

The Universal Wave (2)

The Wave Function (Everything is a Wave)

Text

Quantum Mechanics has been developed over the last century. This theory is very well accepted and proven through experiment. Quantum theory is one of the better proven theories that we have. It has been shown that it is very reliable in providing predictions on the physical universe. Although, Quantum theory certainly has provided descriptions of the universe that were quite unexpected.

"But what appears certain is that no matter how you interpret quantum mechanics, it undeniably shows that the universe is founded on principles that, from the standpoint of our day-to-day experiences, are bizarre." [The Elegant Universe, by Brian Greene, 1999.]

Matter has for a long time been thought of as being made up of solid particles. The expected properties of such particles include having a well-defined size with well-defined edges or borders, particles can exist in only one place at one time, and they behave according to the laws of classical (Newtonian) physics. In Quantum theory, particles of matter are described by a mathematical function called a wave function. As the name implies, the particles of matter have properties of waves, which means they are not as localized as once believed. The wave function describes how particles of matter extend to large distances.

Wave functions are used to describe atoms, electrons, and such. A wave function will describe a probability shape to the orbit of an electron around an atom. This is a mathematical description in the form of a wave. There are several views of what this wave function means. One view is that the wave function gives the probability of finding the electron at a particular point, alternatively, you may think that it gives the percentage of time that the electron spends in any particular spot. Or it is the density of the electron in that location with the electron occupying all locations described by the wave function but with different weights.

With the wave function, you don't just take the highest probability location and say that the electron resides there. We can't truly say that the electron resides at any particular location at a particular time. Even if we see the electron, the wave function is saying that the electron is truly smeared out over space and also exists to a degree in other locations. This is evident in the process of tunneling. If an electron hits a barrier that it does not have the energy to pass through, but one percent of the wave function passes through the barrier, it can pass through the barrier one percent of the time. We cannot see a smeared out electron, we always see it in a defined location. But since the electron is on the other side of the barrier to a small degree, at times it will disappear from view on one side and instantaneously appear on the other side. The smeared out property of the electron is also shown in the Heisenberg uncertainty principal which shows that we cannot completely know the location and velocity of a particle at the same

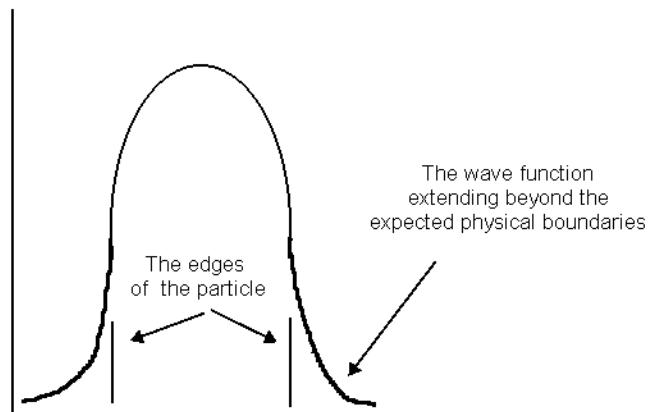
time. The more we know about one property means we know less about the other property.

The particle-waves do not have a well-defined size or borders. There is no end to the edge of a particle. A small particle of matter on earth actually touches the moon, in an infinitesimal way, and other celestial bodies beyond. The wave function describes the particle as being spread out over space, not localized in one spot. The wave function can have spots where the value is zero, the particle does not exist at that location. However, the wave function typically does not go to zero at a specified distance from the center, it normally remains non-zero but infinitesimally small. This means the particle has some existence at large distances from its center.

The wave function does go through zero in and near atoms as the wave function changes sign between a positive and negative values. However, the sign has no particular significance to us, it does mean that the electron will not be found where the sign changes.

In this theory, particles of matter are described as waves using the wave function. Several experiments have shown that this property of a particle-wave means that the particle can behave as if it were in two or more locations at once. We cannot see a particle in two locations. If we see a particle in one location, it automatically eliminates all other locations as being possible locations for the particle. However, through several ingenious experiments, we have allowed a particle the possibility of taking one or both of two paths. After a series of particles have passed the paths, we can tell if they took one or both paths depending on their behavior. And given the opportunity the particles behave as if they have taken both paths. We can see this behavior only after the particles taking the two paths have been allowed to join again. One theory even states that the particles take all possible paths.

Waves of matter also can overlap showing patterns of constructive and destructive interference as waves of light do. This is one of the properties that has been used to show that particles do take multiple paths.



We mentioned physical states, and will talk about them a little more in a bit. Physical states are possible differences in the internal structure or properties of the particles. These states largely describe different energy conditions and could be labeled as spin up, spin down, ground state, excited state, rotationally excited, vibrationally excited, and more.

Here is a general overview of how the wave function works. Particles of matter, and quanta (packets) of energy, are described by the wave function. The wave function can give a probability of finding the particle in a particular location or physical state. When there are two or more paths or states that can be occupied, the wave function allows all the states or paths and describes the probability of finding the particle in each state or path. This is described as being *non-localized* or *non-local*. This can continue to happen adding more and more possible states and locations, until the system is forced to identify where it is through a measurement or other defining interaction. All measurements that we make force the system to identify where it is, forces it to exist in only one of all the possible positions and states. Once, the particle identifies a location, all the other possible locations are excluded so the wave function has to be rewritten showing only the observed location. In terms of the wave function, this is not a smooth process, it is discontinuous (something mathematicians don't like) and is termed the collapse of the wave function.

The problem with quantum physics is that it does not mathematically describe or predict this collapse. This collapse is a transition from a non-local particle to a localized particle. We do not know if the discrepancy is with the math of quantum physics, or with our observation of the universe. The traditional view of quantum theory holds that until a measurement is made no states can be assigned to a system, that the system is truly in multiple states. The use of this non-localized state in the infant field of quantum computing shows that particles truly can occupy multiple states. [provide side bar on quantum computing and other experiments] We cannot yet say that we understand the meaning of the collapse of the wave function. However, there are several theories that try to explain the wave function collapse which we will explore.

Everything is a Wave

The wave function is used to describe atoms and molecules, including very large molecules. However, it is expected that wave functions describe all matter of any size, even up to the whole universe being described by a wave function.

The use of wave functions to describe matter is a well accepted and tested theory. This forms the basis of quantum mechanics.

We will now explore what it means to be described as a wave.

The Extent of Matter

Outline

The reach of the wave aspect of matter is difficult to clearly state for matter larger than small particles. This is because we do not have the wave function for more than small particles of matter. So lacking the wave function, many scientists make the assumption that the reach of the matter wave is defined by the DeBroglie wavelength. However, this is not the meaning of the DeBroglie wavelength.

The DeBroglie wavelength shortens as the amount of matter increases. So many people assume that the reach of matter decreases for larger items.

The DeBroglie wavelength has been measured and verified for small particles such as electrons. However, the wavelength is shorter than the reach of the matter wave. So even though the DeBroglie wavelength is a valid feature of matter, it is not the limiting extent of that matter.

Some even say that the reach of an electron is further than the moon.

Particles as Waves

Outline

The wave function describes all particles as being extended over space in a larger volume than is normally attributed to the particle. When we look for the particle, we find it in one location occupying a volume that is normally attributed to that particle. The extended location that the wave function gives can be thought of in a couple ways. First, the wave function can give the probability of finding the particle in a particular area (mathematically, this is the square of the wave function). Secondly, the wave function can be thought of being the density of presence of that particle in any particular area. Both of these views are acceptable views.

It has been experimentally shown that particles can occupy multiple locations as is described by the wave function.

Other properties of a wave include diffraction and interference. Diffraction means that the waves can and do bend around corners. Interference means that a wave can interfere with itself or another wave to double up density when the waves are in-phase, and to diminish or disappear when the waves are out-of-phase. This property has been used to show that the particle-wave has traveled multiple paths and then interfered with itself when the paths are recombined.

Text

Superposition

Outline

The wave function shows the particles spread out over space. It can also show the particle occupying several energy levels simultaneously.

This is called a superposition of states. A superposition of states is when several states (energy levels, positions, etc.) are occupied simultaneously. Superposition of states is an experimentally verified phenomena.

The energy levels tend to be at discrete levels, so there would be a limited number of discrete states occupied. As for location, this is a smooth trend, so have an essentially unlimited positions, that it is occupying.

We have tested these theories by designing experiments that force the particle into one of several limited options. Normally, there is an unlimited number of options or positions that particles occupy.

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Stateless Particles

One of the interesting aspects of quantum theory is that often we cannot say anything about the physical state of a particle until we measure it. This is not just a lack of knowledge on our part but part of how the quantum system works. Actually, quantum mechanics describes the states quite well but the described states are usually a combination of states. We cannot measure a combination of states, only a single state. Therefore, even though quantum will describe the states of a particle, it will not necessarily describe a measurable state.

Often we can know some properties, but we cannot know all the properties. Some properties are linked, such that if we know one property, we cannot know the other

property. One such linked set of properties is momentum and location. There is a certain limit of fuzziness of knowledge in the system described by the Heisenberg Uncertainty Principle. In this case, we can know both the momentum and position of a particle within a certain error limit for both values. If we know one value precisely, we lose all information on the other value.

The act of measuring a property will set the state of that property. That means a property of a particle can be stateless (another way of saying this is that the particle has a superposition of states which consists of a combination of all possible states) until we measure that property. We change the system by measuring it. It is possible to find pairs of particles that have linked stateless systems, which provide for another type of experiment.

Multiplicity

In Quantum Mechanics, the equations of motion allow superposition of locations and states. This means that a particle can occur in multiple locations or physical states simultaneously. We can only see such superposition indirectly. If we look directly, we see only one position or state. The interpretation of this event is subject to much variation. The standard belief is that the equations collapse to only the observed phenomena. However, other physicists believe that this collapse does not occur. Many of those who believe that the collapse does not occur, actually believe that multiple realities are created. For each of these selection points, two or more separate universes are created. Some physicists believe that the universe remains in a superposition without separation into multiple universes.

The equations and experiments support this last view. The experiments show that superpositions can recombine. If they can recombine, then they have not separated into separate universes, they are still part of one universe.

In the past we can see superpositions recombine. In the future we see superpositions created. In future pasts, we can expect to see some of the future superpositions recombine. So, instead of separate realities being created, One reality with superpositions is the rule.

Particle/Wave Duality

Outline

All particles are described by the wave function and therefore have wave characteristics. However, we also see particle characteristics. But we see the particle and wave characteristics separately. We either see the particle as a particle or as a wave, not as both simultaneously.

We talked about waves, now what are the characteristics of a particle. We generally view particles as having mass and occupying a discrete location or volume, and as being in one location at one time.

The most salient feature of a particle is that of occupying one discrete location at one time.

Another aspect of a particle, especially a fundamental particle, is that an interaction involves the whole particle and not just a fraction of the particle.

So, when a particle, such as an electron, collides with another particle, the whole electron is involved with the collision, and not just a fraction or percentage of the electron as the wave function might suggest.

We can design experiments that show us the wave characteristics of particles. We can design experiments that show us the particle characteristics of matter. We even have experiments that show us the wave characteristic in one part of the experiment and the particle characteristic in another part of the same experiment.

It turns out that the particle characteristic is primarily associated with a phenomena called the collapse of the wave function.

Text

The Wave Function Collapse

Outline

We have a difference between the pure mathematical expression of the wave function and our experiential reality. The mathematical wave function can have any particle remain spread out indefinitely. It can continue to occupy a volume much larger than we associate with the particle. It can occupy multiple paths and unlimited locations, and can have multiple interactions with different particles.

However, when we look for a particle, we find it in one discrete location or state. And from that time on, we find the particle described by the wave function with the particle starting from that one discrete location or state.

Before we look for the particle, the particle is described by the wave function, and the particle/wave occupies a superposition of locations and states. When we look for the particle, we find it in a location or state in a frequency described by the wave function. However, all other alternative locations or states have ceased to be possible. And we see the particle behaving as a particle in a discrete location and energy state. The wave function "collapses" to one discrete location and energy state.

The wave function collapse is not a mathematically smooth process. The math alone would not predict the collapse. The transition from the expanded wave function of before an observation to the wave function after an observation is not described by a

mathematical equation. Instead we through out the old wave function and write a new wave function describing the location and energy state observed.

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Is the Wave Function Collapse Real?

Outline

We cannot answer this question yet. There is debate for both options. Our experiential reality supports the wave function collapse. The mathematical description supports that the wave function does not collapse.

One of the original descriptions that held that the wave function did not collapse was called the "Many Worlds" view. This held that whenever the wave function encountered multiple paths, that each path occurred in essentially separate parallel universes.

There are a number of problems with the Many Worlds view. But a number of other theories have been proposed that keep the non-collapsing wave function that the Many Worlds view had. This author is another supporter of the mathematical description that holds that the wave function does not collapse during observations.

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There are two main interpretations of the wave function collapse, either it is real or it isn't.

Copenhagen Interpretation

The standard interpretation of the wave function collapse is called the Copenhagen Interpretation and it says that the wave function collapses during measurements or observation. The Copenhagen Interpretation says that the wave function collapse is a real physical phenomena.

The Copenhagen Interpretation fits observable reality. We observe one event happens at one time. One item does not do multiple things at the same time, at least when we are looking or making measurements. However, we do find that one particle can be in multiple locations when we are not looking. When we look, the wave function collapses into the single event or location that we observe. It suggests that our awareness affects the physical reality, limiting it to the single reality that we observe.

The main complaint against the Copenhagen Interpretation is that it is not mathematically pretty. We have come to expect that physical reality is described by mathematical equations that are clean, smooth, and otherwise "pretty". The collapse in the Copenhagen Interpretation does not have a mathematical description. At the collapse, we toss out the equations that described the situation prior to the collapse. Then we start

with one part of the original equations, saying that this part now describes the whole. It's a messy process mathematically, which is why some scientists think that there are better descriptions than the Copenhagen Interpretation.

A minority of physicists say that the collapse never occurs because the particles never had multiple states or paths, that the wave function only described the probability of finding the particle, and not its actual behavior. However, we have enough experimental evidence showing that particles truly can occupy multiple states or locations. See the experiments section for a description of these experiments. Scientists have already demonstrated the concept of a quantum computer that uses atoms that have multiple states, the trick in this setup is holding out influences that causes the multiple states to collapse into one state.

Multiple Paths

Outline

The experiments that show wave characteristics typically present a particle, such as an electron or photon, with multiple paths. If we look for the particle in these paths we will find it in one and only one of these paths. However, to detect the particle in a fashion that allows the wave characteristic to become apparent, the multiple paths are brought back together. We can then look for the interference patterns that are characteristics of waves. These experiments, in a variety of designs have successfully shown wave characteristics in electrons and photons.

After the multiple paths are brought back together, we look for the particle and we find the particle occupying discrete locations and energy levels. But the observed locations, of multiple observations corresponds to the interference pattern of the wave function.

These experiments show several features. Particles can and do separate into multiple locations and energy states. However, these multiple locations and energy states are not in separate universes. They remain present in this universe and will interact with each other, and even reconverge together. We are in one universe that has more than four dimensions.

All of the multiple paths are described by a single wave function. The wave function will describe wildly diverging paths. However, these may only have a small percentage of density of the wave function. The higher density portion of the wave function may hold these superposition of paths together keeping them interacting or following a similar direction.

These experiments show a strange feature. Particles can not only enter multiple paths, they can also come from multiple paths. So particles can have multiple futures, but they can also have multiple pasts.

This would be a symmetry in time of wave function superpositions.

Text

Many Worlds

One of the minor alternative theories to the Copenhagen Interpretation is the Many Worlds theory. In the Many Worlds Theory, there is no collapse of the wave function. In place of the collapse, there is an increase in the states of the universe. You might say that the universe splits, but this is not an appropriate description. It is a continuation of the multiple states that we can create in experiment. However, we lose our ability to observe the other states at the point of the collapse. Our act of looking for a state or location causes us to lose the ability to see the other states or locations that also exist. So the states we cannot see, do not cease to exist, but we only lose the ability to observe them.

The Many Worlds Theory creates an ever-expanding number of alternative, unseen, universes or realities. Like entropy, the number of states in the universe would be constantly increasing. The theory does not provide a distinction or weighing between the possible universes, they just all exist.

The discomfort that most physicists have with this theory lies in the ever increasing number of alternative realities. Another discomfort with this theory is the lack of distinction or weighing between the different realities meaning that all the alternative realities are considered equally probable.

It does seem a little strange that we are uncomfortable with ever increasing states of the universe. This is what entropy is, entropy is a measure of the states, or possible states, in the universe. And we are comfortable with the idea that entropy only increases in the universe, this is expressed in the second law of thermodynamics. Entropy is one of our indicators of time. Forward time is associated with increasing entropy.

What are Multiple Paths?

"Everyone agrees on how to use the equations of quantum theory to make accurate predictions. But there is no consensus on what it really means to have probability waves, nor on how a particle "chooses" which of its many possible futures to follow, nor even on whether it really does choose or instead splits off like a branching tributary to live out all possible futures in an ever-expanding arena of parallel universes." [The Elegant Universe, by Brian Greene, Vintage Books, 1999, p. 108]

Some points about quantum theory:

- The universe is described to within experimental limits by Quantum Theory.
- The universe is described by a wave function.
- The wave function allows superimposed paths.
- The wave function "collapses" during observational measurements. (Presumed based on our observations)

Presumably the wave function "collapses" during non-observational consumptive interactions. (A beam splitter is non-consumptive, but a photographic plate is consumptive in that the photon is consumed and converted into something else.)

Photons behave as if they take multiple paths when we are not looking. When we look; however, the photon always takes only one path. This presents two questions: What are multiple paths? And, what is the process of looking?

We cannot ever see or measure a part of a photon, and our theory does not allow a part of a photon to exist. So when a photon takes two paths such that 35% is on one path and 65% is on another path, the photon is not split into two pieces containing 35 and 65% respectively. It means that 35% of the potential paths take one route and 65% of the potential paths take the other route. These potential paths we can describe mathematically but we cannot select which one will occur. We can see multiple paths in the past under certain conditions where we did not look while the action was occurring. However, the multiple paths occurred in the Now, implying that the Now is larger than we see it.

