The Business of Isness: A Look at the Parallel Universes Interpretation of Quantum Physics

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As Woody Allen once put it, "There is no question that there is an unseen world. The problem is how far is it from midtown and how late is it open?" Since the discoveries of quantum physics, the question of the existence of parallel universes--worlds which exist side-by-side along with our own--has taken on renewed interest well beyond mere speculation.

Today, we are facing a new revolution in our thinking about the physical universe--the stuff that you and I are made of. This revolution has been brought to a head by the discoveries of quantum physics which portrays a view of the universe that, although quite bizarre, accurately predicts a wide range of observable phenomena.

Quantum physics deals with a vast arena of the physical world. Its laws govern the behavior of subatomic, atomic, and molecular objects. For example, in modern computer chips, quantum physics describes the movements of electrically charged carriers: electrons and holes.

Up to very recent times, it was believed that quantum physics only applied to the atomic and subatomic world, a world that was well below human perception. Today, quantum physical effects can be observed on a time and space scale well within the world of human perception. (For example, the latest quantum technological innovation is found in liquid nitrogen temperature superconductors). Quantum physics may also apply to the working of the human brain[1].

In contrast to the Newtonian or classical laws of motion, quantum physics laws do not allow us to determine actualities. Instead we are faced with possibilities[2]. For example, the side of a coin flipped and allowed to land, is in principle predictable in classical physics, although in practice difficult. Thus one assigns a probability of 50 percent that it will land heads, and fifty percent that it will land tails.

However, within quantum physics is a new and apparently paradoxical concept: separate possibilities can add or interfere with each other leading to new possibilities. It is as if the two possibilities of observing a flipped coin's face could add together yielding the result that the coin is standing on its edge. These separate possibilities, even though they do not manifest as simultaneous actualities, can actually interfere with each other producing new possibilities.

Also according to quantum physics, a possibility is only realized when it is observed. Thus a quantum object capable of existing in one of two possible states, "suddenly" jumps into one of those states at the instant it is observed. This is called the "observer effect."

A typical example of the interference of possibilities and the observer effect is known as the "double slit experiment." By carefully controlling a stream of subatomic particles or photons of light, the particles are allowed to pass through a screen containing two narrow very closely spaced slit openings (like parallel Venetian blinds). After passing through the double-slitted screen, each separate particle makes its way to a second sensitive screen where it is deposited, making a single tiny spot. The set-up only allows individual particles to either pass through one slit or the other.

Yet, after many particles have made their way through the slits, so that a number of spots are observed, what emerges on the sensitive screen is a pattern of dots that can only be explained by allowing each particle to somehow pass through both slits simultaneously (a wave interference pattern). In other words, the two possibilities actually add together or "interfere" to produce a new result.

WHY PARALLEL UNIVERSES WERE INVENTED

Hugh Everett, III, a graduate student at Princeton University studying under the highly regarded physicist, John Archibald Wheeler, came up with the rather strange notion that even though quantum physics posits a view of the world that contradicts our everyday view of it, we should take it seriously[3]. If it says that two alternative possibilities can interfere with each other, then somehow those alternatives must both exist simultaneously. If possibilities could affect each other, if two or more possibilities could somehow "add up," then somehow these possibilities must really exist somewhere. But where?

According to the Parallel Universes Interpretation (parallel universes interpretation), the two possibilities although describing only a single particle, were composed of two real "parallel" particles--with each particle really existing somehow in a separate universe. Both universes were required to explain the interference. In this way, having separate and parallel universes, only one particle would ever be found in any one universe. That would explain why only a single spot was observed (in each universe) after the particle passed through the slits.

In the usual or Bohr interpretation of quantum physics (named after Niels Bohr a major contributor to the discovery of quantum physics), the observer of an event (such as a particle striking a screen) causes the event to occur in a mysterious way.

Bohr simply said that an act of observation involved a merger of two ways of seeing: the classical world of perception and the atomic world of quantum events. By attributing the effect of an observer to an intrinsic eventual merger of the atomic world with the classical world, the question of the nature of the action of observation is left open. All the Bohr interpretation says is that when an observation takes place the property of the object under scrutiny mysteriously takes on a value. In other words, we don't know how an act of observation really takes place.

In the parallel universes interpretation, when an observer observes an atomic object, he, in effect, interacts with the object in a completely quantum physically predictable way and is thereby changed by the object as well. If the object, after the interaction, exists in parallel universes, then so does the observer.

Thus the parallel universes interpretation also explains the observer effect--the effect that an observer has upon a physical system simply because he or she observed it. Nothing magical happens when an observation occurs. The observer simply becomes part of the universe(s) in which the observation takes place.

Let me clarify this with another example.

TAKING A PHOTOGRAPH OF A PARALLEL UNIVERSE

Electrons possess an attribute called spin. With respect to any given spatial direction, the axis of spin of an electron can be observed to be either pointing along that direction or anti-along that direction. Thus, for example, with respect to the length of this page, an electron could only be observed to be spin-up or spin-down.

