Quantum Reality

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Introduction

This book is an exploration into the known universe of physics and the less explored area of the human experience as it is described by physics. It explores primarily the physical descriptions of the universe as described by quantum theory.

Quantum theory is one of the best tested theories that we have. However, this theory makes predictions that are very different from our common experience of the physical world.

Physicists used to consider the universe to be a very deterministic place. It was started with a set of rules and the universe runs by those rules. If you knew the condition of the universe at any particular time, then you could predict all that would happen at any future time. This is close to how we experience the world around us, and this is the description of classical physics.

This classical view of the universe first started changing with Relativity Theory and has been virtually destroyed during the 1900's with the development of quantum physics.

Quantum physics provides some strange descriptions about our universe. It describes everything as a wave. It actually gives the universe a dual aspect of wave and particle. Everything is both a wave and particle. We will describe and examine this dual nature later on. As part of this wave nature, quantum physics limits how much we can know or predict about the universe. It describes the universe not with certainties but with probabilities describing the possible locations, energies and other properties of particles in the universe. Quantum physics can only tell us the probability of occurrence of the various futures; it cannot predict which future will definitely occur.

Another old assumption of science was that the observer did not influence the observed. The scientists could separate themselves from the experiment and did not influence the outcome of the observation. That also died with the development of quantum physics. We now know that the process of looking, or measuring, definitely alters the experimental system. We can no longer say that we are separate from our experiments, we influence what we look at and how we look at it. We are currently finding ways to use this to our advantage; using looking/measuring or not looking for different purposes, as in the development of quantum computers.

In exploring this theory, this book will focus on implications to the observable universe and show how all this theory states that there is much more to the universe than we are currently capable of observing. And that means observing with our human senses or mechanical detectors. The book will describe aspects of what we would experience if we sensed what the theories imply. We will also examine the implications of how our expectations can influence our experience of the physical world.

We see how our expectations have influenced our view of the world and science. The local surface of the earth appears flat, so a view of the world was held that the world was flat. It took global travel to dispel that belief. The ethnocentric view, largely held by the church, that the earth was the center of the universe took a lot of good science and brave men standing up to the results to change that belief system. In the beginning of the

20th century, the belief was that the universe existed without beginning or end, this lead to the belief that the universe was static in size. Einstein incorporated this concept into his special theory of relativity even though the theory naturally implied that the size of the universe was changing. Einstein later called this mistake his biggest blunder. Which of our unquestioned belief systems is keeping us from seeing the next step of understanding?

Universal Wave

Evolution of physics

Physics is not a static science. It progresses slowly at times and with leaps and bounds at other times. Sometimes physics grows from observation to theory as in the story of Newton and the apple tree. Other times theory grows from attempts to iron out inconsistencies in current theory. Relativity was born by trying to combine two separate equations for electromagnetism. And a newer set of unproven theories, string theory is growing from the attempt to unify the four known forces.

Once a theory is born or has been modified, then the theory can be examined to see what it predicts about the universe. The predictions can then be tested to verify the theory. Up to now all of our theories have been imperfect, they are only an approximation of reality. Usually, there is a region that the theory works well and a different region where the theory does not work at all. As new theories are proposed, they often do not tear down the old theories, they provide a more accurate approximation, or include a different region of the universe.

Classical physics was first supplanted by relativity and then supplemented by quantum theory. Classical physics is an approximation of reality that still works for most of our everyday experience.

Relativity was an improvement that provided more accurate information about large scale aspects of the universe. These aspects are outside our daily experience. Relativity explained high energy and high velocity phenomena, large-scale structures, and strong gravity better than classical physics. However, relativity theory behaves like classical physics at the energies and velocities of everyday life. Predictions from relativity theory have been tested and have shown relativity theory as valid.

Quantum theory followed closely on the heels of relativity theory. Quantum theory provided a description of very small particles, an area that both classical physics and relativity had trouble explaining properly. The exploration and testing of quantum theory has consistently shown the theory to be valid, even when the results are contradictory to what we would expect.