When we look at something we only see one potential action. Whereas, mathematically, we cannot find a criteria to select one on the multitude of potential actions. And experimental evidence implies that multiple actions occur when we don't look. So our looking seems to select the potential action out of the multitude of occurring actions. Our looking is a process of selection! Is it possible to change the way we look such that we stop selecting what we see? If we are able to do this, then what would we see? It seems that we would see multiple actions, or what might be called multiple potentialities or multiple universes. Wild, isn't it? Can we do it?

Quantum Paths

Quantum physics uses a mathematical description of matter called a wave function. As the name implies, matter has properties of waves. These wave properties include spreading over space, bending around corners, and creating interference patterns with other converging waves. This is a very mathematical description, which is very satisfying to physicists. There is one aspect of the quantum description that the mathematical description fall short on. We will examine that event more.

The wave function allows particles of matter to spread out. If something is allowed to separate this spread out wave function, then the wave function will end up with two or more areas of concentration. The particle is essentially taking more than one path at once. Now this is not what most of us would expect, that matter could take two separate paths at one time. However, it is shown by experimental evidence and is being accepted by physicists.

A theory developed from this concept was called the Many Worlds Theory. In this theory, at each of these junction points, all paths are actually taken. Since these junction points are always occurring, this theory has the world continuously creating more and more separate timelines, separate worlds with different occurrences on each. This is represented in Figure 1.

Figure 1. The Many Worlds View of Timelines

Now this theory is not generally accepted. It is a messy theory, continuously creating new world timelines. With the additional problem that we cannot detect these alternative world timelines.

Experimentally, we can see these multiple timelines only after the fact. We can see the effect of multiple timelines only after they re-converge to form a single time line. We cannot see the separate timelines as they occur because whenever we look to see where something is, it is only to be found in one location. We cannot see something in more than one location. This is the point where the mathematical description of matter behaves in a fashion that is not mathematically smooth. When multiple paths are an option, the wave function is spread out with local concentrations on each of the possible local paths. When we try to detect where the particle is, we find it in one location, and the possibility of finding it in any of the other locations suddenly disappears. This requires a new wave function describing the particle after we look compared to before we looked. This is not mathematically smooth, it is discontinuous. However, it fits our perception, and it is the standard physical model of what is happening. The interpretation that describes this event is the Copenhagen Interpretation, and it states that the wave function collapses when we observe or measure the particle. The wave function collapses from a multiple location wave function to a single location wave function. We do not have a mathematical description of this collapse, we say it occurs, write the new wave function and go on from there.

But let's look at what happens between the times that we try to measure the location of the particles. In one experiment, electrons are shot at a sheet of metal that contains two slits. Some distance behind this metal is a sheet of photographic film. Electrons that pass through the slits leave a mark on the film identifying their location. Since electrons, although particles of matter, are described by the wave function they have wave properties. The property that we can see develop on the film is an interference pattern. This pattern is similar to how two sets of waves interact in water. If two high parts of the waves overlap, an extra high area is produced. If two low parts of the waves overlap, then an extra low area results. If a high and low portion overlap, then an area that is level with the bulk water is produced. Visible light will do this producing bands of light and dark areas. And that is what is produced on the film from the electrons, bands of light and dark areas. The electrons interact with each other as waves do. However, this occurs when only single electrons pass the slits, so a single electron behaves as though it passes through both slits at once and the two parts of the wave function re-converges in an interference pattern on the film.

The film is our way of looking at the electrons, so at the film, the electron has a single location. As the electron is passing through the slit it can take multiple paths because we are not looking. This gives a description of multiple time-lines that is different from the Many Worlds View. This description which will be termed here, Quantum Paths is shown in Figure 2.

Figure 2. Quantum paths, diverging and converging timelines.

In this description, which is found experimentally, multiple timelines are only allowed if they re-converge. Actually, this description is becoming accepted enough that another theory has been put forth. A theory has been proposed, and has received some acceptance, that a particle will take all possible re-converging paths along its route. Although, the multiple paths only occur when a measurement is not being made. But between measurements, the particles can take all re-converging paths.

This experimentally demonstrated process is aesthetically more pleasing than the Many Worlds Theory because it does not scatter indefinitely. Physicists tend to like aesthetics in their theories. It also adds something that was not in the Many Worlds Theory, re-converging paths. Many Worlds had multiple futures. Quantum Paths also has multiple histories in addition to multiple histories. It is as if the wave function is holding the separate paths together. They do not diverge continuously because they are still part of the same wave function. The branches that get too far from the center still exist but at a diminishing small potential. The wave function holds the potential together, so that even if the particle has taken several paths, the system does not diverge continuously. Diverging paths will be diminished and converging paths will be strengthened.

This description is currently valid for the periods of time between measurements. If we were to assume that the Copenhagen Interpretation is incorrect and that the wave function does not collapse when we measure the location of particles, then what view of multiple timelines could we expect? The Quantum Paths view is seen to occur when we are not making measurements, and not the Many Worlds view. So we could expect that if the Copenhagen Interpretation is not correct, then multiple paths could occur as described by multiple re-converging timelines.

We do not see multiple paths when we make measurements, only between measurements. This implies our perception through measurements alters the physical universe or that our perceptions are limited. We are not yet able to test for the difference between these two possible events.

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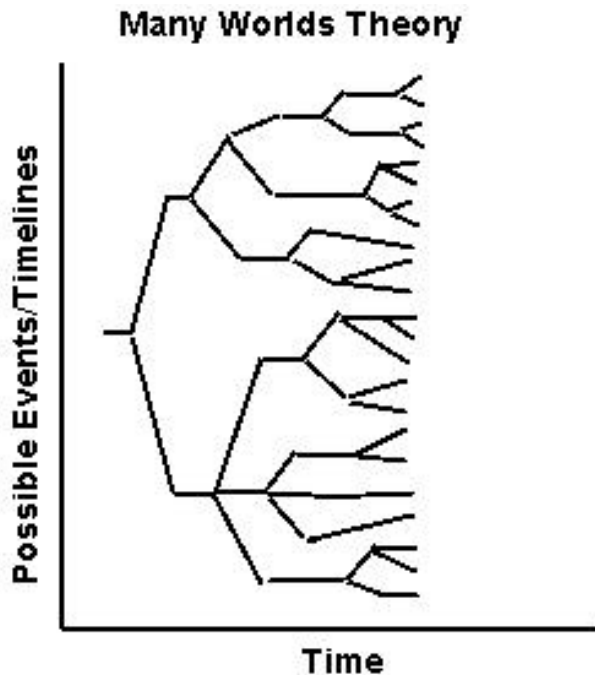


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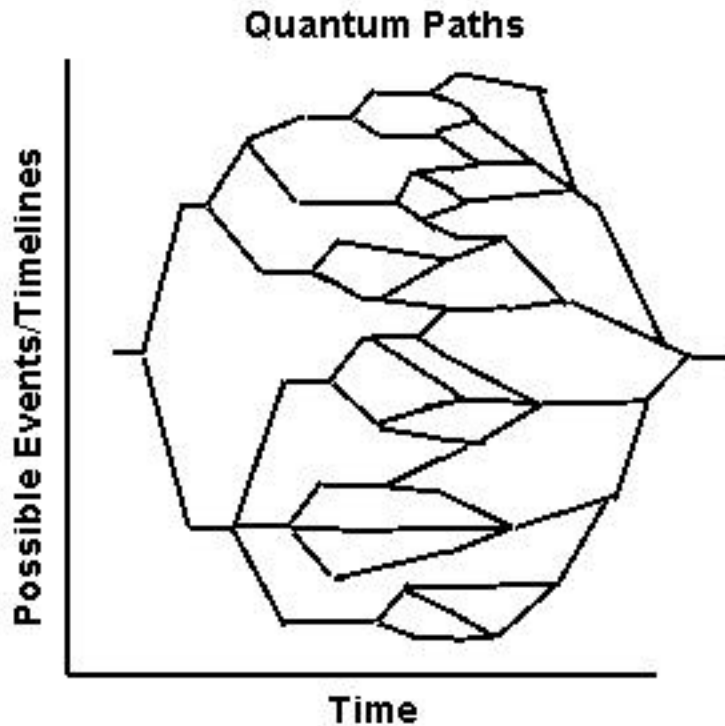


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This experimentally demonstrated process is aesthetically more pleasing than the Many Worlds Theory because it does not scatter indefinitely. Physicists tend to like aesthetics in their theories. It also adds something that was not in the Many Worlds Theory, re-converging paths. Many Worlds had multiple futures. Quantum Paths also has multiple histories in addition to multiple histories. It is as if the wave function is holding the separate paths together. They do not diverge continuously because they are still part of the same wave function. The branches that get too far from the center still exist but at a diminishing small potential. The wave function holds the potential together, so that even if the particle has taken several paths, the system does not diverge continuously. Diverging paths will be diminished and converging paths will be strengthened.

This description is currently valid for the periods of time between measurements. If we were to assume that the Copenhagen Interpretation is incorrect and that the wave function does not collapse when we measure the location of particles, then what view of multiple timelines could we expect? The Quantum Paths view is seen to occur when we are not making measurements, and not the Many Worlds view. So we could expect that if the Copenhagen Interpretation is not correct, then multiple paths could occur as described by multiple re-converging timelines.

We do not see multiple paths when we make measurements, only between measurements. This implies our perception through measurements alters the physical universe or that our perceptions are limited. We are not yet able to test for the difference between these two possible events.

Micro/Macro

Outline

Superposition of states has been shown for microscopic systems of up to 60 atoms. It has not yet been shown possible for macroscopic objects. Although, at the same time it is still felt that macroscopic objects are described by the wave function.

It is assumed by this author that superposition of states is not limited to microscopic systems, and that macroscopic systems share this characteristic.

Those who believe that macroscopic systems cannot have superposition of states base this belief on the collapse of the wave function. However, if the wave function does not collapse, then macroscopic systems can develop superposition of states.

Text***Higher Dimensions*****Outline**

Quantum mechanical experiments suggest that there are more than four dimensions to this universe. These experiments show that a particle not only occupies a four dimensional point, but that it occupies many of these points in what might be thought of as parallel universes. Well, multiple four dimensional points suggest the presence of at least one additional dimension, and possibly more than one.

There is a class of related higher dimensional theories that go by names such as string theory or M-theory. These theories use on the order of 10, 11, or 12 dimensions.

None of these theories have supporting experimental evidence yet. However, there is reason to believe that one or more of these theories will eventually be born out by experimental evidence. The theories show promise in being able to unify gravity with the other three known forces. And we have strong expectations that all four of the forces should have come from one unifying force.

Text**STRING THEORY**

String theory solves the deep problem of the incompatibility of these two fundamental theories by modifying the properties of general relativity when it is applied to scales on the order of the Planck length. String theory is based on the premise that the elementary constituents of matter are not described correctly when we model them as point-like objects. Rather, according to this theory, the elementary "particles" are actually tiny closed loops of string with radii approximately given by the Planck length. Modern accelerators can only probe down to distance scales around 10^{-16} cm and hence these loops of string *appear* to be point objects. However, the string theoretic hypothesis that they are actually tiny loops, changes drastically the way in which these objects interact on the shortest of distance scales. This modification is what allows gravity and quantum mechanics to form a harmonious union.

String theory requires the existence of 9 spatial dimensions. There is a set of string theories. They have been shown to be related to each other and they are now generally grouped together and called M-theory. However, M-theory requires one additional dimension.

The group of theories called string theory and the union of them called M-theory promise to unify the theories of physics. It expects to unify Quantum Theory with

Relativity, it also promises to unify gravity with the other three known forces yielding the one force of the universe.

The concept of string theory (and subsequent membrane theory) had its roots in the 1920's when Polish physicist Theodore Kaluza and Swedish physicist Oskar Klein suggested that space-time may have a hidden fifth dimension that was closed in on itself forming a circle. Quantum waves would fit around the loop only in integer number of waves. Different number of waves around the loop would correspond to different particles with different energies. A fourth dimensional observer could see different charges instead of energies. In the fourth dimension, charge is quantized in the quantity of the charge of an electron, e . To get the correct value for e , the circle would have to be 10^{-33} centimeter in radius. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

The concept of supersymmetry evolved such that for each known particle having an integer spin, there is a particle with the same mass but half integer spin. Supersymmetry promised to unite electromagnetic, weak, and strong forces with gravity, leading to calling these theories super gravity. These theories were most elegant, and limited to, eleven dimensions. However, supersymmetry and supergravity predict particles which have not yet been seen and they do not predict "handedness" of the universe in which left and right are treated separate. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

A class of 10 dimensional superstring theories promised to improve on the 11 dimensional super gravity theory. There were both open and closed string theories. String theories seemed to provide a description of gravity consistent with quantum effects. One theory, the $E_8 \times E_8$ heterotic theory seemed to provide an explanation of the known elementary particles including their handedness. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

Theorists at the Imperial College in London showed that if one of the dimensions in the 11 dimension supersymmetry curled in upon itself and became sufficiently small, it behaved just like one of the 10 dimension superstring theories. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

Some theorists started working with the concepts of membranes in the theories. A moving point will trace out a string, a one dimensional line. A moving string will trace out a two dimensional membrane. A moving membrane will trace out a three dimensional volume, or three dimensional membrane (generalized as a P-brane). (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

Properties

Some of the properties of the universe result from symmetry. Conservation of energy is a result of the symmetry of time. Conservation of charge results from the symmetry of the wave function. Attributes may also be the result of topological

deformities in fields. A knot in field lines, called a soliton, that cannot be smoothed out behaves like a particle. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

Duality

It was then postulated that a duality may be present such that a fundamental particle of charge e would be equivalent to a solitonic particle with charge $1/e$. Another duality, the T-duality, states that the winding particles for a circle of radius R are the same as the vibration particles for a circle of radius $1/R$. This duality suggests that the universe near the Planck length of 10^{-33} centimeters looks just the same as it does at large scales. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

The number of dualities kept growing. A duality was proposed for a five-brane in 10 dimensional space and a string in 6 dimensional space. Dualities between strongly interacting strings in one theory and weakly interacting strings in another theory started to show relationships between the various string theories. When the 6 dimension space was reduced to a 4 dimension space by curling up the extra 2 dimensions further dualities emerged joining together formerly separate dualities. This results in the prediction that the strength in which objects interact, their charges, is related to the size of the invisible dimensions. Charge in one universe is size in another. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

There are many ways in which 10 or 11 dimensions can be reduced down to 4 dimensions. This prevents us from using these theories to predict properties of our 4 dimensional space. However, one surface, the black-brane, which can be interpreted as a black hole allows the different topological spaces to be all connected. Since all the different 4 dimensional spaces are connected, we may need only look for the lowest energy space. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

Dan's note: The dualities presented above imply a duality between curled dimensions. Our four dimensions being flat with the other 7 dimensions being curled up may be the duality of our four dimensions being curled up and the other 7 dimensions being flat.

Duality

Four years ago it was shown that the interpretation of string theory using the Kaluza-Klein idea of curled up dimensions comes with a remarkable twist. Two completely different possibilities for the curled up space (different sizes, shapes and number of holes) can, if properly chosen, give rise to identical observable physics.

Although either member of a mirror pair gives rise to the same physical theory, the technical description of a given physical process very often differs drastically between the two constructions. In fact, certain processes which have an extremely

complicated, and difficult to analyze, description when one curled up space is used, have a transparent, and easy to analyze, description when the mirror is used.

One of the theories used in physics is string theory. For this theory to work requires the existence of 9 dimensions (?). Well, I can't picture 9 dimensions yet. But maybe we can work on what a couple more dimensions might look like. We perceive ourselves in a four dimensional universe. Now, that we perceive four dimensions does not rule out more dimensions, it is just a statement of our awareness.

Our visible universe has three space dimensions and one time dimension. The three dimensional space requires three descriptors to describe a unique point. The descriptors can be three lengths as in the Cartesian coordinate system, two angles and a length as in the polar coordinate system. And I'm sure that coordinate systems exist or can be made that would use two lengths and one angle or three angles.

However, to fully describe a location a time coordinate is required. Time is very unusual in that time is the only dimension that is a vector; it has an arrow to it pointing in one direction. This is not expected from the mathematical treatment of physical laws. In the mathematical description of the universe, there is no real difference between forward and reverse time.

There are some properties that also have an arrow to them. One of the properties is entropy. Entropy always increases overall. Increasing entropy is from the expanding universe. As the universe expands, it has more possible energy states that it can exist in, this is increasing entropy. Now since the universe is expanding in the three dimensional spatial universe, it is only reasonable to expect it to be expanding in the dimension of time.

Now lets explore the possibility that time may be multidimensional. Right now, time appears to be a vector, which is one-dimensional. What is time has another dimension? So we would have 5 dimensions total. Well, two-dimensional time would have parallel time lines adjacent to ours. The adjacent time lines would be slightly different from ours just as one point in time is slightly different from the next. But with two-dimensional time, there are only two directions to go for adjacent time lines. Now that there is only two directions to go for additional time lines does not mean that the are two identifiable unique adjacent time lines. Since for any defined distance from one line, there is always a smaller distance. Unless a quantum unit time distance is reached.

If we add a third time dimension, 6th dimension overall, now we can go any number of directions for parallel time lines. Again, the adjacent time lines would only be slightly different from ours. I have been calling them time lines to allow for a direction

to time. However, our experience does not rule out that other directions to time do not or cannot exist.

We can use our understanding of our one time line to postulate what other time lines may be like. First to change time lines may not be a big leap as it may sound. As long as you are going in the same directions, your experience of time will behave. If you migrate to adjacent time lines, you will not know that you have changed time lines. You will have entered one of the many possible futures or experienced one of the many choice points that change our lives. Our futures are not predetermined; there are an infinite number of possible futures. Maybe we select or create our own future by moving laterally to our general direction in time. We would not be able to say that we changed our time line.