When the observation is made of the direction of the electron's spin, it will, according to the Bohr Interpretation, jump into a state of spin-up or spin-down. In the parallel universes interpretation, no jump occurs. The electron splits into two parallel electrons and the observer of that electron, at least the mind of the observer that is able to make the distinction, also splits into two parallel minds. In each universe, there exists an observer of the electron's spin direction and, at the same time, an electron with its spin appropriately matching the observer's observation.

If other observers measure the electron's spin, then each of these observers will also split into one of the two universes. After N observations by N observers (where N is arbitrarily large), there will be two well-separated universes. In each universe there will be

N observers all agreeing that they saw the same thing (spin-up in universe-one and spin-down in universe-two) and the two universes will no longer interfere with each other.

A Possible Model for Multiple Personalities & Schizophrenia?

However, going back to the single observer, if the interaction involved in observation is also governed by quantum rules as stated in the parallel universes interpretation, it is possible that the two universes could still interfere with each other.

Thus, suppose that the original electron exists in the brain of a human being and that the ultimate observer of this electron consists of another electron in that same brain. And suppose that the act of observation consists of the two electrons interacting with very low energy. That means they interact in such a manner that their total spin, the number you get when you add their spins together, is zero.

In a classical Newtonian world this would mean that one of the electrons had spin-up and the other spin-down. But there is no way to determine which electron has which. According to the quantum rules, each electron after the interaction has two possibilities. According to the parallel universes interpretation, in one universe one of the particles has spin-up and the other has spin-down. But the other possibility also exists, as an actuality in a parallel universe, that the electrons have their spins flipped.

However, even though the two electrons are no longer interacting, and even though their individual spins are no longer determined, their total spin (the sum of the two spins added together) is fixed at a value of zero because they point in opposite directions even though no individual direction is defined. This total spin of zero could still be measured.

Now suppose such a total spin measurement is carried out. Of course there will have to be an observer of this total spin. This observer could be a molecule in the brain. It will measure that the total spin is zero and report this observation to some other observer higher up in the mental functioning of the human being.

Suppose that each electron exists in an environment that is capable of registering the direction of the electron's spin. Call that environment the electron's "memory." If the "zero" information is fed back to the observer electron's memory, then that memory will contain two very interesting bits of information. In one universe, it will contain the fact that the electron has spin-up and the fact that the electron and its partner are part of a spin-zero system. In the other universe, it will contain the fact that the electron has spin-down and the fact that the electron and its partner are also part of a spin-zero system. The memory state will be, so-to-speak, schizophrenic.

The interesting schizophrenic bit of information is the spin-zero part. That bit tells the electron memory that another parallel universe exists[4]. The memory, in effect, in one universe, has a "photograph" of another parallel universe.

Let me speculate a bit with this. If we think of the electron's memories as engrams or any other mind material capable of storing a memory, we can construct a model for a well-known psychic disorder called multiple personalities. Each separate engram acts totally independently unless there is some feedback of information about the totality of personalities. With the feed back about the "spin-zero state" each engram is aware of the presence of the other parallel engram. Even though only one engram is "on" (e.g., a spin-up state) and the other one doesn't seem to be operating, the "on" engram will feel its presence (the spin-zero state). This also could be a base explanation for some forms of schizophrenia.

A PARALLEL UNIVERSES QUANTUM COMPUTER

Now that I've told you about parallel universes and how they might reflect light on some forms of mental disorder, you might wonder what this could lead to in a practical hard-nosed business sense. The answer is a new form of computer, one that if built, and this would take some sizeable funding, could bring forward a new type of artificial intelligence device. It also may be able to make computations that could literally see into the future. Let me tell you how.

As it may have dawned on the reader, the computer industry is continuing to develop smaller and smaller computers with ever decreasing chip sizes. These chips are shrinking so fast that it won't be too long before we are looking at the first molecular chip that is capable of putting into memory a quantum sum of possibilities.

David Deutsch of Oxford University has used this idea[5] to describe a quantum mechanical computer that can solve a variety of problems in a new way. The idea is to break up any problem into a series of separate parts (today this is called parallel processing), and then to have the quantum computer carry out the calculations of those parts simultaneously, in tandem so to speak, in separate parallel universes (but in only one computer element). Suppose we call part one, possibility-one, and part two, possibility-two.

The physical state of the machine at the end of the calculation consists of the superposition of those separate possibilities in one area of memory. In a classical computer two separate memory locations are required to carry out the calculations or, if it takes the whole computer to compute each possibility, each possibility must be computed separately. If it takes a full day to compute a possibility, then two whole days would be needed to compute both possibilities. Not so, in the parallel universes computer. When the calculations are complete, the results (the sum of the possibilities) are in encoded in the computer's memory.

USING A QUANTUM COMPUTER TO PREDICT THE STOCK MARKET

Deutsch imagines a very practical use of his machine: predicting the stock market. Suppose that a two-part investment program is written for an ordinary classical computer to estimate tomorrow's Stock Exchange movements given today's. Suppose that the investment strategy can be computed based on information obtained from the sum of possibilities and a running time of one day for each possibility is required.