Unfortunately, general relativity and quantum mechanics are mutually incompatible: any calculation which simultaneously uses both of these tools yields nonsensical answers. Prime examples of such situations are spacetime *singularities* such as the central point of a black hole or the state of the universe just before the big bang. These exotic physical structures involve enormous mass scales (thus requiring general relativity) and extremely small distance scales (thus requiring quantum mechanics).

This means that even though each theory is correct and valid in its own region, neither is the ultimate theory. There is still a better theory waiting to be developed that will incorporate both quantum and relativity within its range.

Quantum theory and Relativity theory work in different realms. But the theories are expected to cover all realms. We will be looking at quantum theory and what it means to us at normal experience scales.

Relativity

The theory of relativity was developed early last century. The theory of relativity was developed in two stages, the special theory came first and the general theory came second. The theory of relativity was brilliantly developed using a simple concept that there is no special frame of reference. That means that each observer (person), regardless of their direction or velocity of motion, could consider their frame of reference to be primary frame of reference or a stationary frame of reference. If two people are moving relative to each other, either one could consider themselves to be stationary and the other as the moving person. Both viewpoints are equally valid.

When the math was worked out for the theory it was found that some strange effects resulted. It was found out that matter and energy are related and can actually be interconverted. Time turns out to be relative and dependent on relative speed, there is not one set time-line for the universe. Space and time are also connected and a conversion can be made between them.

Relativity shows that there is not a single time line. There is not a single time that everything follows. But that time is unique for each observer. The order of events can be different for different people. We will come back to this concept and explore it more later.

The original special theory left out the effect of acceleration and gravity (an accelerating force). The general theory found a way to include these effects by making equal the effects of gravity with an accelerating frame of reference. This resulted in gravity creating a bending or warping of the shape of space. Space is no longer completely flat. Gravity defines the shape of the universe. In general the universe is flat (parallel lines neither converge nor diverge); however, it is bent around large masses such as galaxies, large stars, and black holes.

General relativity provides a good description of the cosmology of the universe, the shape and growth of the universe. General relativity does not provide a description of small particles. That is where quantum theory steps in.

Quantum Theory

Quantum Theory 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.

However, 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 however, 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.

The Wave Function

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 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.

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.

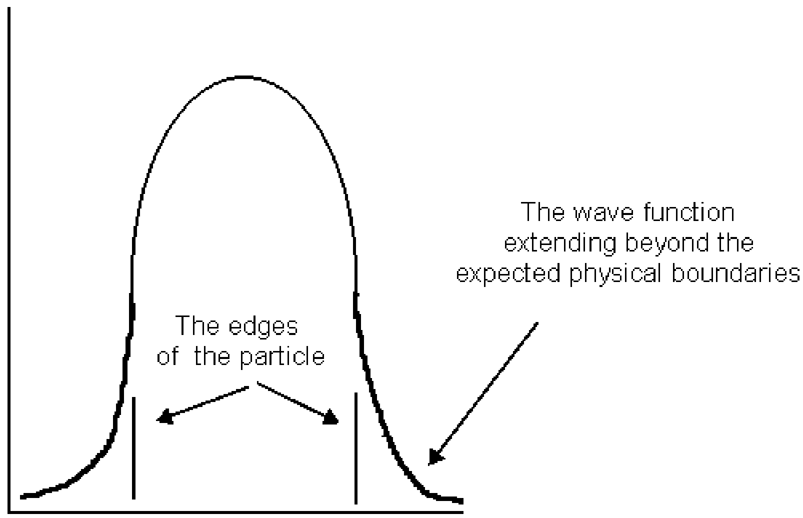
Here is a general overview of how the wave function works. Particles of matter, and quanta (packets) of energy, are described by the wave function. The wave function can give a probability of finding the particle in a particular location or physical state. When there are two or more paths or states that 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.