Now, what if the vector quality, the arrow, is not a defining property of time. That travel in time could possibly go in any direction, forwards, backwards, and sideways. The way to tell if we go backwards in time is if entropy decreases. Sideways in time would be when another physical property besides entropy would become the defining property to time.

Why do we experience a direction to time? It may be that we are caught or under the influence of a local or strong phenomenon, the big bang. All of the defining or parallel properties to time (such as entropy) also are defining, or parallel properties for an expanding universe. We move in this direction and we have inertia, or momentum, keeping us from changing direction drastically. So time appears to have the arrow attached to it which is only the arrow of our own momentum. And of course we cannot change momentum without colliding with something. A collide in reverse is when something breaks apart into separate parts. The momentum is conserved in either direction.

Even without changing momentum through collision we can have an infinite number of futures. Since the universe is expanding, by expanding into the time dimensions then more time states are created and we have to pick which state we end up in as we move along... An infinite number of futures without having to change momentum.

Another set of possibility is String Theory and other related higher dimensional theories. String theory, tube theory, and others offer the possibility of unifying all the four forces by allowing a higher number of dimensions to exist. Several specific number of dimensions are proposed by potentially competing theories. If we allow that there are twelve, or twenty, dimensions then the universe becomes a very strange place. We see four dimensions. If there are twelve dimensions, then why do we not see 12 dimensions. The popular view is that somehow the dimensions split and the other 8 curled upon themselves forming infinitesimal coils. Therefore, we cannot see the other 8 dimensions because they are too small. This not to say that there is nothing in those infinitesimal dimensions.

Some physicists discount these higher dimension theories because we cannot see the other dimensions.

But the universe may be even stranger. The proposed number of dimensions is a result of the equations used to state the theory. Parts of the equations were written by a mathematical genius but not fully explained before the genius's death. We are not fully versant on the use of and manipulation of these equations. They give us a possible solutions to the universe. But the number of proposed dimensions seems arbitrary and random. When we become proficient with the math associated with the higher dimension theories, we may just find more equations with different number of required dimensions. We will look for ways of testing these theories. We currently have no experience of other than four dimensions so we cannot measure any properties of these dimensions. We can still test the theories if they can be used to make predictions or statements of our current four dimensions. Once we find such statements or predictions, then we will go about trying to find which one equation is the true equation. We will tend to assume that only one equation is correct and that multiple equations cannot be correct unless that they are complementary theories. The best provable theory with the highest number of dimensions would tend to be treated as the most complete theory and lower number of dimension theories would be subsets of the higher dimension theory.

But different theories don't necessarily have to be subsets of each other. The number of dimensions may be truly random and that theories with any number of dimensions may be possible. The number of dimensions may be truly innumerable or infinite. We are not prepared to work with infinite dimension math. At least not yet. But let's allow for the possibility of an infinite number of dimensions. That truly makes the universe vast and potentially incomprehensible.

We are still left with the question of why we cannot see the other dimensions. First be glad that you don't because seeing an infinite number of dimensions would overwhelm our current mental capacity. The other dimensions could still be curled up in infinitesimal loops. But that might be an ethnocentric viewpoint. It may be more likely that our four dimensional space is curled up and somewhat isolated from the rest of the infinite-dimensional universe. We don't see the rest of the dimensions because we are curled up into an infinitesimal surface. If we allow that, then the universe is truly vast and we just don't see it. The separation between our four dimensional space and the rest of the universe may not be as vast or complete as our senses may make it appear. Just because we don't see the other dimensions does not mean that we are not connected to them. If we extrapolate our current quantum theories and experimental evidence, then we have to say that we are intimately connected to the rest of the universe and that any action or awareness in this space can ultimately affect anything in the rest of the infinite-dimensional universe. If this is so, then the rest of the universe affects us. This leaves open the possibility of us having some awareness of the rest of the infinite-dimensional universe. We of course could say the same thing of being aware of all of the current four dimensional universe. We haven't developed the ability to sense the locations of planets using our bodies ability to sense gravity. However, we have developed instruments which could make the measurement of small gravity changes.

Dimensions which are close to us and have stronger effects on us would be the most likely dimensions which we could experience first. We are likely to develop senses

to experience other dimensions before we develop instruments, unless we develop the mathematics first. If we have the math then we will most likely find ways to develop instruments.

If other dimensions exist, then their effect on us must be very subtle. We would have to look at very subtle affects to see the other dimensions.

People are having experiences which don't fit into our standard view of the universe. These extraordinary experiences are usually not believed by the general public. These unusual experiences include alien encounters and abductions, angelic encounters, spirit channels, UFO's, etc. There are various explanations of these encounters. Another possible explanation is that these entities are from other dimensions. An angel or spirit may be from another dimension. An alien may be from another dimension, or just use understanding of multidimensional space to travel vast distances across the known 4-dimensional universe.

Is there any evidence of dimensions besides our current four? There are some unusual results from quantum physics. It turns out that the universe shapes itself based on our awareness of the universe. The universe responds to our awareness. Awareness happens to be a fundamental aspect of the universe. However, our understanding of the universe has no description of the role that consciousness plays in it. Consciousness may be a fifth force of the universe. Or consciousness may be more fundamental than the other four forces and may be linked to another dimension. If this is so, then we may not be able to describe consciousness fully until we can describe a fifth dimension.

There are some other unusual results from quantum that bring into question the validity of a four dimensional universe. There are several situations in which something appears to travel faster than the speed of light. Now the speed of light is supposed to be a fundamental property of the universe, which cannot be exceeded by anything. Well, the experiment that shows that consciousness shapes the universe also shows that this shaping can occur over large distances instantaneously. If you were to say that the change started at one point and traveled to the other point, then the change would have traveled faster than the speed of light. In a different experiment, electrons are caused to tunnel through walls. Tunneling occurs when the electron does not have enough energy to pass through the wall, but the quantum equations says there is a small but significant probability that the electron can appear on the far side of the wall. During the small fraction of times that the electron appears on the far side of the wall, the transition from one side to the other has been instantaneously. Again, if you try to calculate the speed it is greater than the speed of light. In both cases something occurred over a distance instantaneously. In both of these cases the speed of light limit is not technically violated since no energy or matter travels a distance faster than light. With the consciousness experiment, no known energy moves at all. With the electron experiment, the electron does not travel the distance. Instead, it disappears in one location and reappears in a different location with no time difference between disappearance and reappearance. These results may be a sign that something is occurring outside our 4-dimensional space.

Another unusual aspect is related to the consciousness experiment. When we look, become aware, at something it has to have a single location and a single energy

(within the limits of the uncertainty principle). However, when we don't look at something directly but look at some indirect information, then a particle can appear to travel in multiple paths. The behavior of travelling multiple paths can only occur when we do not look directly at something. We can infer this from watching the behavior of the particles after they complete a multiple path transit and have been recombined. If we look when they may be in multiple paths, we see only one particle in one path. However, the particle behaves differently downstream of where the paths recombine when we look compared to when we don't look. This suggests that quantum particles are not as unitary as are assumed. Or, it suggests that there are multiple paths to the universe. That is there can be divergent copies of the universe along with convergent copies of the universe. (If there was only divergent copies of the universe then we would only see one path in this experiment).

Multiple copies of the universe have been postulated to explain some quantum results. The "Many Worlds" theory postulates that at each point where two or more outcomes are possible, that the universe splits into two or more universes. Well, once you have a second universe, then you have another dimension, a fifth dimension. Also, if we have five or more dimensions then there is no driving force to make the number of copies of our universe increase in time.

So, we have several speculative theories that postulate more dimensions. We also have unusual results of a proven theory that suggest more dimensions.

If the universe is such a vast and incomprehensible place, how can we possibly describe God, except in the most general terms. We cannot describe the depth of a infinite-dimensional universe. God is at least as complex as the universe. When we try to describe or define God, we are limiting as much as we are describing. We define what God is not when we describe God. "God is good". "Evil is not of God". "God is Jesus, Jehova, or Allah". "God is not Satan or the devil". Each of these statements limits as much as it defines. Who are we to limit God?

At the same time, are we not of God? Do we exclude ourselves from God? Do we exclude everything we see from God? That is how many people think of God? God made what we see, but it is not God. Of course, nothing we see IS God. Everything we see is only a miniscule aspect of the universe. Our whole visible universe is such a small part of the infinite-dimensional universe that it can't be measured as a fraction. (As a point has no length) However, everything we see is of God. It is a part of God. As nothing can be separated from the rest of the universe, nothing can be separated from God.

But what is God? Well God has to be at least as great and magnificent as the infinite-dimensional universe. My tendency as a scientist would be to say that the infinite-dimensional universe still represents one energy that has manifested itself in many energies, forces, dimensions, etc. I would tend to say that that one source energy is God. However, that still may be an attempt to limit God. Many people say that God is outside its creation. That may be partly true, although God is not separate from its creation. If an infinite-dimensional universe exists, then God is largely outside our four-dimensional universe. If an infinite-dimensional universe exists, how can we say that there is nothing

more than an infinite-dimensional universe. There can be layers upon layers of levels of complexity that we have no hope of comprehending now. Whatever we can imagine, there can always be more.

To me the term God could be used two ways. It could mean the source of everything that there is. In our current physics theories, the single energy at the beginning of the big bang is the energy from which everything was created. We can not say anything about possible histories of a higher dimensional or infinite-dimensional universe. But we could say that God encompasses everything that exists and was the source of all that exists.

The other common way to use the term God is that God is Good and that evil is not of God. This is more a statement of direction of where to find God. The aspects associated with Good and God such as tenderness, Love, compassion, healing, helping, giving, etc tend to promote people to open up to each other and the universe at large. The not-God aspects associated with evil and the devil such as hate, jealousy, greed, avarice, cruelty, sadism, etc. tends to cause people to separate from each other and withdraw from the universe. What causes us to open up to other people and the universe is of God and helps us to open up to God. What causes us to withdraw from others and the universe is not-God and should be avoided. Calling God Good is a way of pointing us to opening up to more of the universe and also opening up more to God. Everything we see and imagine in the universe is God. And God is still probably much more than anything we can imagine.

String theories have 10 or 26 dimensions.

Stephen W. Hawking, A Brief History of Time, From the Big Bang to Black Holes

Plank stated that Einstein's general relativity theory meant that "each individual particle of the system in a certain sense, at any one time exists simultaneously in every part of the space occupied by the system." And the system is the entire universe. Menas Kafatos, Robert Nadeau, The Conscious Universe, Part and Whole in Modern Physical Theory, Springer-Verlag, 1990.

String Theories

Another possibility is String Theory and other related higher dimensional theories. String theory, tube theory, membrane theory and other variants offer the possibility of unifying the known four forces by allowing a higher number of dimensions to exist. Several specific number of dimensions are proposed by potentially competing theories.

The concept of string theory (and subsequent membrane theory) had its roots in the 1920's when Polish physicist Theodore Kaluza and Swedish physicist Oskar Klein suggested that space-time may have a hidden fifth dimension that was closed in on itself forming a circle. Quantum waves would fit around the loop only in integer number of waves. Different number of waves around the loop would correspond to different particles with different energies. A fourth dimensional observer could see different charges instead of energies. In the fourth dimension, charge is quantized in the quantity of

the charge of an electron, e . To get the correct value for e , the circle would have to be 10^{-33} centimeter in radius.

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Theorists at the Imperial College in London showed that if one of the dimensions in the 11 dimension supersymmetry curled in upon itself and became sufficiently small, it behaved just like one of the 10 dimension superstring theories.

Some theorists started working with the concepts of membranes in the theories. A moving point will trace out a string, a one dimensional line. A moving string will trace out a two dimensional membrane. A moving membrane will trace out a three dimensional volume, or three dimensional membrane (generalized as a P-brane).

There are many ways in which 10 or 11 dimensions can be reduced down to 4 dimensions. This currently prevents us from using these theories to predict properties of our 4 dimensional space. However, one surface, the black-bane, which can be interpreted as a black hole allows the different topological spaces to be all connected. Since all the different 4 dimensional spaces are connected, we may need only look for the lowest energy space.

How Many Dimensions?

Outline

Once we accept that there are more than four dimensions, then we are left questioning how many dimensions might exist. We have several potential higher dimensional theories that use one of several different number of dimensions.

Do any of these number of dimensions have to be concrete number of dimensions? No, it has been shown already that dimensions can hide within some of these theories. They can hide by existing but not affecting the properties of the universe as described by the equations.

Plus, even higher dimensional theories can incorporate string theory or M-theory. So currently, we have nothing to limit the number of dimensions, outside of our ability to work with the equations that describe them.

The potential number of dimensions can be expected to be unlimited or infinite.

Text

How Many Dimensions are there?

Conventional physics (Relativity and Quantum mechanics) states that there are four dimensions to the universe. The four dimensions consist of three space dimensions and one time. The three space dimensions we can think of as length, width, and height.

One dimension would be represented by a line, a surface for two dimensions (surface of a table or of the earth), and three dimensions are represented by a volume. Three dimensions combined with time allow movement to occur. Higher numbers of dimensions are hard to visualize.

Mathematically, the number of dimensions is represented by how many numbers are required to describe a location. For a line, only one number, a distance along the line is required to specify a point on a line. In the physical world, one dimension could represent a building address, the street being the line.

A surface is two dimensions. Normally, to represent a point on a surface, we can do so with two numbers, x and y coordinates. In the physical world, it could be a street and a cross-street to specify a corner.

In space, we describe location with three numbers; x, y, and z. In physical space, we could specify the building at the corner of two streets and then the floor number. However, if we want to meet someone there, we have to give the fourth dimension, we have to state what time we are meeting.

Mathematically, we can work with any number of dimensions and we do. Also, we can always use a higher number of dimensions to represent a smaller number of dimensions. But is there any physical reality to higher dimensions?

A growing number of physicists now believe that there are more than four dimensions. There is increasing development of a set of theories going by various names such as string theory, membrane theory, m-theory, that rely on 10, 11, or 12 dimensions to represent reality. The mathematics required for these theories is difficult and will take time to fully develop.

An incentive to pursue theories with higher number of dimensions is that we cannot reconcile all the known forces of the physical world into one theory. And we sincerely believe that all the forces belong in one theory, that the universe should be described by one theory, one equation.

Well, it only makes sense that we can mathematically describe the universe using more than four dimensions. More dimensions always include the lower number of dimensions, so more dimensions can always be used to represent a lower number of dimensions. And with the theories the physicists are working on, they expect to do what they couldn't do using only four dimensions. They expect to unify all the known forces into one theory, giving us one Theory of Everything.

Are more than four dimensions reasonable? Quantum mechanics implies that it is. Quantum mechanics is one of the best tested physical theories. However, it does have a number of startling results. One of these is that small particles can bi-locate, or tri-locate, meaning that small particles can occupy multiple locations at the same time; however, this occurs only between measurements when we cannot directly see the particle. One theory by Richard Feynman is that particles take all possible paths. This means that the particles occupy a large number of locations simultaneously, possibly an infinite number of locations. The location of the particle is then described by a probability, a percentage showing the likelihood of finding the particle at that location.

This property of quantum mechanics implies that there are more than four dimensions. For a particle to be both here and several miles away implies another dimension, movement in this extra dimension allows different locations in the three dimensions we know. Particles occupy space in the three dimensions we know. This means that they are not described by an infinitely small point. They have length, width, and height. Apparently, they are also not described by a point in the extra dimension, they have a breadth in this dimension also allowing us to describe particles at various locations in the three known dimensions beyond their normal size.

Related to the property of being spread out over space, particles also occupy multiple energy levels or physical states. When we make a measurement, the particle can only occupy one energy level or physical state. However, when we do not make a measurement, the particle can occupy many energy levels or physical states. This phenomena is termed a superposition of states. This is a real phenomena and is currently being used in the development of a quantum computer. This superposition of states also suggests that there are more than four dimensions to this universe.

Another clue from Quantum physics comes from the behavior of light. There have been a number of experiments that have made light go faster than the speed of light. The speed of light is thought to be a universal constant that cannot be exceeded. However, under several circumstances, light has been made to go faster than the speed of light. So far, no physicist claims to have broken the theory by violating the speed of light limit. However, in each case where the speed of light has been exceeded, the light did not travel faster than the speed of light in this space. Instead, it disappeared from this space and reappeared in another location instantaneously. The distance covered instantaneously is not allowed by the speed of light, but it did not travel the distance but skipped it. Now how can light disappear from space and reappear in another location instantaneously? This implies that there are more dimensions that allow for instantaneously connections between different points in space.

This does not prove that there is more than four dimensions. It only suggests that there are more than four dimensions. Proof will come when a higher dimensional theory makes predictions that can later be proved by experiment or observation.

However, if there are more than four dimensions, how many are there? Many physicists are betting on 10, 11, or 12 dimensions, depending on the specific theory. They expect this because they are using a system of math that uses that number of dimensions, and they expect that this math can provide a unification of the known forces of nature. The math is difficult, but we will eventually master it. If one of the theories can predict properties that can be verified by experiment, then the theory will become accepted or proven.

If this happens, it will mean that the universe has at least as many dimensions as the proven theory. Will that be the total number of dimensions? Well we can always create more theories with greater number of dimensions. Theories with higher number of dimensions can always include the theories with a lower number of dimensions. This provides us with the ability to always develop theories with increasing numbers of dimensions. And there is no limit to this game. Mathematically we can always increase the number of dimensions.

But will there be a physical reality to these higher dimension theories? Four dimensions is what we observe on the macroscopic everyday level. If we prove that there are more than four, what makes us think that the first theory we come up with will be the end of it? It would only be arrogant to believe that the first theory that exceeds four dimensions is using the only correct number of dimensions.

If we can continually increase the number of dimensions mathematically, then we can expect that the universe may have an unlimited number of dimensions. At least it may have more dimensions than we could ever describe. For each theory we make, the universe could have more than those dimensions. So we can and should end up with an unlimited or infinite number of dimensions.

