible, the theory must suppose, furthermore, that each particle of our Universe would keep up instant connections by means of non-local ranges, (quantum potential), with every-one of the other particles. The quantum potential is not an incongruent theory per se, but it is not a strong theory either, since it has numerous ad hoc suppositions. Perhaps this is why it has never been welcomed on the whole by physicists.

If we put Deutsch's experiment into practice, perhaps it would demonstrate that Everett's theory is true, so settling the matter, or if the worst comes to the worst we would rule out one more interpretation, as Alain Aspect did in his time with the theory based in the existence of hidden local variables, on carrying out his famous experiments on E.P.R. (Einstein, Podolski, Rosen's correlations) at the Orsay Department of Applied Optics, South-Paris University, in 1982.

Unfortunately, the current technology seems to need decades or perhaps centuries to be in a position to create that super-mind which would permit putting Deutsch experiment into practice.

But, meanwhile, we can do something: I have modified and expanded Deutsch's experiment. Through the introduced modifications, I think it is possible to prove that Everett's theory is incongruent with the special theory of relativity.

My reasoning is as follows: We ask the robot to record, before erasing the information kept in its first quantum memory unit, the alternative observed by that unit (which 'he' has never been aware of) in a third quantum memory unit. We extract and read it. It is obvious that, even though Everett's theory were true, the interference phenomenon would not happen in the second stage of the experiment: on having been conscious of the alternative the artificial observer was exposed to in the first stage of the experiment (and that it 'filtered' through its second modified quantum memory unit), we generate the irreversible wave function collapse, and, therefore, the two universes will not superpose again. If, on the other hand, we erase without 'reading' it that third quantum memory unit, there is no reason why the experiment could not finish (if Everett is right) until reaching the second stage, that is: the interference phenomenon.

Taking this modification as a starting point, let's complicate things a little more: instead of erasing the third quantum memory unit, we put it (still without 'reading' it) in an inter-stellar ship, and agree with the crew member that if a certain event occurs when the ship is at the established distance (which may be in principle some light-years far), he must 'read' the information kept in that third quantum memory unit and, otherwise, erase it without 'reading' it. Knowing the speed of the ship, we can calculate when this event occurs and, then, carry out with the quantum observer the second part of the experiment. If the quantum memory unit has been erased, the quantum observer will inform us that the superposition of quantum states happens in its brain. Otherwise, that is, if the quantum unit has been 'read' by the astronaut, the artificial observer will inform that it only senses in its brain one of the two quantum alternatives.

This way we could make a mechanism to send instant information and, at the same time, it could be possible to state a preferential reference system, contradicting in both ways the special theory of Relativity, which first defends that all Lorentz's reference systems are equivalent and, in the second place, that nothing can travel faster than light in vacuum, information included, even in the hypothetical case of this lacking a means of transport, since if this were to be possible we could send signals to an observer's past, generating logical- kind contradictions.

In the case of the E.P.R. correlation -Einstein, Podolsky, Rosen- we cannot properly speak about instant communication, because even though it is true that there exists a non-local aspect, and the two particles correlate regardless of the distance which may separate them, it is not in principle possible to use that circumstance to send useful information, given that we cannot 'load the dice' in a particle in order to force the other one to behave in a particular way. The behaviour of they both -though correlated- is fortuitous.

What we can do is to co-ordinate this characteristic and Deutsch's robot to experiment in another way with Everett's theory. Let's see how:

Let us imagine that a subatomic particle disintegrates into two protons which shoot out along the same way but, obviously, opposite directions. The three components of each proton spin are designated X, Y and Z. Quantum physics rules prevent the three components of each proton spin from being known at the same time, but if we measure only one of them, for example X, we shall get for a proton the value 1 and for the other one, always the value minus 1. But until we do not take a measurement, the value of the X component of each proton will be a genuine superposition of quantum states, (1 and -1). Now, we let both particles split up to a long distance (which may even be some light-years). We put Deutsch's robot in front of one of them, and 'he' will become conscious that there has occurred one and only one of the two quantum alternatives, but not their superposition. In front of the other proton we also put a quantum memory unit which may be manipulated by a second observer (not necessarily an artificial one) at his discretion, for it to inform him about which alternative occurs, or that one and only one of them has occurred, but not the superposition of them both.

It is easy to guess what I mean with this experiment: If the second observer becomes conscious of the occurred alternative, the quantum robot will not see in its brain, in the second stage of the experiment, the superposition of quantum states. Otherwise 'he' will see it, being the second observer able this way to send instant information through a simple binary code, becoming or not conscious of the happened quantum alternative.

Again, and for the same reasons, we should conclude that Everett's theory is incongruent with the special theory of Relativity.

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