Systems become and remain non-local until a measurement is made. A measurement forces the system into one of several possibilities. The wave function includes all the possibilities. One of the possibilities is only a fraction of the original wave function. The wave function is said to collapse during the measurement. The problem with quantum physics is that it does not describe this collapse. This collapse is a transition from a non-local particle to a local particle. However, is the problem 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.

From the last measurement, the particle will start to have multiple possible paths presented and the wave function smoothly expands to include these possible paths until the next measurement is made. Richard Feynman proposed that the particle takes all possible paths between measurements.

When we do graphical representations of electrons or atoms, we show a shape with a surface. That presents an image that the particle has a definite surface. It does not. The surface represented usually will contain 90 or 95% of the particle. The rest of the particle extends indefinitely from that surface.



One of the strange properties of quantum theory and experimental observation is that they don't fully match. This is a big area of varying interpretations that will be explored more fully later. The wave function describes particles as being spread out. However, whenever we look for the particle, we can see it in only one location. And future locations can only be derived from that one location that was observed. When we don't look at the particle, the particle follows the description of the wave function and is spread out over space.

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

Waves

Let's start with waves. If a rock is dropped into a pond circular rings of waves will form around the rock and spread outwards. Each ring is a wave, and in quantum theory each ring would be one particle regardless of how big the ring got. So waves spread out. [Figure]

If the wave hits the edge of a pier, it will bend around the end of the pier and continue down the side of the pier. So waves bend around corners. [Figure]

If two rocks are thrown into a pond a little distance apart, they will both set up ring waves. When these waves start overlapping they set up interference patterns. When the top of two waves intersect, the peak becomes almost twice as high. When the peak of one wave crosses the trough of another wave, they cancel out and the water level is about the same of the rest of the pond. So waves interfere with each other. [Figure]

If the wave from one rock hits a tree trunk, the wave will bend around the tree trunk from both sides and then create an interference pattern with itself. So waves can interfere with itself. [Figure]

There are two main properties that describe waves: frequency and wavelength. Frequency is a measure of how many wave peaks, or cycles, pass a point in a second. The other property is the wavelength. The wavelength is the distance of one whole cycle of a wave, it can be measured as the distance between two peaks of the waves. Wavelength and frequency are inversely proportional. This means that as wavelength increases, frequency decreases, and as frequency increases, wavelength decreases. For light, which has a constant velocity, the wavelength and frequency are directly linked. For other particles, such as electrons, which can have different velocities, this inverse link between wavelength and frequency is not as direct, in that there can be a greater variation in one of these than in the other. For light the variations in wavelength/frequency corresponds to the variation in colors that we see.

The properties of waves are really the property of matter since all matter is described by wave functions. So let's describe the wave function more.

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.

The Universe is One

Physicists yearn to discover the single theory 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 all their energetic and material manifestations.

The belief is strong that the universe is a single whole entity, which means that there should be a single complete theory that describes it. Both theory and experiment support the concept that the universe is a single whole entity.

The theories and experimental evidence of quantum mechanics show that separate parts of the universe are intimately linked through paired states called entanglement. Entanglement allows particles that have once interacted remain connected to each other regardless of the distance between them. Then interactions with one of the particles can instantaneously affect the other particle. And this instantaneous effect works without regard to the speed of light. This phenomenon will be discussed in more detail later in the book.

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.

Particle/Wave Duality

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.

However, 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.

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 Extent of Matter

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. This is shown in the double slit experiment. We get multiple lines of interference showing the various constructive and destructive overlap of the waves. To get multiple lines of this interference, it means that the extent of the electron is larger than it's own wavelength. So even though the DeBroglie wavelength is a valid feature of matter, it is not the limiting extent of that matter.

The DeBroglie wavelength describes the length of the wave only in the direction of movement. The wave spreads out to a much larger degree towards the sides. [Figure]

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

Superposition/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.