Actually, Alain Connes, a mathematician based at the Institute of Advanced Scientific Study in Bures-sur-Yvette, France, has developed an infinite dimensional geometric space that can describe the ordering of prime numbers and the energy levels of atoms and molecules. (**New Scientist magazine**, 11 November 2000.) So once we drop the requirement of having only four dimensions, we can expect that there really is an infinite number of dimensions present.

In the string theories and m-theories, it is shown that the other dimensions, out of ten, eleven, or twelve dimension, have a dramatic, intimate effect on the shape of the visible universe. However, by comparing the different versions of the theories, it can be shown that a dimension can be hidden to have no effect on the visible universe. And if one dimension can hide, then many can hide. So, we see that some other dimensions affect the shape of this universe. However, many more dimensions can be present without any visible effect on this universe.

So some dimensions affect the shape of our universe in an intimate fashion and others have no observable effect. The ones that shape our universe are so intimately connected that we possibly cannot separate their effects.

What is the effect of innumerable dimensions?

The first effect of having additional dimensions is that of requiring some modifications to our language to help us clarify what we are talking about. What is meant by the term "universe"? It can mean all that exists, or it can mean our visible four-dimensional universe. Some people have started using the term multiverse to mean all that exists, and universe is our one visible four-dimensional place. This seems appropriate and will be continued here.

In the multiverse there can be many universes. Actually, once there is one additional dimension, then there can be an unlimited number of four-dimensional universes. With an unlimited number of dimensions, then there can be an unlimited number of universes with any number of dimensions. There can be 3, 4, 7, 24, or 1000 dimension universes. When we loose the ability to count dimensions, we loose the ability to describe all the possibilities of universes.

But, can these universes be present or occupied if they are curled up into an infinitesimal ball? The current theory is that our universe is expanded and flat, and all the other dimensions are curled up into a tiny ball. This might be so; however, we might not be able to tell if we were curled up into a tiny ball ourselves. In the string theories, there is a reflection point at a distance called the Planck length. A set of dimensions curled up smaller than this size, can have the appearance to anything inside it of being larger than the Planck length. And the small it is, below the Planck length, the larger it would appear to its occupants. So, even though we like to say that our universe is large and flat (a description of shape), we cannot prove it.

So all the other possible universes within the multiverse can be occupied regardless whether they are large or infinitesimal. And in the concept of General Relativity, there may be no absolute set of dimensions that could be called expanded.

Parallel Universes

Outline

So if the wave function does not collapse, then we have to expect that superposition of states occurs for large objects, not just atomic scale objects.

However, since we do not perceive superposition of states, but only one state, then the additional states will occur as parallel universes that are not open to our direct observation. [I don't like this, they are not parallel universes but they are this universe, part of our wave function. Our universe just consists of more than four dimensions. And our extent includes more then just four dimensions.]

Text

The Universal Wave

Outline

If we make the assumption that the wave function does not collapse, we get a picture developing of how this universe appears.

Everything will occupy a superposition of states, in what appears to be parallel universes. However, these parallel universes are not diverging or separate universes, but influence each other. They constantly interact with each other both separating and converging with each other, and creating interference patterns within themselves.

All of these parallel universes are all described by a single wave function, showing that the parallel universes are not separate but are all part of the same thing.

Text

Physicists yearn to discover the single equation that will describe the universe. One of the terms they use to describe this hypothetical theory is the Theory of Everything. This Theory of Everything will describe the four known forces (gravity, electromagnetic, strong, and weak) and their energetic and material manifestations.

Let's first look at the universe. The drive to explain the universe with a single equation, along with properties of quantum mechanics, show that the universe is a single entity. The theories and experimental evidence of quantum mechanics show that separate parts of the universe are intimately linked through paired states or entanglement. This phenomenon occurs when particles interact with each other. The combined states of the particles after interaction depend upon the combined of the states before interaction. The sum of the states before and after interaction must conserve energy and symmetry. However, in quantum mechanics the states of the two particles are not defined until one of them interacts with another particle. When that occurs, the states of both of the particles are instantaneously defined. The second interaction determines the states of the interacting particles. But the paired particle from the first interaction has its state instantaneously defined to conserve energy and symmetry from the first interaction. This instantaneously definition of the states of multiple particles can occur after the particles have separated by a few miles or even a few light years.

Now we see that according to quantum theory, that particles that have interacted with each other are intimately linked to each other regardless of distance. However, if we explore the concept, we will realize that any two random particles in the universe are linked through a series of interactions of a series of particles. The universe does not have any isolated spots that don't interact or haven't interacted with the rest of the universe. This, of course, started early in the life of the universe, when the four forces were only one. As the four forces were created from the one force and matter created from energy,

energy and symmetry would be conserved. This sets up a connection between particles from their creation. This connection only continues and intertwines as the particles interact with each other.

Therefore, the universe is a cohesive single entity. In quantum mechanics the universe would be described by a single wave equation. What we are used to describing as separate entities, and separate wave functions, are actually subsets of the universal wave function.

In Quantum Mechanics particles are described as a wave using a mathematical function called the wave function. This is a statement that all particles of matter also have the characteristics of waves. Each particle of matter, such as atoms and electrons, can be described by a wave function. Also, groups of particles can be described by a wave function. And, by extension, it is theorized that the universe (the biggest grouping of particles) can also be described by a wave function. This carries with implications about the shape of reality.

What does this mean with the universe described by a wave function? It means that all particles of the universe are smeared out over space. The particles within the universe can and do occupy or travel several paths and locations. This means that there is an extent and breadth to all actions within the universe. Each particle or grouping of particles does not just do one thing at a time, but particles and groupings of particles do multiple things at a time, occupy multiple locations at once, and possibly occupy multiple times simultaneously. This does not agree with our general perceptions, but we'll discuss our perceptions later. This multiplicity of actions implies a type of multiple universes within our universe. However, this is different from how other people have described how the wave interpretation of the universe might have multiple universes.

Other interpretations for the potential of other universes based on the wave function uses the concept of localized maximums. A representation of the wave function can be drawn showing the probability as height of the line and the horizontal line representing distance in space (see Figure 1). If there is more than one high spot on the graph, these other high spots or localized maximums can be alternative universes. However, even if the universal wave function did not have multiple localized maximums, it still represents multiple universes. (See Figure 2). In Figure 2, the wave function is represented approximately by a single curve. A single vertical line would represent our experience of the universe. This represents a single location for all objects within the universe. A vertical line slightly to the side would represent a universe with a slightly different configuration. The farther the line is from the first, the more drastic the representative changes of the universe will be. The trick is that for the wave function interpretation to be correct, all the representations covered by the wave function exist at the same time. The wave function description requires a fuzzy multiplicity of objects and events to exist in the universe. The wave function would allow multiple paths, multiple histories, and multiple futures.

On wave functions of particles, there is no edge to the wave function. Well, we cannot write out the wave function for the universe, but presumably it also does not have a sharp edge to it. But since we cannot write out the wave function, we cannot say how drastic of changes it would predict from our observable universe. The shape of the wave

function would determine if multiple paths are only allowed for subatomic particles or for macroscopic activities also. A real narrow wave function would allow only small deviations from the central reality, probability manifesting only in small particles. A wide wave function would allow greater deviations from the central reality. A deviation might be manifest in terms of the placement of a pen on a desk varying by a centimeter. A really wide wave function would allow even greater divergences in reality such as people being in different locations.

By applying the wave function to the universe, it implies that there is a variability to the universe that we don't expect. The universe is not set in one absolute set of conditions. We like to think that only one set of conditions can exist at a time. However, the wave function implies that many sets of conditions exist to some degree. That we see only one set of conditions appears to be a condition of our awareness, not a condition of reality.

For example, in the double slit experiment, if we watch which slit the electron passes through, it behaves as if it passes through only one slit. If we do not watch which slit it passes through it behaves as if it passed through both slits. The electron behaves as if it had multiple realities, multiple pathways. We can see these multiple paths only because they were allowed to rejoin into one path that we could see.

This is a small example of what a universal wave function would allow. The wave function would allow multiple paths, multiple histories, and multiple futures. The shape of the wave function would determine if multiple paths are only allowed for subatomic particles or for macroscopic activities also. A real narrow wave function would allow only small deviations from the central reality, probability manifesting only in small particles. A wide wave function would allow greater deviations from the central reality. A deviation might be manifest in terms of the placement of a pen on a desk varying by a centimeter. This would not be earth shattering and the realities could be brought back together the next time the pen is picked up. A really wide wave function would allow even greater divergences in reality.

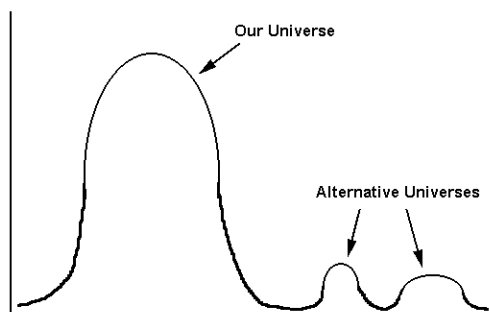


Figure 1. Wave function with localized maximums

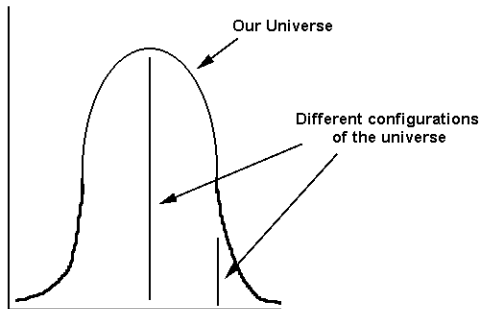


Figure 2. Wave function without localized maximums

The Many Worlds Theory was an attempt to explain how particles seem to have many paths until we try to observe them. The theory stated that at each moment of decision between paths, that the particle took both paths creating separate realities. This theory is not commonly accepted. The Many Worlds Theory creates an ever expanding number of alternative universes. If the Many Worlds Theory were combined with a universal wave function, it would mean that the wave function starts out narrow and slowly becomes wider until it becomes essentially a flat line. Clearly this does not sound acceptable to us. It would mean that any and all possible realities are equally likely.

However, a version of the Many Worlds Theory could be a way of viewing the universal wave function, keeping the dominance on the wave function theory. At each decision point between paths for a particle, both paths are taken; however, not equally but at a proportion determined by the wave function. Some of these separate paths will remerge together as is seen in the double slit experiment. Some will continue to diverge in increasingly smaller probabilities. The shape of the wave function is retained with most of the paths circling around the center. The diverging paths lose importance and become vanishingly small.

We cannot yet explain how our awareness fits into the universal scheme. We are now aware that awareness plays a fundamental role in our experience of the shape of the universe. Our awareness can only see one reality at a time. We cannot see the multiple realities allowed by wave functions. We see that our awareness is shaping the observable universe. We cannot say how our awareness affects the overall universe. Is our

awareness shaping the universe or is the greater part of the universe hidden from our awareness? When we observe a particle that has several possible paths, we see only one path and we state that the wave function "collapsed" from the several possible paths down to the one observed path. Is this true or do the other paths exist but are hidden from our awareness? We do not have a way of testing for hidden realities. We cannot even prove that an electron has taken multiple paths in the double-slit experiment. The data implies it but that is not proof. Following the same parallel, if the universal wave function is wide enough to create macroscopic variations, we will only be able to see multiple possible histories only when there was no observer to fix the path taken. We already have that uncertainty.

Symmetry

The universe is a very symmetric place. There are four known forces in the universe; electromagnetic, weak, strong, and gravity. Each of these forces represents a different symmetry operation.

Eastern philosophies describe the universe as a place of opposites with the concept of yin-yang. And this is a good description. The universe is a place of opposites that sprang out of the nothing of vacuum. The universe makes matter from nothing, but makes it in pairs of opposites of combined matter and antimatter. Of course there is some symmetry breaking going on which allows to experience a universe of primarily matter with very little antimatter.

We can describe energy as being positive or negative. There are numerous instances in physics where the experiential reality of two descriptions of the same thing are indistinguishable.

And then there is super symmetry. In this case, a theory proposes essentially reflections of all particles to create new particles. We haven't seen these new particles yet. However, some predictions of super symmetry have been born out in laboratory experiments, lending weight that the universe is a very super symmetric universe. It is almost that any symmetry that we look for, we find somewhere.

It can be expected that as we develop the higher dimensional theories of string theory or m-theory, that we will continue to find additional symmetries.

Dark Energy/Dark Matter

Outline

Most of the universe consists of dark energy and dark matter, meaning that we do not yet know what they consist of. One of the theories for dark matter is that the effect of gravity leaks through to parallel universes. So that the parallel universes feel the effect of the matter and gravity from the adjacent universes. This makes even more sense if the parallel universes are part of the same wave function and are continuously splitting and merging or otherwise influencing each other.

Text

The Wave Function is Extended in Time

Outline

We have a habit of thinking of our experience of "now", the current time, as being a point. And in math, points have no extent. However, time and space are inter-convertible dimensions in our four-dimensional space. Time is not uniform throughout, it is bent as is space. Time is not separate from space. Time share's properties with space. One of those properties shared is that of the extension of the wave function. The wave function describes a wave over space. We tend to run time as the motor on a projector, projecting our waves onto space. However, we have to treat time similarly to space. So we would expect that the wave function is spread out in each dimension that it participates in. And the wave function participates in a four-dimensional space, so it's characteristics will occupy all four dimensions.

This means that the wave function of our bodies and also the wave function of our consciousness extends not only in space but also in time. We are connected to our extended wave function body. And this body extends to some degree into the future and the past, and also locationally different parallel sections of our extended reality.

Text

Non-local

[See how it fits into the quantum section]

The aspect experiment shows that the universe is nonlocal. This means that a quantum system which has separated in space is still intimately connected. When properties of one part of the system is determined by interaction or measurement then corresponding properties of the distant part of the system are instantaneously determined and this determination occurs on a time scale which exceeds the speed of light.

The double slit experiment and calcite crystal experiment are showing that single quanta are to some degree nonlocal in space. Electrons and photons are aware of a second slit or second channel. They are not limited to the small space of a particle even though they act as particles at times. It is as if the quanta act as an arc of a wave moving outward from the quantum event which produced it. The quanta wave front encounters a wall with two slits in it, sometimes it appears to stop on the wall and other times it passes through the slits. If we do not watch which slit it passes through then it acts as if it passes through both slits before it interacts as a local particle on the photographic film. By recording a large number of these electrons we see that they form an interference pattern as waves do even as they leave single spots on the film as particles do.

The polarization experiment with photons passing through quartz crystals gives similar results. The photon acts as if it passes through two separate channels in the quartz crystal and that it is aware of what happens in both channels. Again it appears that the quanta wave front is able to take more than one path and that when it has a chance to recombine it will with full history of both paths. In both of these experiments the single quanta shows that it behaves as a wave which has nonlocal characteristics, it is able to travel more than one path. However, whenever the quanta interacts with another system or is measured. The interaction takes place in a localized point in space-time as a particle would.

The delayed choice double slit experiment shows a similar characteristic. The quanta wave front passes through the double slits and then our choice of what property to measure determines whether we see a wave characteristic of the quanta passing through two slits or a particle characteristic of the quanta passing through a single slit. In both results the quanta acts as a particle with the detector, the experimental setup and measurement choice determines if we see a single history or dual history of the quanta.

Quantum theory describes quanta as waves. During measurement it is said that the wave function collapses to the single state which is measured. This collapse has not been mathematically described with the theory. Quantum theory does not appear to allow separation of the multiple outcome states. Of course our experience, reality, dictates that only one state can be the outcome. When a quantum event produces multiple quanta which then separate the wave function which describes the quantum event and resultant quanta does not separate. This is the reason that distant linked quanta are still intimately connected at a time frame faster than the speed of light because they are part of the same wave function describing the quantum event. Although each separate quanta could be adequately described by its own wave function the larger combined wave function gives a more complete description of the system.

When a system has a spontaneous emission of a quanta, such as a photon from an excited electron state, we cannot predict the direction the quanta will travel. If we were to try to write wave functions for different directions, we would not be able to separate the wave functions or state which one predominated. The only way to determine the direction the quanta traveled is to measure it in which case the wave function has collapsed. In appropriate measurements we see that the quanta does not travel in a single line but in an arc. We do not know how large of an arc the quanta may cover. We are limited in measurement to measuring the quanta at a single point in space-time.

Quanta act primarily as waves when we are not looking and primarily as particles when we measure them. Depending on how we measure them we can see wave characteristics in the particle that we measure.

In the quantum theory of gravity, gravitons are the quanta which shape the gravity field lines of the universe and generate the attraction forces between masses. Each massive body we see has gravity acting in all directions around it. This means that gravitons are travelling and interacting in all directions around it. As we reduce the size of the massive body to a single particle we expect the gravity well of the particle to still be spherical around the particle which means the gravitons are travelling and interacting in all directions around the particle. Again we can not predict which direction a graviton will travel from this particle but we can assume that it will also travel in an arc and not in a single line. But how large is the arc? It is possible that the arc is complete, spherical. We have already shown that an expanding, separating, quantum system can be distant and still act as a single system. The quanta coming off of a particle could be spherical and still be measurable at a single point because the act of measurement would instantaneously determine the result of all the other directions that the quanta is travelling. From the many possible interactions, or futures, only one is chosen in the act of measurement. And this choice affects the entire system that shares a quantum interaction history.

However, the idea that quanta travel in all directions is not without problems. If a quanta travels in all directions then it will have the potential to interact with the nearest object in any direction. Of course, there is only a probability that any particular quanta will interact with any particular object in its path. And even when a quanta interacts with an object it does not have to stop the travels of the quanta. As the electron passes the wall containing a double slit, the electron interacts with the wall to know the shape of the wall and the shape of both slits; however, the wall does not stop all electrons, although it does stop some of the electrons.

A spherically expanding quanta may register the presence of the nearer objects without being stopped by these objects. And the quanta still travels on toward more distant objects. At some point, with an infinitesimally small probability, the quanta interacts with a system in such that its further travel is stopped, at least to our vision. The quanta, when it is stopped by an interaction, creates a quantum system which at some indeterminate future time will release quanta which continue travelling. Some of the history of that first quanta is carried on in these secondary quanta through the history of the quantum levels which were transmitted in the quantum interaction. This can link these secondary quanta to other quanta from the initial system which released the initial quanta. Future actions involving these quanta can affect all the other linked quanta at a time frame faster than the speed of light.