Since each possibility takes a full day to run, to compute a strategy, the classical computer would need two full days to be able to make its prediction. This makes the classical computer quite useless, since by the time the computer had finished its calculation, the day for the investment would have passed. Today's stock predictions serve no real predictable power for yesterday's market.

The quantum computer runs quite differently. It sums both possibilities of the calculation in one memory location that exists in parallel universes on the same day. One possibility of the calculation is carried out in universe one and the other in universe two. So the program is completed in time for the next day's market.

However, there is a tradeoff. Even though both possibilities of the program are completed on the same day, they exist in parallel universes. All one can do is enter the memory to fetch the desired information that is encoded in both universes. This is equivalent to entering the brain in the previous example and attempting to observe the spin-zero state of the electron-pair universes and one of the electrons in a spin-up state, simultaneously. However, because the answer exists as a superposition, there is a probability that the calculation will not be correct. You might get the spin zero state and the electron in a spin-down position. In entering the memory, the act of fetching will put you in one universe or the other.

Consequently, you may not always fetch the successfully computed strategy you seek. To make this simple, suppose that when the strategy is correctly fetched a memory bit shows the value "zero" (like finding the electron with its spin up), while if it is not successfully fetched it shows the value "one" (like finding the electron with its spin down). Suppose that in the act of fetching, the strategy is successfully fetched fifty percent of the time. The quantum computer computes an answer each day, but one can't be sure that a successful strategy is arrived at on any given day, i.e., that the memory bit discovered for that day will be a "zero" and not a "one".

What the quantum computer trades off in comparison to the classical computer is less time for successful completion with a probable strategy completed on any given day versus more time for completion with a probability of certainty for completion one day after. The classical computer is always accurate, but it is always too late to do anything with the answer.

The quantum computer is successful in computing a strategy only one day out of two on average (when the memory bit shows a "zero") and on that day a successful investment can be made. When the quantum computer is not successful in computing an answer (the memory bit shows a "one"), no investment is made for that day.

Thus the practical investor has a distinct advantage of weighting his bets to invest when and only when a successful calculation of the strategy is made.

Deutsch believes that quantum computers will be possible in the near future and I concur. I believe that they will use magnetic flux quanta as the fundamental memory units instead of today's on-off fixed Boolean logic elements. Professor Deutsch also believes that the Everett Parallel Universe model is not just an interpretational choice, but a testable reality. He points out, as I have stated in my book, *Star Wave*, that a true artificially intelligent computing machine cannot be realized until quantum interference effects, such as the parallel universe theory predicts, can be performed.

CONCLUSION

The parallel universes interpretation is one of the strangest ideas put forward by modern science. It could be also one of the most important in enabling us to understand not only how our brains work, but also lead to new forms of technology that would have far reaching implications to understanding the nature of human consciousness. I have only sketched very briefly some of the implications in this article. More information can be found in the references listed at the end of the article[6]. If the parallel universes interpretation turns out to be correct and testable, our minds are capable of "tuning" to other parallel realities. In my view, there cannot be anything like the existence we all experience without a much extended form of reality as described by the existence of parallel universes. Only the future will tell us if this is correct.

NOTES

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1. See my articles: Wolf, Fred Alan. "On the Quantum Physical Theory of Subjective Antedating." *Journal of Theoretical Biology*, 1989, Vol. 136, pps. 13-19. and "The Quantum physics of Consciousness: Towards a New Psychology." *Integrative Psychiatry*, Vol. 3, No. 4 December, 1985: p. 236.

2. I will use the word possibility in two senses here. The first sense is the one you are familiar with. In its second sense it means a quantum physical mathematical quantity that when multiplied by itself gives the mathematical probability that an event happens.

3. Everett's ideas explained in simple language can be found in: Dewitt, Bryce S. "Quantum mechanics and reality." *Physics Today*. Sept., 1970. p. 30-35.

4. In case you are wondering why the spin-zero indicates the existence of a parallel universe, the reason has to do with the quantum rule that the spin-zero state can only be constructed by adding together both possibilities: electron-one (spin-up) and electron-two (spin down) with electron-one (spin-down) and electron-two (spin up). If we delete one of these possibilities, the total spin would not be zero with absolute certainty. It turns out that it would be zero with only a fifty percent chance.

5. Deutsch, D. "Quantum theory, the Church-Turing principle and the universal quantum computer." *Proceedings of the Royal Society of London*, Vol. A 400, pps. 97-117 (1985).

6. See my other books. Wolf, Fred Alan. *Taking the Quantum Leap: The New Physics for Nonscientists*. San Francisco & New York: Harper & Row, 1981, 1989. Also see: *Star Wave: Mind, Consciousness, and Quantum Physics*. New York: Macmillan, 1984. *The Body Quantum: The New Physics of Body, Mind, and Health*. New York: Macmillan, 1986. *Parallel Universes: The Search for Other Worlds*. New York: Simon & Schuster, 1989; Touchstone, 1990.