Multiple Locations

The distance over which the wave function describe particles as being spread out is a much larger space than the particle occupies when we measure it. 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. [See Experiment] 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 observing 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 as the two paths join together again. 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 recent theory even states that the particles take all possible paths.

So we have experimental evidence that the wave function description is true, and that particles occupy multiple positions [called superpositions] simultaneously. This superposition of positions occurs definitely when we are not observing the particle. When we observe the particle, we see only one position. We see the multiple positions in experiment when we allow the particle to take multiple paths, and then allow the particle to recombine before we observe it. So we see both a superposition of particles and a single particle in one experiment.

States/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. 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.

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.

Superposition of states is well accepted. In fact, we have started using superposition of stated in designing quantum computers. We have already made tiny quantum computers using superposition of states to demonstrate the concept is valid.

Multiple 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 can 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.

"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)
- Presumable 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 is 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.

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.

Experimentally, we can see these multiple timelines, or multiple paths, 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.

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

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.

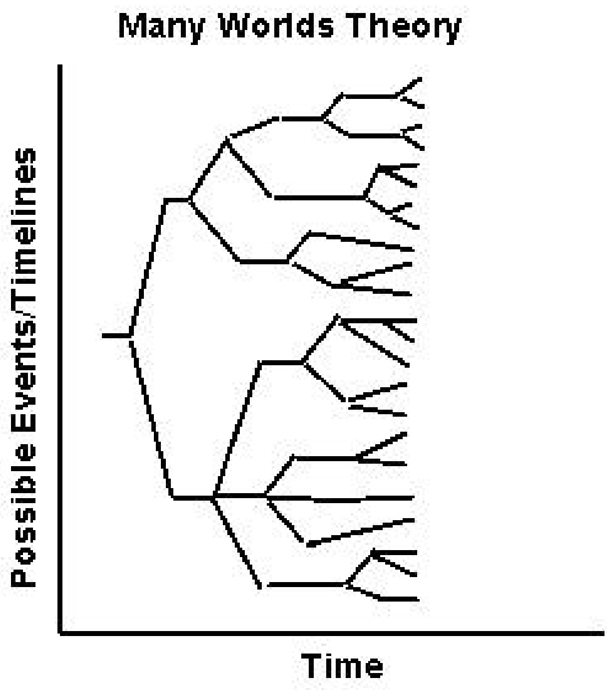


Figure 1. The Many Worlds View of Timelines

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. It two high parts of the waves overlap, an extra high area is produced. If two low parts of the waves overlap, then and extra low area results. If a high and low portion overlap, then and 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.