The whole universe acts a single quantum system. In the early growth of the universe, the universe is adequately described as a single quantum system. As the universe expanded and quanta separated, they remain linked such that quantum events and measurements in one part of the universe can affect distant parts of the universe instantaneously. Of the many possible interactions and futures, we can only perceive one. We see that quanta can travel multiple paths, but we can only measure only one

quanta at one location at one time. Is there any reality to the other possibilities which we do not measure? Is reality larger than we experience it?

Our physics, our description of reality is based on what we see and experience. If our experience is limited then our description of reality is by necessity limited and only a poor approximation. If we are in a locally expanding region of the universe with other regions of the universe contracting, we would still describe the history of the universe as a big bang type of the universe because there is a horizon in the universe beyond which we are unable to see. If the universe has a different structure beyond the universe, we will not see it no matter how big we build our telescopes. Our vision of the universe is limited by distance. Because we are in an expansion region the frequency of light travelling from this horizon is stretched out to zero frequency. We cannot measure light with zero frequency although I doubt that it is completely accurate to describe that light as non-existent even though we cannot verify its existence through measurement.

Another horizon to our vision is black holes. Light cannot escape from the gravity well of black holes. Therefore we cannot see into a black hole and our description of reality through physics may break down within a black hole and certainly does within the singularity within the black hole. We have some theoretical description of black holes and some evidence that they exist. We cannot see within the black holes and cannot verify any theories about the interior of the black holes.

We have another horizon to our knowledge of complementary properties of quantum systems. Our knowledge of complementary properties of quantum systems is limited by the Heisenberg uncertainty principle. We are not allowed to know too much of the quantum properties of the universe.

There may be other horizons to our knowledge of the universe and if we do not look closely at the horizon we may not be able to know the horizon exists. Since time is such an unusual dimension, I suspect that we have a major horizon of knowledge surrounding time. Certainly we are not able to know the future even though we know the past. This limit creates an arrow or direction to time which rules our perception of time. This horizon may seriously limit our knowledge of the reality of the universe.

Photons behave as if they take multiple paths when we are not looking. When we look; however, the photon always takes only one path. This presents two questions: What are multiple paths? And What is the process of looking?

We cannot ever see or measure a part of a photon, and our theory does not allow a part of a photon to exist. So when a photon takes two paths such that 35% is on one path and 65% is on another path, the photon is not split into two pieces containing 35 and 65% respectively. It means that 35% of the potential paths take one route and 65% of the potential paths take the other route. These potential paths we can describe mathematically but we cannot select which one will occur. We can see multiple paths in the past under certain conditions where we did not look while the action was occurring. However, the multiple paths occurred in the Now, implying that the Now is larger than we see it.

When we look at something we only see one potential action. Whereas, mathematically, we cannot find a criteria to select one on the multitude of potential actions. And experimental evidence implies that multiple actions occur when we don't look. So our looking seems to select the potential action out of the multitude of occurring actions. Our looking is a process of selection! Is it possible to change the way we look such that we stop selecting what we see? If we are able to do this, then what would we see? It seems that we would see multiple actions, or what might be called multiple potentialities or multiple universes. Wild, isn't it? Can we do it?

Non-Local Particles

The photon and electron behavior in these experiments is "non-local". Non-local behavior means that the behavior of the photons and electrons are influenced by events that are not local to the expected size of the photon and electron. The electron is influenced by a second slit at a distance from the first slit. The photon is influenced by the second path which is separate from the first path. The distance of separation in some of these experiments can be made quite large.

Quantum mechanics describe particles using a wave function. In essence, quantum mechanics states that everything is a wave, including macroscopic things such as tables and chairs. One of the things a wave function can provide is the probability of the particle existing at a particular location. However, the wave function does not provide absolute boundaries for particles. The wave function will show where the particle is expected to be. Although, where the particle is not expected to be, there can still be a negligible probability of the particle residing there. In essence, the quantum particles "sense" the entire system and not just a local area.

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The Extended Universe

Outline

Matter in the universe is extended well beyond what appears to be its physical limit, it's skin.

This physical universe has a lot of presence to it. This makes it more difficult to hear the more subtle levels that extend farther. If we quiet our minds enough, we could expect to sense more of this physical universe.

If we sense more of the subtle aspects of this universe, we could expect to see more at a distance, either space or time.

Sense in the Extended Universe

Outline

We generally do not sense anything outside our apparent universe. However, some people do sense things that do not fit into our standard universe. These senses are referred to as ESP, extra sensory perception. Can ESP be related to the extended universe?

Let's examine the extended universe. We are a part of it. And all of our superpositions in the extended universe are part and parcel of our selves. So, even though the dominant universe dominates our senses, we can expect that we have some sense of our other superpositions. We would expect that these senses would be more subtle and more difficult to sense.

If we were to train ourselves to sense these subtle superpositions, what could we expect? Well, our superpositions extend some distance from our dominant bodies. So we could expect to sense at a distance. Also, our superposition bodies extend in time, so we would expect that we can sense some aspects of the future or past.

And when we consider entanglement, then there is no definite limit to the reach of our senses in space or time.

Conscious Interaction

Outline

The universe has been shown to be shaped by this unknown force of consciousness. This is shown on the quantum mechanical level.

This is shown in a couple ways. When we choose to make a measurement, we can, but this measurement makes the wave function "collapse" into a single state. Secondly, we choose what type of state to make the wave function collapse into. If we look for spin, we find spin. If we look for polarization, we find polarization. If we look for energy, we find energy. If we look for location, we find location. And some of these properties are mutually exclusive because of the Heisenberg Uncertainty Principle. For example, the more we know about the energy of a particle, the less we know about the location.

So in effect, the universe gives us what we look for, or what we decide to look for shapes the universe.

Conscious Interaction with the universe has been shown on the macroscopic level also through studies of prayer. Prayer has been shown to help patients without the patients awareness that they were being prayed for. Also, the people praying were not physically or even emotionally close to the patients.

The other side of this view is that the universe is shaping consciousness. We decide to look and the universe gives us information that our consciousness uses. So the universe and our consciousness shapes each other.

Text

Overview of Theories

We see now that there is a disparity between what our physical theories say about the universe and our perceptions of the universe. Which is correct? We have seen through history that our perceptions can be limited. A number of theories have shown us parts of reality that were not visible to our senses. For example; we cannot see or feel radio waves; however, once we had the mathematical theories, we were able to develop tools to use radio waves.

Scientists usually try to fit their theories to observable reality, and sometimes to their expectations of observable reality. This is not always satisfactory. Sometimes our beliefs are so ingrained that we do not recognize them as beliefs instead of as facts. Einstein did this when he developed his General Theory of Relativity. The accepted view back then was that the universe was static, neither expanding nor contracting. Einstein accepted this belief and put a "cosmological constant" into his equations to keep the size of the universe static. He later referred to this action as his biggest mistake.

In relativity, we see that awareness is relative to the frame of reference. Time appears normal to anyone regardless of how extreme their frame of reference is compared to others. A person traveling at 99% the speed of light compared to others will experience time at a significantly slower compared to the others; however, they will experience time normally and would see the others as experiencing time at a significantly accelerated rate. This will also occur if they are near a black hole or other severe gravity center. And everyone could take their speed as zero and treat others as moving relative to them. Now this is true and valid to all, but as we see sometimes it is easier to treat a larger frame of reference as the resting state. So after many years of dispute, we treat the universe as resting and the planet earth as moving. The main point here is that our awareness is dictated by our frame of reference.

In Quantum Theory, the Copenhagen Interpretation of Quantum Theory states that the wave function "collapses" when an observation is made. This transition is not mathematically smooth. However, this is the accepted process because it makes the theory fit our perception. This interpretation is important in that it shows that human perception is very important in the shaping of the visible reality. This implies that consciousness is a fundamental aspect of our visible reality.

At the same time the math of quantum theory seems to be stating that there are more realities than just the visible reality, or more precisely, the reality is more extended than the visible reality.

If we look at some of the alternative interpretations of the wave function collapse such as [...fill in???], we see that reality may be much more extended than our visible reality. Even with the Copenhagen Interpretation, if we don't look closely, we miss seeing

that particles occur in multiple locations simultaneously. If the Copenhagen Interpretation is not correct, when we look closely, we still somehow miss seeing the multiple locations that objects occupy simultaneously. But somehow, there is an extension to objects in space, and probably in time.

The various string theories also state that there is more to this universe than we can sense. These theories state that there are more dimensions than we can perceive. A set of these dimensions are intimately connected to the shape of the reality that we experience even though we cannot sense those dimensions. Additionally, the theories have shown that there can be additional dimensions that have no impact on the shape of our universe. These theories show that there is much to the universe that we do not sense and may never be able to sense. These theories imply that there may be innumerable dimensions, and universes upon universes in a vast multiverse. This limits our awareness to a tiny speck within the vast reality.

So from relativity we see that conscious awareness depends upon our position in this reality. From quantum theory, we see that conscious awareness shapes our visible reality. And from both quantum theory and string theory, we see that there is much more to reality than what we see.

The Conscious Observer

The universe is a relativistic, quantum mechanical entity. Both relativity and quantum mechanics reveal that there is no real distinction between the observer and the observed. Both observer and observed are part of the same reality, they cannot be separated. They can be separated in space-time, or spatially distinct; however, and still be connected. We don't fully understand the implications or mechanisms of this non-locality feature. However, we can explore some of the implications of this aspect of the universe.

To proceed, we have to explore how consciousness relates to the universe. We obviously don't have a complete grasp of the place consciousness plays in the universe. We think that we are aware, which implies that consciousness exists in us and that consciousness exists in the universe. Obviously, we are connected or united with at least some of the consciousness in the universe. We have no physical proof that consciousness exists in the universe since consciousness is not physical. Acknowledging that consciousness exists, acknowledges, that the universe is at least partly consciousness.

Scientists declare, and seek to prove mathematically, that the universe consists of a single unified field. This unified field manifests itself in various entities which each obey distinct mathematical laws. These entities, consists of energy existing within four known fields which are a subdivision of the unified field. These four fields are the strong (which holds atoms together), weak (which is responsible for radioactivity), electromagnetic (responsible for the various forms of light and electromagnetic radiation), and gravity (curvature of space from matter). This subdivision of one field into four is caused by coldness induced by expansion of the universe from its near initial condition of compressed and hot.

Consciousness may be another form the energy manifests as it cools or another field, a fifth field created from the unified field. Or consciousness may be an overlooked subtlety in the four known fields or it may represent a new and different field.

In the quantum mechanical universe there are many opportunities of decision, a point where a state is created/selected without any predictors except for probabilities that can be measured with large samples. These selections which happen when we measure properties, such as polarization of light, or events such as the passing of an electron through one of two holes. These quantum selections also happen unwatched when various particles interact and states are selected for the interaction. If consciousness expresses itself on the quantum level as it should, then these moments of selection would be the obvious place to look for it. If a consciousness makes decisions on a quantum level, you would expect to see some sign of consciousness in the outcome of the quantum selection process. Quantum selection appears to be random within certain probabilities. Although the probability patterns observed, show some dependence on conscious knowledge in some controlled experimental circumstances.

We observe the universe and the universe adjusts itself to our observations. (shown by double slit experiments) We ask a question and even history adjusts itself to provide an answer. (Shown by the delayed choice version of the double slit experiment, see p. 46 of the conscious universe) The universe responds to humans looking at it. It doesn't matter which humans look, as long as one human is looking at it, then it responds. This is confirmation that human consciousness is also a part of the whole, an undescribed part of the unified field.

As a conscious entity, a human, asks a particle, or collection of particles (such as electrons) to select a state, the particles respond and select a state. However, what type of state is selected is determined by how the observer looks. If they look at certain aspects of an event, they see a particle, look at different aspects and they see a wave. If the conscious entity does not look then the energy can exist stateless. It is neither a particle or a wave, it is a stateless quantum mechanical entity which can be described by other quantum variables. I venture to guess that four quantum variables describe most if not all entities. Four quantum variables are not the same as four fields in our universe. However, they probably represent the fact that we are in a four dimensional universe. However, if consciousness represents a fifth field, then maybe it also represents a fifth dimensional universe which we are having trouble seeing. Psychic observation may represent seeing in a five dimensional universe.

The quantum mechanical universe is described by exchanges of quantum energy packets between quantum energy entities. These energy exchanges occur on the single event level and on the extremely large population, probabilistic level. This will include the energy of consciousness. As we look on the single event level or even as we look at the known fields and energies we do not see consciousness nor can describe it mathematically. But we know that consciousness exists. If we find consciousness mathematically, will it be deterministic or something else? We have to get there first before we can answer that. The first step is to look for and explore consciousness. We might be able to find some of our answers within ourselves as we learn more of ourselves and our relationship to the universe.

We have to admit that as part of the whole (the universe), we (our consciousness's) are subject to similar laws as our matter because the energies are not truly separate. The separateness is an appearance of how we look at the universe. If we look for a different aspect of the universe, we may see it differently, as was shown in quantum mechanical experiments. And what is revealed to us is not limited by time (Delayed choice experiment, p. 46 "Conscious Universe") or distance in space (Bell Theory and Aspect Experiment, Ch 3 "Conscious Universe").

Now is the process of quantum entities selecting states caused only by humans (or other conscious entities) looking at them. Now that is hard to tell since we can't measure when consciousness is present. The only evidence for consciousness is anecdotal. However, I am willing to accept the evidence and except the existence of consciousness.

I understand that quantum states are also selected when humans aren't looking. Quantum interactions occur even when humans don't look. States are selected during quantum events even if we can't tell what they are without looking. And the quantum states selected might be restricted in that it can only show an aspect of itself depending on how we look at it. Now if other conscious entities look at an event while we are not looking then we have to expect that their process of looking forced the system to select a state. Since we did not look, we cannot verify this. If another conscious entity looked at an quantum event that we were also looking at, would we see the same result? Probably not. If we were looking at different aspects of the event, then we would see different things. If we talked with these other conscious entities we might not be able to recognize the event which we both observed.

Now, conscious entities also interact. What is the nature of that interaction. Two gravitational bodies will exchange many gravitons depending upon the distance separating them. A gravitational body is a local concentration of gravitational quantum (energy/matter). It may be extrapolated that a conscious body, such as a human, is a local concentration of conscious quantum which appears to be clustered differently from gravitational quantum. Gravitational bodies appear to influence all of the other gravitational bodies within the boundaries of the known universe. A singularity might be viewed as a boundary of the universe. That suggests that conscious bodies also influence all other conscious bodies within the known universe.

That is not our experience, but we have not looked for our influence yet. As we change what we look for, we can expect the universe to change what it shows us.

If we assume, as extrapolations from experiment suggests, that conscious entities exchange many quantum of energy as suggestive of their "distance", then we can start to explore how this exchange of energy might occur.

We humans experience the universe through five traditional senses (sight, sound, smell, taste, touch). We experience and describe the universe based on these five senses. We know that other animals experience the universe with slightly different senses and can perceive things the unaided human cannot. We have extended our senses using mechanized tools. However, these tools are designed as extensions of our existing senses and are defined by our senses. There is no reason to assume that our range of senses covers the range of experience or information that exists in this reality. If our senses are

limited then it would be expected that our instruments are limited. If we were to develop additional senses then our perception of the universe would change. What we would look for would be different along with the information presented back to us.

We exchange energy through our senses. We should expect that quantum mechanical properties also apply to these energy exchanges. Such that the listener to a sound is influenced by and influences the source of a sound. The same can be said of the visually observed and observer. It would also apply to the observer of smells, taste, and touch and the sources of the smells, taste, and touch.

We are conscious entities within a quantum universe. We appear to have a physical boundary which separates us from each other and from the universe. We perceive a self, other, inside, outside, I, you, us, them, energy, matter. The property of complementarity in quantum physics, where one entity can be viewed as two different sets of properties (particle/wave) are both required to describe the whole entity, appears to play in our consciousness where we perceive ourselves as separate from the rest of the universe. Complementarity can appear anywhere that we group ourselves into an us/them. But in quantum physics both aspects are needed to describe the whole. A description of only one side is incomplete. This suggests that increased understanding of ourselves requires, or will foster, an increased understanding of the universe. And increased understanding of the universe will foster an increased understanding of ourselves.

Another property of the quantum universe is non-locality. Non-locality reveals itself in that a quantum event at one point in space, primarily a measurement of a quantum level, instantaneously reveals a complementary quantum level at a point distant in space. The determining of quantum levels at two points distant in space takes place instantaneously. The information traveled faster than the speed of light. This property of having quantum levels determined at a remote distance when a measurement is made has been shown to act on points distant in time. It has been shown that measurements can determine sets of actions, or levels, in the past.

We are constantly exchanging matter with the environment and with each other. The water molecule in me today can be in you tomorrow. We are also exchanging energy all the time including thermal energy and chi energy. All of these quantum of energy and matter pass through our body. At some time in the body the quantum of energy and matter interacted with the other masses of quantum in the body. Once quantum of energy interact then the system acts as a whole, and when a part of it is measured/observed then the complementary part of the whole is also determined.

This implies that we, who have shared matter and energy with the universe are part of the whole, part of the universe we are interacting with. Our actions and observations intimately determine other aspects of the universe at points distant in space and time. Our actions in the apparent present affect points/events in the past and at distant locations in the present. One might suggest that our actions in the present can also affect events in the future. Extrapolation from quantum physics we see that our actions in the present shape the past, the future, and the present at distant locations.

Why is our awareness limited to ourselves in the present, while our decisions and actions affect much more? Can our awareness be expanded such that we become aware of more of the results and interactions of our actions. So that we become aware of how we affect other people and the environment and how other people and the environment affect us. We study various parts of this interaction in various science disciplines. But can we experience the interaction on a more personal, sensory level.