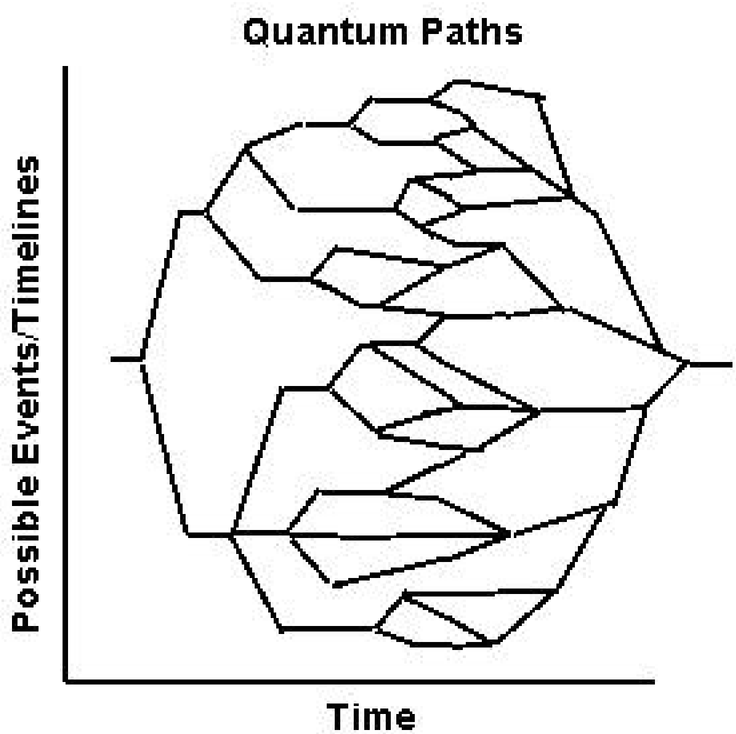


Figure 2. Quantum paths, diverging and converging timelines.

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.

The Wave Function Collapse

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 *superposition*. This can continue to happen adding more and more possible states and locations, until the system is forced to identify where it is [select a state or position] 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 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.

From the last measurement, the particle will start to have multiple possible paths presented and the wave function smoothly expands to include these possible paths until the next measurement is made. Richard Feynman proposed that the particle takes all possible paths between measurements.

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. This is one of the debated areas of Quantum theory. There are several theories that try to explain the wave function collapse, which we will explore.

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.

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

Copenhagen Interpretation/Copenhagen/Copenhagen/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.

Many Worlds

One of the early 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 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. 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 loose 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 loose 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, or parallel realities, 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.

The Many Worlds view of the universe won't go away and keeps getting reincarnated in new versions. Many physicists believe in some version of a multiple reality universe. A universe that has other universes, parallel realities, or such, is termed a Multiverse.

Multiverse/Parallel Universes

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 and expected that the universe (the biggest grouping of particles) can also be described by a wave function.

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.

Common interpretations for the potential of other parallel 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 simultaneously. 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 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.

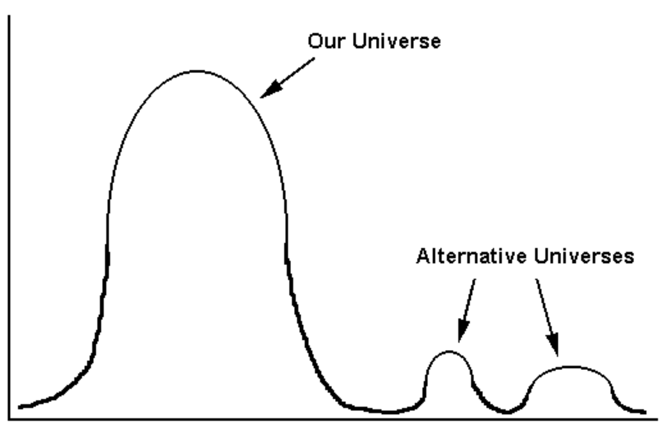


Figure 1. Wave function with localized maximums

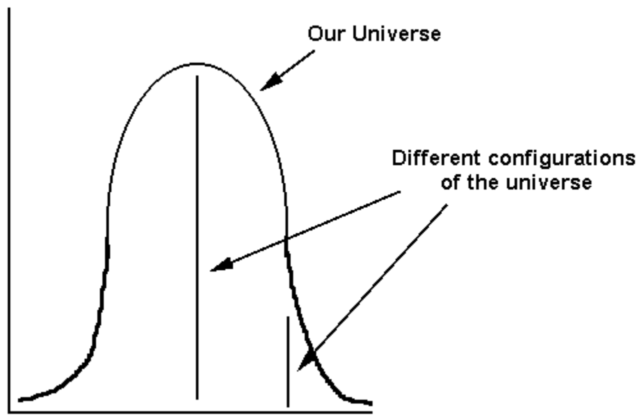


Figure 2. Wave function without localized maximums

Entanglement/The Holographic Universe

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 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.

The Universal Wave/The Extended Universe

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.

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.

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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.