All of the energy and matter flowing through us, including traditional energies and chi energy, contains information of its past and patterns for its future. We do not perceive much of this information. The majority of this information is either filtered out as noise (where we just don't understand it) or as unpleasant information we don't want to deal with.

We also have the tendency to hold onto things, such as events, circumstances, expectations, etc. It may be possible that if we learn to let go of some of the things that we hold on to, then we may experience/sense more. If we let go of some of our own expectations then we may sense some of the unexpected. We may see more when we expect less. When we expect certain images and events then we aren't open to seeing other images and events. We like to control what we experience and see. When we let go of our expectations then what happens to our control? I don't think that we lose our control. I think that we learn a new way of control which is hard to predict. Of course, as people start to expand their consciousness then they will learn different ways of control. After all, we are different even if we are intimately linked into the whole as a result of energy exchange. We are each complementary parts of the whole and are different while at the same time we are whole which transcends you and me.

Consciousness can be thought of as an energy field, or possibly more accurately as a focal point of energy or bundle of energy. But what is the energy of consciousness? We don't know that yet. We know that consciousness is very important to this reality because it shapes the reality that we observe. (This is shown scientifically in our study of quantum effects)

Through quantum physics we see that consciousness shapes the physical universe. There is an intimate link between consciousness and the physical world. The physical world though is a sea of energy. Even matter is condensed energy. Consciousness is intimately tied into this sea of energy. Is consciousness another type of energy? Or, is consciousness a bundling of energy? It seems that consciousness is not a bundle of the known energies. We cannot detect a difference in energy to tell us if consciousness is present.

It seems that consciousness is an energy or a bundling of energy that has not yet been discovered. However, from quantum physics we know consciousness is a force to be reckoned with even though we can't yet define it. String theory opens up a grand new possibility for many new forms of energy. String theory relies upon additional dimensions, about ten or eleven dimensions instead of the accepted four dimensions (three space and one time). Having additional dimensions will certainly reveal new energies. That may include energies confined to certain dimensions, our four forces and the energies derived from them may be confined to our four dimensions. Other energies

may not be confined and are accessible across all the dimensions. (We currently see no sign of energy leaking out of, or in to, our four dimensions; therefore, if it happens, it is with an energy that we have not yet defined.)

Consciousness may be an energy that crosses out of our normal dimensions. The effect that we now observe between consciousness and matter is not restricted by the speed of light limit. Consciousness can affect matter at large distances in a time frame that would be called instantaneous. This is faster than any information could be carried on light, our fastest energy. For consciousness to cause effects at a distance, faster than the speed of light allows, it seems that it would have to act outside our normal four dimensions. Consciousness is attached onto energy that is not limited to our four dimensions.

Is The Mind Distinct from matter?

If we are to believe our gut instincts, then the answer is no. Our gut instincts tell us that there is a unified field from which our universe is composed, represented by the Grand Unified Field Theory for which we strive for. This theory proposes that there is a single force/field from which the universe is composed and that all forms of matter and energy are different representations of this single field. If the Grand Unified Field Theory is true then mind is another representation of the single field, a different representation of matter. As light and matter can be interchanged and electrons can be smashed into quarks, mind can be interchanged in some fashion with light or matter.

The question; however, can be rephrased to be more difficult to answer. Is a mind a distance from the matter of the body it appears to inhabit. The mind may be an energy that is temporarily bonded to the matter of a human and that at the end of the life of a human the mind drifts on. Or the mind may be the energy system made up of the electro-chemical patterns of the brain and that when the brain dies, that energy system (the mind) ceases to exist. In stopping the mind the energy is not lost, it only changes form; such as a neutron can decay into an electron and a proton.

Since mind is part of the universe, the universe has developed consciousness and an ability for self determination. This means that the universe always had the ability for consciousness and self determination. This ability for consciousness and self determination may be expressed in other ways across the universe.

Perception

The universe is layers upon layers of dimensions. We perceive only three. We try to explain why we would not see the other dimensions. The accepted reason is that they are curled up too small for us to experience. However, at the same time, they are not too small to fundamentally define our three and four dimension space. Since they fundamentally define the shape and functionality of this space, we should also expect that a direct observation or experience would also be available to us.

What would that experience be like to sense within a larger dimensional space? We can postulate what some of the experiences might be like. Let's assume that human awareness has attained a sense of an additional dimension space.

An additional dimension sense might include only one additional dimension or more. Multiple additional dimensions might be indistinguishable from only one additional dimension. For our examination, we can ignore if there is only one or more dimensions, but we'll call it the fifth dimension.

We should expect that with an additional dimension sense, that we would see multiple four-dimensional images within what we would call one four-dimensional space. Depending on how people sense that additional sense, different people may experience it differently. We might find different four-dimensional images shifting in and out of view. In this situation, the awareness sees in four dimensions, but is able to shift through the fifth. This is similar to seeing the image of a hologram, and only the image, as your position with respect to the hologram shifts. Alternatively, the awareness might shift into the fifth. This one is hard to predict it's possible experience. It would be similar to having your awareness enter the hologram. You would experience, in a sense see, all aspects of the hologram at once. You would see all the images in the hologram, from all possible angles, at one time, in one space. From this view point, the expanded awareness would see multiple four-dimension images within one five dimension area.

We should expect the holographic description to be a valid one because of the quantum description of particle behavior. Particles in quantum theory get entangled with each other such that certain actions on one particle affects other particles widely distributed. A network of such particles as in our universe, carries and distributes information in the same pattern of a hologram. Each particle carries an imprint of the universe around it. Each little part carries an image of the whole. This is the same way a holo gram works.

With the expanded awareness, one five-dimension image would be made of many four-dimension images. Each four-dimension image is only a small part, or slice, of the five-dimension image. The composite of all of these four-dimension images would make up a new, potentially dramatically different image.

So we can either shift between four-dimension images or acquire a whole new image. We could also expect that there is a range between these ends. If we shift between four-dimension images, an increase in this ability would be a sense of where the shift is going, or an ability and understanding of how to direct the shifting image. Before an understanding of how to direct the shifting image might be a precognition of what will shift into view. An ability to shift the image without full understanding of the mechanism might also appear as telekinesis, the shifting of matter in apparent violation of physical laws by awareness alone. A person might attain the ability to see in this additional space with out ability to shift the image. They would appear very wise compared to people who have not yet sensed the additional dimension.

People who have attained the ability to consciously control the shifting dimension, may or may not appear powerful to the other people. The difference may depend on how well the two of your consciousnesses are synched. If the two consciousnesses were synched, then the person who sees in four-dimensions would be aware of the shifting. They would witness telekinesis and other amazing abilities. If the two consciousnesses were not synched, then the one who sees in four dimensions would have different awarenesses show themselves during the shift. Each part of his awareness

would think that it was the only aspect of its awareness. That each part thought that it was the whole. That each part of the awareness on both sides of the shift, thinks that its experience is the only experience.

Consciousness is a force

Consciousness is not well understood. We are trying to understand Consciousness such as where it lies, how much the mind drives consciousness, or how much consciousness drives the mind. However, we have no mathematical equations which describe how consciousness works. We are aware of our own thoughts, so we say consciousness exists. We don't know much more than that.

However, experimental evidence shows some strange results pertaining to consciousness. We have conducted several experiments that shows that our awareness of the location, or characteristics, of quantum particles changes how they behave in measurable ways. Our consciousness somehow forces quantum particles into certain directions, excluding other possibilities/ potentialities. This is experimental fact although we don't have a clear mathematical explanation of what happens. In quantum theory, this event corresponds to the collapse of the wave function, which is also not well defined mathematically. The collapse of the wave function is when reality is suddenly limited, because of consciousness awareness of experimental measurement, to a smaller portion of its former self. The wave function spreads out over a range of potentialities. During measurement, it is suddenly restricted to a small subset of potentialities. It is our awareness of the measurement results which force this transition. This is showing that our awareness is forcing or creating a change in the physical universe.

This strongly implies that consciousness is a force in our universe. We are at a very early stage understanding consciousness as a force, similar to when we discovered that mass objects attracted each other or when electric charges either attracted or repelled each other. We do not have a clear understanding of how the conscious force works and we have no math to describe it.

Waves of Perception

Quantum physics is one of the two main proven scientific theories describing the physical universe. Relativity is the other main proven scientific theory of the physical universe. Generally, quantum physics is used on the microscopic scale and relativity is used on large scales. Having two different theories describing the physical universe is perturbing to physicists and current efforts are being made to unify these theories on all levels to arrive at one theory to describe the physical universe.

However, what is currently known of the physical universe from these theories and experimental evidence implies that our current perception of the universe may not be complete. This is not totally unexpected. We know that we cannot perceive a lot of what we know to exist. We can only see a narrow band of electromagnetic radiation, visible light. We cannot sense radio waves, gamma waves, microwaves, etc. Yet we know that they exist and we use them in products for our convenience.

Let's examine some of the properties of quantum physics that have implications for our perception of reality. First, some groundwork. In quantum physics, matter and energy in the physical universe is described by what is termed the wave equation. These equations describe all matter and energy as having the property of waves. You can think of the waves formed by a stone dropped in a pool to understand some of the properties of waves. They spread out over distance, they are continuous, they constantly move, they bend, reflect, etc. Light, which is energy, has properties that are easy to recognize as waves; they constantly move, they can bend and diffract as they pass through a prism. Particles of matter, such as electrons, protons, and larger groupings such as marbles are not as obvious as having wave characteristics. We tend to think of them as particles, as having discrete locations, not diffracting, and the only interactions with each other are either bouncing off each other or combining together such as in chemical reaction. However, the wave equation description of matter says that particles of matter are also waves with wave properties. And experimental evidence proves this true, with an unexpected result.

The experimental results depend on whether we try to see where the particle is. If we do not try to see where the particle is, it behaves as a wave. If we do not try to identify where the particle is, it behaves as a wave. Our attempt to observe the particle shapes its behavior. Let's look at an experiment. If we shoot a beam of electrons at a sheet of metal with a slit in it, a small number of electrons will hit the slit and pass through. Then we put a sheet of photographic film some distance behind this sheet. The electrons that pass through the slit will hit the film and leave a mark that will show up when the film is developed. After a sufficient number of electrons have passed through the slit, if we develop the film, we will find what looks like a shotgun blast pattern on the film. This looks like a good particle pattern, the same form that the collection of individual shotgun pellets produces.

If we repeat this experiment with two slits instead of one, we might expect to find two shotgun blast patterns on the film when we develop it. Instead we find an interference pattern, similar to how two sets of waves interact in water. If two high parts of the waves overlap, an extra high area is produced. If two low parts of the waves overlap, then an extra low area results. If a high and low portion overlap, then an area that is level with the bulk water is produced. Visible light will do this producing bands of light and dark areas, called an interference pattern. And that is what is produced on the film, bands of light and dark areas. The electrons, which are small particles of matter, interact with each other as waves do. The particles are also waves.

However, it gets even more interesting when we slow the rate of electrons down until only one electron passes through the slits at a time. In this case we expected that there is no second electron for any of the electrons to interact with, so they could not form an interference pattern. An interference pattern results from two or more waves overlapping with each other. If there is only one electron, where is the second wave for the interference pattern. Well in this and other similar experiments, the electron behaves as if it is going through both slits and interacting with itself to form an interference pattern. This is such a reproducible result, that a theory has been proposed that a particle-wave will take all possible paths to get to its destination. Now all possible paths will not

lead it to that particular destination. But since we find that it arrives at this particular destination, we accept that it has taken all possible paths that lead to this destination.

Now this occurs if we only look to see where the electron ends up. If we look to see which slit it passes through, then it only passes through the slit that we observe it in. It then does not simultaneously pass through both slits so it does not produce an interference pattern. Let's look at the situation where we are not checking on its path. Then the electrons transverses several or many paths to get to its destination.

If we stand at the destination where the electron hits the photographic film and look back in time, we find that the electron has not one history, but two or more. One history has the electron going through the left slit and the other history has the electron going through the right slit. The electron has multiple histories. However, the only reason that we can see them is that the separate histories have re-converged into one path.

This shows that on the microscopic level, that particles of matter have multiple paths, and multiple histories. A particle will be in multiple locations at one time. As we scale up from the microscopic electrons and protons to the macroscopic, golf balls, tables, and people, physicists expect these multiple paths to not be effecting the macroscopic level of matter. The probability of all the particles of a person taking the appropriate separate paths such that the person ends up bi-locating, is infinitesimally small, that it is generally considered impossible. Now, according to the theories and accepted wisdom, it is not impossible, but very, very, extremely unlikely.

Since it is not impossible and we do not yet know how conscious intent influences the process, we should consider the implications. Theoretically (although at a very small infinitesimal level) it is possible for people, tables and other macroscopic objects to have multiple paths and multiple histories. Now one theory, called the Many Worlds Theory, that says these multiple paths create multiple diverging futures is generally discredited. We will avoid this by only looking at the multiple paths that re-converge. So we are looking at multiple intermediate histories coming from a common history; or multiple futures that converge into a common future. This is exactly what happens on the microscopic level.

How can this happen on the macroscopic level. If a person puts a glass down on a table, they can put it near the right side or the left side. Later on the glasses from both sides of the table are picked up and put in the same location in the dishwasher. The glass has taken multiple paths, but those paths have re-converged. This ignores the history of the glass that has been dropped and shattered, because it cannot be re-converged with the whole glasses. However, it may be re-converged in a longer future when the glass is broken in the dishwasher, and both of these broken glasses end up in the same garbage can.

Now, if we try to put a mathematical number for the probability of these separate paths being taken, the number will be so small we would say it is impossible. However, we have trouble seeing multiple paths directly. We can only see them indirectly. The indirect evidence is impressive that the multiple paths is actually occurring. But

whenever we look, we can see only one path. Our perception appears to limit the behavior of the universe. There is another possible explanation. It may be that the universe is not limited by our perception, but that only our perception is limited. I find this the more satisfactory explanation. The universe is not really shaping itself differently when we look. We are just limited in what we can see.

We have a very strong belief system that there is only one reality, only one time line, only one place that any particular piece of matter can occupy at one time. This strong belief system is based on our perceptions but also may be shaping our perceptions and holding it to this particular way of seeing.

If we accept that multiple paths might be possible for the macroscopic as well as the microscopic scales, what can we expect from perceiving these paths? It might be like seeing a double image, with one image over or under another image. The two images do not have to be the same strength, one may be much stronger or weaker than the other image. One can be just a ghost image over or behind the main image. However, the double images are only transitory and will re-converge into one solid image. If we were to interact strongly with one of these multiple images so as to break the re-convergence of the multiple images, then we shouldn't even see the other image because it does not re-converge. So multiple paths will be possible when we are not able to interact with the separate paths, or if we allow the paths to evolve with our trying to interact with or separate them.

If people were to witness multiple paths and describe them to others, they would be labeled as being schizophrenic. This is an incentive to repress any suspicious imagery. If two people saw the different paths separately and then told each other about their different observations, they would disagree but not be able to prove either one wrong. Since the paths they observed re-converged. Each path is true and there will be no evidence that could prove either one wrong. The two people will just have to accept that they cannot prove either one right or wrong.

Our experience and conditioning teaches that only one thing can happen at one time. If we accept that the universe can have multiple paths, will our senses expand to sense the multiple paths? What additional information is available from observing multiple paths? The answer to the second question may lie in the emotional intent of the people involved.

Intent

Another aspect of multiple paths is that of multiple intent. If multiple paths occur on a macroscopic level, then they can also occur with different emotional aspects for the people involved. The different paths can include different intents on the actions of the people involved. Since a persons intent on their action is energetic, not physical, then we can actually expect multiple intents (multiple paths containing different intents) to more readily occur than multiple physical paths.

We often apply the only one action concept to human intent, saying that one action has one intent. This is a rather limiting view. We can easily give some coins to a panhandler for several reasons such as to get these annoying coins out of their pocket, to get this person away from their window, to tithe, to look generous in front of their friend. An action does not need to be limited to only one intent. The intent may come with various weight. Maybe giving the coins is primarily to look good in front of a friend and only to a small part to get the coins out of their pocket.

But if actions come with multiple intents, how does this bode for those who like to know the intent of an action? It obviously makes it difficult. If they figure out one intent, it does not preclude additional intents. If they figure out one intent, it may not be the major intent. And you can never be sure if all intents are known. The person initiating the action probably cannot tell you all the intents of their action because some of them are likely to be from the unconscious.

In an interaction between people, the focus of intents can be shifted to achieve a purpose. One particular intent may offend someone. Without losing that intent, another participating intent can be presented in some fashion to appease instead of offending that person.

The intent of a action can be presented not just by words but by subtle presentation of actions, that highlight one reason for the action over another. Since people can be aware of subtle behavior, emotional state, or even some level of the others thoughts, people respond to each other and shift their behavior to present what they hope to present to the other. If they feel a person is picking up on an intent that they do not want the focus to be on, they can shift to present another intent more strongly.

Consciousness

Consciousness can be thought of as an energy field, or possibly more accurately as a focal point of energy or bundle of energy. But what is the energy of consciousness? We don't know that yet. We know that consciousness is very important to this reality because it shapes the reality that we observe. (This is shown scientifically in our study of quantum effects)

Through quantum physics we see that consciousness shapes the physical universe. There is an intimate link between consciousness and the physical world. The physical world though is a sea of energy. Even matter is condensed energy. Consciousness is intimately tied into this sea of energy. Is consciousness another type of energy? Or, is consciousness a bundling of energy? It seems that consciousness is not a bundle of the known energies. We cannot detect a difference in energy to tell us if consciousness is present.

It seems that consciousness is an energy or a bundling of energy that has not yet been discovered. However, from quantum physics we know consciousness is a force to be reckoned with even though we can't yet define it. String theory open up a grand new possibility for many new forms of energy. String theory relies upon additional dimensions, about ten or eleven dimensions instead of the accepted four dimensions

(three space and one time). Having additional dimensions will certainly reveal new energies. That may include energies confined to certain dimensions, our four forces and the energies derived from them may be confined to our four dimensions. Other energies may not be confined and are accessible across all the dimensions. (We currently see no sign of energy leaking out of, or in to, our four dimensions; therefore, if it happens, it is with an energy that we have not yet defined.)