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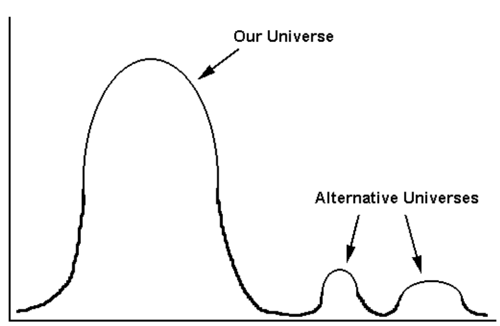


Figure 1. Wave function with localized maximums

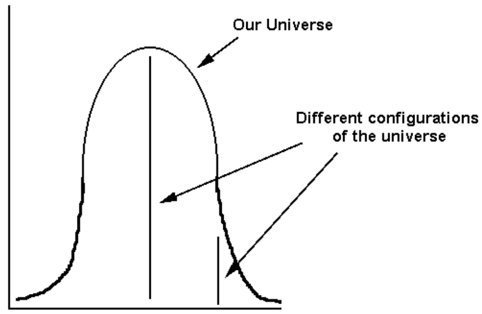


Figure 2. Wave function without localized maximums

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 loose 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.

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

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.

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.

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.

Higher Dimension Theories/String Theories

Some theories use from ten to 26 dimensions. This may be a limit; however, we would not be able to prove it and in the future it may be advantageous to use higher numbers of dimensions to advance our theories.

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.

STRING THEORY

String theory solves the deep problem of the incompatibility of Quantum theory and Relativity 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, or membrane theory. However, M-theory requires one additional spatial 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 forth dimensional observer could see different charges instead of energies. In the forth 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} centimerter in radius. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

The concept of super symmetry 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 X 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 solition, 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 weekly 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-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. (Concepts from "The Theory Formerly Known as Strings", by Michael J. Duff, Scientific American, February 1998, pp 64-69.)

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 spatial dimensions. 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 my 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 possible 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 no 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.

The Universe is Vast

The universe is unimaginably vast. How can it be unimaginably vast? Because, whatever level we can imagine of the universe, the universe can be at least one level larger.

Let's start with the four-dimensional universe. Recently, it was shown that the rate of expansion of the universe is increasing. This counters the former theory that the gravity of the universe was slowing down the rate of expansion, possibly to the point of causing the universe to collapse back upon itself. With an increasing rate of expansion in the universe, this means that the universe is "open" or infinite. So the visible universe is infinite, it will expand forever, and it's extent is limitless.

However, it is likely that there are more than four dimensions to this universe. We are working with various theories that use 10, 11, 12 or 26 dimensions. However, we should not expect that the number of dimensions is limited by our theories since we have already shown that dimensions can be hidden from influencing our universe, within our existing theories. So we can expect that the number of dimensions is unlimited or infinite.

So we have an infinite universe that is only several dimensions of an infinite dimensional universe. The standard view is that our dimensions are "flat" and all the other dimensions are curled up to a very small scale. However, we have also shown that there is no observable difference between large expanded dimensions and tiny curled up dimensions. So we could be in the curled up dimensions and the other dimensions are flat, and we could not tell the difference. Also, if our dimensions were curled up and all the other dimensions were curled up, again we could not tell the difference.

So it is possible, maybe even likely, that all dimensions are curled up. There may even be a relativity of dimensions that allows any coherent set of dimensions to be considered as flat.

We could expect that chaotic/fractal patterns are found in the expression of the dimensions. There could be patterns found on certain levels (patterns such as string theory), different patterns on other levels, but the patterns can repeat in a fractal pattern as the levels are changed.

This creates many possibilities. There may be whole universes floating around within our universe. We may be a speck floating around within many other universes. There will certainly be many universes that are not anywhere near our universe. And there may be universes that intersect ours, not as tiny specks, but as full open universes, just not visible to us.

Of course, this vastness is well beyond our experience or senses. Is there anything close to our universe that may influence our universe?