Consciousness may be an energy that crosses out of our normal dimensions. The effect that we now observe between consciousness and matter is not restricted by the speed of light limit. Consciousness can affect matter at large distances in a time frame that would be called instantaneous. This is faster than any information could be carried on light, our fastest energy. For consciousness to cause effects at a distance, faster than the speed of light allows, it seems that it would have to act outside our normal four dimensions. Consciousness is attached onto energy that is not limited to our four dimensions.

Sense/Force

Our senses have a force to them. Touch is the most obvious. We can touch and sense texture, heat, and movement. Or we can push and pull, putting a force into the sense. With the sense of hearing, we can listen to sounds loud and small. The sense organs, the ears, do not generally produce sounds. However, we have the ability to produce sounds. We have sense of taste and smell. While the mouth and nose are not generally the source, we do produce smells, and we generate flavors if tasted.

Vision is the least obvious. We see objects via the light emitted from them or reflected off of them. We do not emit visible light. When visible light is present, when we can see, then we reflect light and create images for others to see.

This ability to create forces or senses for others extends to the subtle senses. We can sense vision, or we can impose our vision. We can hear voices or we can send voices. We can feel love and we can give love. We can feel someone's strength or we can be strong.

Time

Outline

Time is not the linear dimension that we usually take it to be. Relativity has shown us that time is curved the same way that space is curved by gravity. Time is one of our dimensions along with the three space dimensions. Both time and space are curved. And time and space are interconvertable.

We tend to think of time as a line, with the current time being a point on the line. This is not a sufficient view of time. It is more appropriate to think of time as a sheet or plane with the current time being a line (curved) across this curved sheet. It is reasonable to think of this line as *our* current time. However, it is not *the* current time. Different

observers would see different sections of our current time line as being in our future and other segments as being in our past.

Time is usually treated differently from space as though it is the motor of the projector, which projects our three dimensional space. This tendency is inbred into our mathematics. Our equations usually have time and space variables separate. The time variable is usually the dependent variables and the space variables are independent [check use of dependent and independent]. It is logical to expect that a wave function that extends in three dimensions in a four-dimensional space would also extend in that fourth dimension. We should not expect that a wave function have breadth in three of four dimensions, and be flat in the fourth dimension.

So our wave functions extend into the future and past in addition to extending breadth in space. Is this possible? We actually have experimental evidence of precognition, that is knowledge of the future. The experiments were done on a subconscious level. Subjects were shown images and their brain waves recorded. It was found that for emotionally strong images, the response as measured in the brain waves was received before the image was seen. The subjects somehow saw the images in the future.

Text

The Expanded Block-Time Universe, The Future is Not Fixed

Physicists generally view the universe in a version called block-time. In this view, the universe is a four-dimensional space with all of time, past, present, and future, existing within this space. This is an accepted view because in our physical theories, there is normally nothing that makes the present moment any different from any future or past moment. All of time is equal. However, this view leads to an unexpected conclusion. This block-time view of the universe creates a deterministic universe. There really is no choice, all actions are predetermined. Essentially, everything has already occurred. Now, this may be the way things are; however, there are some other things to consider.

Quantum Mechanics experiments suggest that things are not so simple. These experiments show that small particles can lead multiple lives. They can travel over two or more paths simultaneously, as long as we are not looking. We can't yet figure out why particles have multiple locations when we don't look but collapse into one location when we do look.

Many physicists believe that the quantum equations say that multiple realities are created. If multiple four-dimensional realities are created, then the universe has more than four dimensions.

Also, if we include the concept of string theory or M-Theory, then we see that there are eleven or more dimensions. Adding additional dimensions into block time creates what we can call to be the Expanded Block-Time Universe. This universe will have multiple

four-dimensional spaces. This universe will have multiple futures, multiple pasts, and even multiple now's.

This is starting to look similar to the Quantum experiments where multiple paths exist except when we look. With additional dimensions, there will be multiple four-dimensional spaces, but we see only one.

Let's look at how block-time changes when additional dimensions are added. Figure A is our standard four-dimensional block time. These are the 3 space dimensions and one time dimension that we experience. This is represented by a volume. The slice through the center would represent the three dimensions of the current time. This scenario is similar to a movie. The current time represents a frame of the film. The arrangement of the frames in the movie is set and just has to play out.

Figure B represents adding one more dimension to block time giving 5 dimensions overall. In this case our four dimensional universe would be represented by a sheet. The line through the center of the sheet would represent the current time. Unlike the previous description, the sheet has the ability to move around in the volume. This can create different futures. This is more like a video game than a movie. Your actions in the present changes how the game plays out. There is not a set future.

Figure C represents a total of 6 dimensions. In this case, our four dimensional universe is now represented by a line with the current time represented by a point. Again, the line can move around creating different futures that are not fixed.

As we add even more dimensions our representation of the four-dimensional universe may drop down to a point even including multiple possible futures.

So by adding the additional dimensions that quantum mechanics implies and string theory demands, we see that the future becomes variable and not fixed.



Figure A. Four Dimensional Block-Time

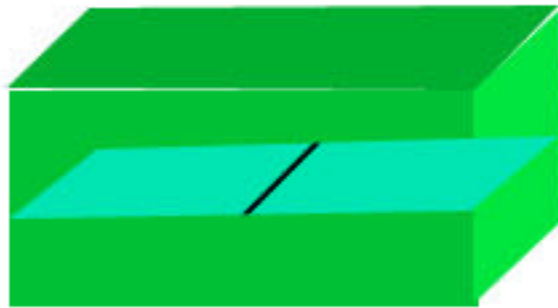


Figure B. Five Dimensional Block-Time

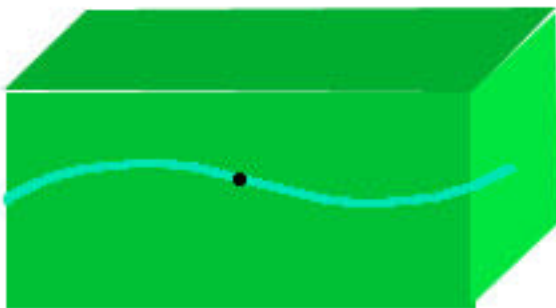


Figure C. Six Dimensional Block-Time

Our belief about the past is that it is fixed and immutable. Let's look at what Quantum Mechanics says about this. In quantum mechanical experiments, such as the double slit experiment, the particles take multiple paths. After the experiment we can say that the particle has a history of taking path A and a history of taking path B. We can either say that it has a history of taking both paths or two histories of taking separate paths. Without a precise design to the experiment to see that two paths were simultaneously taken, then we are likely to say only one of the two paths is the actual history.

Our expectation is that only one history is possible. Quantum mechanical experiments shows that multiple, converging histories are reality. The histories have to be converging for them to be histories of the present time, or reference time. In the double slit experiment, the two paths converge before the detector allowing both histories for the detected electron.

This implies that there are multiple histories to the universe. However, our expected reality is that there can only be one history. So our perceived history is only one of the potential histories.

The Time of Mind

For this discussion, I'll use the term consciousness to include all possible awareness, and the term mind to be the awareness that comes from the physical/chemical/electrical processes of the brain. I allow that some consciousness may derive from other sources than the brain. Now, with the definitions out of the way, let's look at how time fits into the experience of the mind. For the mind to observe something, a stimulus has to activate a nerve. Then a signal runs up the nerve channel to the brain, the brain receives the signal and puts an image/label on it and we see or feel something. This is a fast process but not an instantaneous process. Every sense the mind gives to consciousness is already a moment in the past.

Even though what the mind gives to consciousness is always in the past, it is fast enough for us to live our lives. We are able to hunt, pick up objects, and find each other, because the time lag is very small. But how is the time effect on trying to be aware of the moment through meditation. In some of the meditative traditions, the goal is to be fully in the moment, not in the past or future. The mind works from the near past, often processes images and feelings from the far past, and plans and dreams of the future. Because the mind uses electrical and chemical processes that incur a time-lag, it seems that the mind can never be fully in the present moment.

What about images that arise in the mind without external stimuli? The brain is constantly active, and in the process of activity it will bring up images and feelings that were not stimulated by current external stimuli. A set of nerve firings can create an image, but this set of nerve firings took a fraction of a second, so the images presented to consciousness are already a moment past their origination.

Now, let's allow that there is a level of consciousness that is separate from mind. If this consciousness is at a nexus of inflowing energy and outflowing energy, then that consciousness can exist in that instantaneous moment of now. Our consciousness is

usually quite occupied by the images and feelings of the mind. Now the question is, what consciousness can exist outside the mind?

Is there a consciousness separate from the mind? There would be if we consider that consciousness is a separate 'force' or property of the universe and not a product of the brain. And considering the strange properties of how consciousness or awareness affects quantum particles, we should believe that consciousness is not derived from the brain but a fundamental property of the universe.

Quantum physics show that an element of consciousness shapes the universe. The process of observing certain elements of the universe shapes how the universe behaves. This implies that consciousness is a fundamental property of the universe and is not just a construct of the chemistry of our brains.

Since consciousness is an aspect of the known universe, then there should be an element of our consciousness that is not constructed by our minds. Actually, that is what the physic experiments imply since our consciousness changes the shape of the universe, then our experienced consciousness is part of that universe.

Since our consciousness is a property of the universe, then there should be an aspect of our consciousness that does not follow the mind but that can exist instantaneously in the moment of now. This universal property of consciousness should be able to precede the slow mind. This consciousness of now may be able to experience some of the universe unfiltered by the mind.

You may ask how the consciousness can experience the universe without sense organs, such as skin, eyes, and tongue. However, if consciousness can shape the universe, then we can expect that the universe shapes consciousness. So consciousness should have a direct experience of the universe without the slow filtering action of the body and mind. So to achieve the conscious state of being fully present in the instantaneous now, should actually give a more direct and fuller experience of the universe.

Entanglement

Outline

Through a process called entanglement, we have been able to show that the universe is "non-local", meaning that distant parts of the universe are connected in ways that can cause action that would not otherwise be allowed by the speed of light.

Entanglement occurs when particles interact, and leave the interaction in a superposition of states with the state of one particle being connected to the other particle through a conservation of momentum/spin/energy or such. So, later, when the particles are at a distance, causing one to select a state, causes the other to instantaneously select the complementary state.

Entanglement shows that interactions between particles doesn't force a selection of state. In addition, entanglement shows that the universe is intimately connected with itself on a vast level, even beyond that allowed by the speed of light.

Text

The Holographic Universe

Outline

The process of entanglement resembles that of a hologram. In a hologram, any part of the hologram contains information of the whole image. In an entangled universe, any part of the universe can contain information from throughout the universe.

We see evidence of a holographic universe in entanglement and also in the concept of a universal wave function. If a wave function describes the whole universe, then all parts of the universe are deeply connected. So, it could be said that all parts contain information about all other parts of the universe.

This is also the process of entanglement. Particles become entangled because they share a wave function. So after the entanglement occurs, the wave function describes the entangled states of the particles. And even when the particles are widely separated, they respond instantaneously to each other's state selection process because it is one wave function connecting the two entangled particles together.

The universe is holographic because it is one vast wave.

Text

The Extension of Entanglement

Outline

So we are entangled with many particles outside of ourselves. These particles may be widely distributed in space. Both because the wave function can extend in time and because the particles we are entangled with are distributed in space, which includes time variations because of gravity and velocity differences, we are entangled with particles that are in different times than our local time. The entangled states extend in time, not just in space.

So our wave function extends some length in space and time. We will be in entangled interactions in those spaces. What we are entangled with, in our extended wave

function existence, is also entangled with other places and events (locations in space and time) that are even further distant (in space and time).

As part of the holographic universe, we can be entangled with the entire universe. And this includes the entirety of time of the universe.

Text

The Holographic Consciousness

Outline

Because we are extended in space and time, and there is no limit to the extension between the distributed aspect of the wave function and entanglement; we become part of the hologram within the holographic universe. As part of the hologram, we touch or contain a vast extent of the universe and the universe contains or touches us.

We can guess that consciousness may be describable by a wave function. This wave function may, or may not, have a strong association with the physical wave function.

Since consciousness is able to shape the local universe, but the local universe is connected to the distant universe through entanglement, then consciousness is able to shape and be influenced by a large portion of the universe.

Our physical bodies and our consciousness is extended in space and time.

Text

The Eternal Now

Outline

When we think of the term, "now", we usually think of the smallest possible point in time, the instantaneous intersection between the past and the future. The time between the past and the future is immeasurably small. It's a point in time.

However, we see that all matter, including ourselves, extends in space and in time. We cannot get to a point in time without ignoring parts of ourselves that extend away from that point. We extend in time, and that extension is immeasurably large.

The present, or now, is not immeasurably small, but it is immeasurably large.

The present moment not only includes all of space but also all of time. Everything is linked and affects each other through the process of entanglement and of the universal wave function.

Text

Present Multiplicity

The present moment in time is not shown to have any significance in the equations for quantum mechanics, relativity, or any other physical theory. So if the future and the past can be described by superpositions, then the present is also described by superpositions. Our experience is that of a single sharp reality. The equations describe a fuzzy reality where multiple positions and physical states can occur.

Physicists have a habit of looking primarily at binary systems because they are easier to deal with. In these systems, we either have A or B or a superposition of A and B. In the equations this is a bimodal system or the system has two local maxima. The system is centered around A and B even in a superposition state.

If we look at systems that are not binary, such as location, there can be a wide variation in the possible superposition states. Each of these possible locations will be described by a percentage number representing the probability of observing the state in that position. In these systems, if we plot the probability versus location, we probably will find one local maximum that is centered around the most likely position and drops off in each direction. However, there is nothing that prohibits having two or more local maximum.

What would this look like???

Conscious Interaction

We see that the universe if has a richness and fullness of texture and detail that is not seen by us. We appear to be following a thin shell of reality and not the fullness of depth.

The next question is what are the rules for conscious awareness of this universe. Is there an aspect of physical reality that limits awareness to a thin shell? Or is consciousness more capable than that, and is capable of seeing more of the fullness of reality?

It has been said that to think a sin is to already commit it. I would also say that to think a kindness is to already do it. To think a thought is to connect with a part of the extended universe where the thought represents reality. To think something represents that it's reality exists. And to think a thought is to bring that reality closer. The more it is manifested as a thought, the closer it becomes.

Our thoughts can be a window to the other layers of our universe that are either nearby or have their own center of intensity.

And the thought is the connection between our area of the universe and the area described by that thought.

By holding a thought, we can bring that reality closer to us.

Hyperwave Function

Outline

If there are more than four dimensions, then we have to expect that the wave function that describes our space has a higher dimension counterpart. However, they are not separate. Our wave function would be incorporated into the hyperwave function.

Text

Subtle Energy

Outline

We see that we live in a universe that has layers upon layers of information. We can expect that we have layers upon layers of dimensions in this universe. But we also see that we interact with more than just the particles that touch our body. These particles carry entangled states of more distant particles. And entangled states of even more distant particles can be reflected through those particles. We shouldn't be surprised if these layers of entangled information obey chaotic principles, where a small change in one area (in us or at some distance from us) makes unpredictable changes at a distance.

We have seen much of the basic information that light carries. We use it to describe the universe since it carries much information and travels at the fastest speed of the speed of light.

We have been able to show photons being entangled with each other. This is a layer of more subtle information. And we have not been able to use to extract information out of the universe, but primarily to show that it happens.

We may even find even more subtle layers of information that is carried by light or other particles.

Text

Intent

Another aspect of multiple paths is that of multiple intent. If multiple paths occur on a macroscopic level, then they can also occur with different emotional aspects for the people involved. The different paths can include different intents on the actions of the people involved. Since a persons intent on their action is energetic, not physical, then we can actually expect multiple intents (multiple paths containing different intents) to more readily occur than multiple physical paths.

We often apply the only one action concept to human intent, saying that one action has one intent. This is a rather limiting view. We can easily give some coins to a panhandler for several reasons such as to get these annoying coins out of their pocket, to get this person away from their window, to tithe, to look generous in front of their friend. An action does not need to be limited to only one intent. The intent may come with various weight. Maybe giving the coins is primarily to look good in front of a friend and only to a small part to get the coins out of their pocket.

But if actions come with multiple intents, how does this bode for those who like to know the intent of an action? It obviously makes it difficult. If they figure out one intent, it does not preclude additional intents. If they figure out one intent, it may not be the major intent. And you can never be sure if all intents are known. The person initiating the action probably cannot tell you all the intents of their action because some of them are likely to be from the unconscious.

In an interaction between people, the focus of intents can be shifted to achieve a purpose. One particular intent may offend someone. Without loosing that intent, another participating intent can be presented in some fashion to appease instead of offending that person.

The intent of a action can be presented not just by words but by subtle presentation of actions, that highlight one reason for the action over another. Since people can be aware of subtle behavior, emotional state, or even some level of the others thoughts, people respond to each other and shift their behavior to present what they hope to present to the other. If they feel a person is picking up on an intent that they do not want the focus to be on, they can shift to present another intent more strongly.

Creative Awareness

Science has shown that this universe will respond physically to human awareness. However, science does not have a good description of this response. They just know that it happens. In spiritual groups, it is also known that the universe will respond to human awareness. However, in these groups the response of the universe is directed by the content of the awareness, whereas in science the response is only directed by the presence of awareness.

Science could not show if the universe responds to the content of awareness. The content of awareness is not measurable or reproducible, so science cannot measure a response to it. However, if the universe responds to the content of awareness, then we can work with it even before science can catch up.

One of the standard ways of trying to modify the universe with awareness is through prayer. Prayer is a conversation with a deity. Often the conversation is a monologue. Sometimes the conversation is a dialogue. For the conversation to be a dialogue, the person praying has to be paying attention. That is also the main way to see if the universe is responding at all. We have to pay attention.

As we pay attention to the universe around us, we can experience more of the subtle aspects of the universe. These subtle aspects will show us more of a response to the universe. They will also give us a feedback to how we are interacting with the universe. As we see that the universe responds to our thoughts and actions, we should realize that we are shaping the universe, we are co-creators of the universe. As co-creators of the universe, it is wise to become aware of our creative process on the universe. Are we creating what we want to create? Or are we like bulls in a china shop?

The way to be aware of our effect is to pay attention. The rules might not be written out completely. However, we can expand on our own knowledge just by paying attention. Be aware that we are co-creators and pay attention to our creation process.

Self-Mirroring Universe

Quantum physics shows us a couple unusual aspects of this universe. One surprising item is that the universe is affected by our awareness. This is surprising to scientists because they always thought that we can be totally separate from anything they observe. Another unusual aspect of the universe is that particles that get entangled (by interacting with each other), share a related future. What happens to one of the particles can instantly affect the other particle. And this shared interaction can happen regardless of the distance that separates them.

We can examine how these two proven aspects of the universe may combine. Particles get entangled with each other through a variety of processes; sometimes it may just be from a collision, or it can be from both participating in the same chemical reaction. There is a constant flux of particles/matter through our body. We drink a quart of so of water a day, eat food, breath air. Many of these particles enter our body and take up residence in our tissues. However, they are replacing materials that used to participate in our bodily processes and now are leaving. The materials that are leaving the body are now entangled with the materials in our body, we will share a connected future.

The other proven aspect of the universe shows that our awareness of events, shapes how those events evolve. That means by putting our awareness on aspects of the universe, we are shaping those aspects. Now if we put our awareness on ourselves, by this principal we will affect our own bodies. This is the basis for some of the alternative

health techniques, using visualization, positive thoughts, etc. And there is a body of evidence that shows that these techniques do work.

But if the matter in our bodies is entangled with the universe around us, what happens when we change our bodies with our thoughts? Well, the universe around us will change also. Our bodies are not isolated from the universe. We change ourselves and the universe also will change. In essence, there is a mirror effect between the internal and external. What happens around us will affect our bodies. This is a two way effect, the inside and outside reflects each other. This property can be used in any visualization or positive thought therapy. We might be trying to create change within ourselves. We can also look outward to see how the external universe is supporting or hindering our personal transformation. If we are trying to change something in the external universe, we can look within ourselves and find the area that reflects the change we want. We make sure this area in ourselves is aligned with what we want to manifest in the external universe.

In general we can look at both the internal aspects of ourselves and external world to insure that they are aligned. If we try to make a change in the external world but our internal aspects are not aligned, then the desired result will not appear. We need to make sure that we are a clear and distortion free mirror between the internal and external worlds. This will make our lives more powerful.

There are many traditions that already incorporate this. Feng Shui is used to clear and align the external world to allow our internal self to be more harmonious. Meditation is used to align our internal selves when we are seeking a change in the surrounding world. The more we become aware of this mirroring aspect of the internal and external, the more we can align them and make our lives more powerful.

Surface/Level of Chaos

The universe is a multifaceted folding of dimensions. We are on a 3/4 dimensional surface. However, it is likely to be just that, a surface. And surfaces can have various descriptions. A surface separates, it can contain, it can entwine throughout. But it always implies that there is something else besides just it.

We see from our study that at the very least, that something else is a fuzzy extension of our experiential universe. This extended universe contains many superimposed variations of the universe beyond our experience. With the most similar variations being more pronounced in this fuzzy extension of the universe.

It is also very likely that there are distant expressions of the universe that are vastly different from ours. And some of those expressions could be expected to be more pronounced or expressed (real?) than our universe.

We have seen chaotic patterns expressed in areas with rich texture. The universe seems to be filled with endless texture. We can expect to find chaotic patterns through it. We might find them probably anywhere we can get the detail to see.

So chaotic patterns could be found coursing through the surface layer of our universe, creating the variations in the fuzzy universe around us.

What we experience may just be a layer in the chaos, where the pattern appears similar. Beyond the layer, a phase transition occurs, and a new chaotic pattern occurs.

We might be experience one phase of chaotic patterns, or possibly the layer between two, or more, other layers. And, these two choices could be ways of expressing the same thing.

Chaos

Outline

Chaos is a theory of patterns, patterns that repeat without being predictable. Patterns that look similar on different levels. The patterns are not predictable, because the smallest of changes in one area cause vast changes in other areas. This is a feature that we see in many aspects of our world and universe. Chaotic patterns describe surfaces of planets, it describes weather patterns, or earthquake frequencies. We are in the process of becoming more aware of chaotic patterns. We can only expect to find them in more locations and processes.

Text

The Chaotic Universe

Chaos is a mathematical description of behavior that appears random but has an underlying order. This description can be used to describe many behaviors such as population variations, changes in weather, a dripping faucet, turbulence in a river, etc. In many cases where behavior appears random, it is actually chaotic instead. With chaotic behavior, if the behavior is looked at in specific ways, often by plotting the data against a different number of dimensions, then a pattern becomes apparent. The pattern is usually rich in detail but unpredictable as to its next direction of motion.

Usually, apparently stable systems have chaotic regions. A pendulum may swing steady receiving a small push of air to overcome the friction that tries to slow it down. The pendulum has one period, it has one cycle describing its swing from one end to the other and back. And one cycle is the same as the next. This is what we consider to be a stable system. However; at times when the push of air is increased or decreased, the pendulum begins to move erratically. This erratic motion is actually chaotic motion. This chaotic motion also carries more information. In the stable swing, the motion could

be described by the width of the swing and the time it took to complete a swing. In the chaotic regime, the motion cannot be described, there are always new aspects to its motion that are being revealed. And all the varied intricacies of this chaotic motion slowly describes an elaborate, detailed pattern. The chaotic region carries richly detailed information, but does so in an unpredictable fashion.

There is a border region between the single stable state and the chaotic region. The first step from the single stable state and chaos is that of period doubling. The single state first splits into two. The pendulum swing will go from a single swing into two where the two swings will have different widths. The pendulum will swing wide then it will swing narrow. And this pattern will repeat. But this period doubling can increase rapidly. The two periods can double into four. And four can double into eight. This can rapidly progress until the system enters the chaotic region that has apparently random motion.

What does this have to do with our view of the universe? Well currently we experience one stable universe. However, we know from the physical theories that the universe is allowed to have more than one expression of reality, as we would call it. If we assume that our perceptions are correct and that we see the only expression of the universe, then that means the universe as it stands is in the single, stable period one state. We do not know what energy might be able to push the universe into a chaotic state, but let's examine what might happen.

The first step would be a period doubling, there would be suddenly two coexisting universes. Unless our vision or senses changes in the process, then we might expect to see two superimposed images. Although, it is possible that our senses might change with the period doubling allowing us to see both images individually without superimposition. If this occurs then essentially our awareness expands as the universe doubles. This would be desirable otherwise we could become less aware as the universe continues to double and the information becomes a blur. Because if the universe continues to double, next to four then eight, a superimposed image would appear to become noise. Separate images would provide more information. As the universe became chaotic, it would become very information rich. Our awareness would have to expand with this increase of the universe for us to remain functional in that type of universe. Without an expansion of awareness, the only other way to remain functional is to hold onto only one thread of the expression of the universe. However, in a chaotic regime, this one thread will behave in an unpredictable fashion. If we were holding onto such a thread, then magical or miraculous things would appear to happen. Since miraculous and magical events do not normally happen, it appears that we are truly in a single stable expression of the universe.

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The Universal Wave (1)

The Wave Function (Everything is a Wave)

A fundamental aspect of quantum mechanics is that all particles are described by wave functions. Wave functions are mathematical descriptions/equations that describe particles in the form of a wave.

This means that all matter, both small and large is described as being a wave.

The wave function is well used to describe atoms and molecules, including very large molecules. However, it is expected that wave functions describe all matter of any size, even up to the whole universe being described by a wave function.

Particles as Waves

The wave function describes all particles as being extended over space in a larger volume than is normally attributed to the particle. When we look for the particle, we find it in one location occupying a volume that is normally attributed to that particle. The extended location that the wave function gives can be thought of in a couple ways. First, the wave function can give the probability of finding the particle in a particular area (mathematically, this is the square of the wave function). Secondly, the wave function can be thought of being the density of presence of that particle in any particular area. Both of these views are acceptable views.

It has been experimentally shown that particles can occupy multiple locations as is described by the wave function.

Other properties of a wave include diffraction and interference. Diffraction means that the waves can and do bend around corners. Interference means that a wave can interfere with itself or another wave to double up density when the waves are in-phase, and to diminish or disappear when the waves are out-of-phase. This property has been used to show that the particle-wave has traveled multiple paths and then interfered with itself when the paths are recombined.

Superposition

The wave function shows the particles spread out over space. It can also show the particle occupying several energy levels simultaneously.

This is called a superposition of states. A superposition of states is when several states (energy levels, positions, etc.) are occupied simultaneously. Superposition of states is an experimentally verified phenomena.

The energy levels tend to be at discrete levels, so there would be a limited number of discrete states occupied. As for location, this is a smooth trend, so have an essentially unlimited positions, that it is occupying.

We have tested these theories by designing experiments that force the particle into one of several limited options. Normally, there is an unlimited number of options or positions that particles occupy.

Particle/Wave Duality

All particles are described by the wave function and therefore have wave characteristics. However, we also see particle characteristics. But we see the particle and wave characteristics separately. We either see the particle as a particle or as a wave, not as both simultaneously.

We talked about waves, now what are the characteristics of a particle. We generally view particles as having mass and occupying a discrete location or volume, and as being in one location at one time.

The most salient feature of a particle is that of occupying one discrete location at one time.

Another aspect of a particle, especially a fundamental particle, is that an interaction involves the whole particle and not just a fraction of the particle.

So, when a particle, such as an electron, collides with another particle, the whole electron is involved with the collision, and not just a fraction or percentage of the electron as the wave function might suggest.

We can design experiments that show us the wave characteristics of particles. We can design experiments that show us the particle characteristics of matter. We even have experiments that show us the wave characteristic in one part of the experiment and the particle characteristic in another part of the same experiment.

It turns out that the particle characteristic is primarily associated with a phenomena called the collapse of the wave function.

The Wave Function Collapse

We have a difference between the pure mathematical expression of the wave function and our experiential reality. The mathematical wave function can have any particle remain spread out indefinitely. It can continue to occupy a volume much larger than we associate with the particle. It can occupy multiple paths and unlimited locations, and can have multiple interactions with different particles.

However, when we look for a particle, we find it in one discrete location or state. And from that time on, we find the particle described by the wave function with the particle starting from that one discrete location or state.

Before we look for the particle, the particle is described by the wave function, and the particle/wave occupies a superposition of locations and states. When we look for the particle, we find it in a location or state in a frequency described by the wave function. However, all other alternative locations or states have ceased to be possible. And we see the particle behaving as a particle in a discrete location and energy state. The wave function "collapses" to one discrete location and energy state.

The wave function collapse is not a mathematically smooth process. The math alone would not predict the collapse. The transition from the expanded wave function of before an observation to the wave function after an observation is not described by a mathematical equation. Instead we throw out the old wave function and write a new wave function describing the location and energy state observed.

Is the Wave Function Collapse Real?

We cannot answer this question yet. There is debate for both options. Our experiential reality supports the wave function collapse. The mathematical description supports that the wave function does not collapse.

One of the original descriptions that held that the wave function did not collapse was called the "Many Worlds" view. This held that whenever the wave function encountered multiple paths, that each path occurred in essentially separate parallel universes.

There are a number of problems with the Many Worlds view. But a number of other theories have been proposed that keep the non-collapsing wave function that the Many Worlds view had. This author is another supporter of the mathematical description that holds that the wave function does not collapse during observations.

Multiple Paths

The experiments that show wave characteristics typically present a particle, such as an electron or photon, with multiple paths. If we look for the particle in these paths we will find it in one and only one of these paths. However, to detect the particle in a fashion that allows the wave characteristic to become apparent, the multiple paths are brought back together. We can then look for the interference patterns that are characteristics of waves. These experiments, in a variety of designs have successfully shown wave characteristics in electrons and photons.

After the multiple paths are brought back together, we look for the particle and we find the particle occupying discrete locations and energy levels. But the observed locations, of multiple observations corresponds to the interference pattern of the wave function.

These experiments show several features. Particles can and do separate into multiple locations and energy states. However, these multiple locations and energy states are not in separate universes. They remain present in this universe and will interact with each other, and even reconverge together.

All of the multiple paths are described by a single wave function. The wave function will describe wildly diverging paths. However, these may only have a small percentage of density of the wave function. The higher density portion of the wave function may hold these superposition of paths together keeping them interacting or following a similar direction.

These experiments show a strange feature. Particles can not only enter multiple paths, they can also come from multiple paths. So particles can have multiple futures, but they can also have multiple pasts.

This would be a symmetry in time of wave function superpositions.

Micro/Macro

Superposition of states has been shown for microscopic systems of up to 60 atoms. It has not yet been shown possible for macroscopic objects. Although, at the same time it is still felt that macroscopic objects are described by the wave function.

It is assumed by this author that superposition of states is not limited to microscopic systems, and that macroscopic systems share this characteristic.

Those who believe that macroscopic systems cannot have superposition of states base this belief on the collapse of the wave function. However, if the wave function does not collapse, then macroscopic systems can develop superposition of states.

Higher Dimensions

Quantum mechanical experiments suggest that there are more than four dimensions to this universe. These experiments show that a particle not only occupies a four dimensional point, but that it occupies many of these points in what might be thought of as parallel universes. Well, multiple four dimensional points suggest the presence of at least one additional dimension, and possibly more than one.

There is a class of related higher dimensional theories that go by names such as string theory or M-theory. These theories use on the order of 10, 11, or 12 dimensions.

None of these theories have supporting experimental evidence yet. However, there is reason to believe that one or more of these theories will eventually be born out by experimental evidence. The theories show promise in being able to unify gravity with the other three known forces. And we have strong expectations that all four of the forces should have come from one unifying force.

How Many Dimensions?

Once we accept that there are more than four dimensions, then we are left questioning how many dimensions might exist. We have several potential higher dimensional theories that use one of several different number of dimensions.

Do any of these number of dimensions have to be concrete number of dimensions? No, it has been shown already that dimensions can hide within some of these theories. They can hide by existing but not affecting the properties of the universe as described by the equations.

Plus, even higher dimensional theories can incorporate string theory or M-theory. So currently, we have nothing to limit the number of dimensions, outside of our ability to work with the equations that describe them.

The potential number of dimensions can be expected to be unlimited or infinite.

Parallel Universes

So if the wave function does not collapse, then we have to expect that superposition of states occurs for large objects, not just atomic scale objects. However, since we do not perceive superposition of states, but only one state, then the additional states will occur as parallel universes that are not open to our direct observation.

The Universal Wave

If we make the assumption that the wave function does not collapse, we get a picture developing of how this universe appears.

Everything will occupy a superposition of states, in what appears to be parallel universes. However, these parallel universes are not diverging or separate universes, but influence each other. They constantly interact with each other both separating and converging with each other, and creating interference patterns within themselves.

All of these parallel universes are all described by a single wave function, showing that the parallel universes are not separate but are all part of the same thing.

Dark Energy/Dark Matter

Most of the universe consists of dark energy and dark matter, meaning that we do not yet know what they consist of. One of the theories for dark matter is that the effect of gravity leaks through to parallel universes. So that the parallel universes feel the effect of the matter and gravity from the adjacent universes. This makes even more sense if the parallel universes are part of the same wave function and are continuously splitting and merging or otherwise influencing each other.

Conscious Interaction

The universe has been shown to be shaped by this unknown force of consciousness. This is shown on the quantum mechanical level.

This is shown in a couple ways. When we choose to make a measurement, we can, but this measurement makes the wave function "collapse" into a single state. Secondly, we

choose what type of state to make the wave function collapse into. If we look for spin, we find spin. If we look for polarization, we find polarization. If we look for energy, we find energy. If we look for location, we find location. And some of these properties are mutually exclusive because of the Heisenberg Uncertainty Principle. For example, the more we know about the energy of a particle, the less we know about the location.

So in effect, the universe gives us what we look for, or what we decide to look for shapes the universe.

Conscious Interaction with the universe has been shown on the macroscopic level also through studies of prayer. Prayer has been shown to help patients without the patients awareness that they were being prayed for. Also, the people praying were not physically or even emotionally close to the patients.

The other side of this view is that the universe is shaping consciousness. We decide to look and the universe gives us information that our consciousness uses. So the universe and our consciousness shapes each other.

Entanglement

Through a process called entanglement, we have been able to show that the universe is "non-local", meaning that distant parts of the universe are connected in ways that can cause action that would not otherwise be allowed by the speed of light.

Entanglement occurs when particles interact, and leave the interaction in a superposition of states with the state of one particle being connected to the other particle through a conservation of momentum/spin/energy or such. So, later, when the particles are at a distance, causing one to select a state, causes the other to instantaneously select the complementary state.

Entanglement shows that interactions between particles doesn't force a selection of state. In addition, entanglement shows that the universe is intimately connected with itself on a vast level, even beyond that allowed by the speed of light.

The Holographic Universe

The process of entanglement resembles that of a hologram. In a hologram, any part of the hologram contains information of the whole image. In an entangled universe, any part of the universe can contain information from throughout the universe.

The Holographic Consciousness

Since consciousness is able to shape the local universe, but the local universe is connected to the distant universe through entanglement, then consciousness is able to shape and be influenced by a large portion of the universe.

Maya

Maya means illusion. There are a number of aspects of this universe that seem to be illusionary. Some physicists state that nothing really exists when particles are in superimposed states. This is a possibility, that reality is really an illusion until we look. However, just the opposite may be true. The superimposed states may be the true reality, and the single states that we observe may be the true illusion. The math of quantum would suggest this interpretation.

There are other aspects of the universe that have an illusionary nature. There are a number of reflective symmetries such that observations from either side of the symmetry is indistinguishable. One such symmetry is the size of the universe. The universe can be very large, as we observe it, or very small (below Planck's length) and observationally would appear to be the same.