From our knowledge of quantum mechanics, we should say yes.

Quantum mechanics shows that there are superposition universes. That is versions of our universe with some things being different. But these different versions of our universe are not isolated from our universe. Quantum mechanics shows that superimposed states influence each other and can merge again.

So we are surrounded by a cloud of universes with slightly different paths, different actions, and different intentions. But these related universes interact with our visible universe. The universes can merge with or just pass through both merging and diverging again.

Is this cloud of connected universes useful to us since we do not perceive them. There might be a chance that we could learn to perceive these universes. Potentially, some people perceive these shared universes already. If so, they are most likely either masters or mad men. Such information would not be generally useful or even accepted in our current society.

However, what can this cloud of shared universes present to us? We move through a path of these universes along a direction that we call forward time.

Direction

Our movement through time comes with certain expectations of behavior. This behavior comes from having a limited range of potential universes that we move into. This movement has a sense of inertia to it. We are moving in a direction and absent any force, we continue moving in that direction. We get to choose between the options that are only in the direction we are already moving.

Well, the question is, what force can change the direction of motion? And what can happen if we change the direction of motion?

The first question, I cannot answer. The second question, we can postulate what can happen. If we can shift the direction of motion so that it does not follow the normal inertial arrow of time, then we can violate laws of nature that want to follow the arrow of time.

An example would be levitation. The arrow of time dictates that bodies fall toward the earth in a reasonable fashion. If we can curve our direction of travel through the parallel universes consistently moving into one with our body a certain distance off the ground, then we will be levitating.

Certain masters are said to be able to do this activity. Most of us are not able to work on this level. But we still shape our directions through our choices.

Choosing

Our path is created or chosen through all the choices we make in daily life. And we move in a smooth path from one shared universe to another shared universe.

What are all of the choosing processes? We have conscious decisions, unconscious decisions, desires, wishes, and thoughts. These all can influence the path we take through the universes.

Sure, decisions and choices will direct the path that we take. But why would desires, wishes, and thoughts direct our path?

Well, we see from quantum experiments that human awareness affects the shape of the universe. This shaping is occurs in two ways. If we look at a process, we force the process to be in one of the many possible universes. And what we look for also limits the options of the things that we will see.

So we see that human awareness and choice is a shaping influence on this universe. We not only shape the universe with our direct actions, but the universe also responds to our choices and decisions.

How much of the universe do we see?

Based on the concept that the wave function collapse is not real, we are left with the view that the universe consists of a multiverse, a multiple universe. That means that the visible universe is only a thin slice of the overall universe. How much is unseen is hard to say.

The universal wave function might be narrow, in which case, there is not much besides what we see. The wave function might be broad, which would mean that there is much besides what we see. The wave function might have multiple maximum (centers), which could mean that there are parallel universes that are widely divergent from our universe.

Considering that at every moment in time, there are innumerable quantum decisions being made, that's innumerable new quantum paths being created, then we have to assume that there are innumerable parallel realities in this multiverse. However, the density of the reality of each of those parallel realities might be vastly smaller than the one we are on. Although, at the same time, there might be parallel realities that have a greater density than the one we are on. We would like to assume that our reality is the main reality. We do not have support for this position.

Time

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.

We recognize four dimensions to our universe, three space dimensions and one time dimension. The time dimension is unique in that it has a direction to it. As we may say, time flows in one direction; although more appropriately, we flow in one direction in time. Time is such a fundamental aspect of our existence that we would be hard pressed to imagine existence without time.

Why does time have a direction? It is not readily apparent to us. There are several properties that also have a direction with time such as entropy. The theory is that entropy of a complete system will increase with time, it cannot decrease. If you see entropy decreasing, it implies that you are looking at an incomplete system.

However, most physical theories do not have a time direction associated with them. The mathematical equations that make up the theories work just as well in reverse time as they do in forward time. Another strange aspect to time comes from Relativity Theory. In Relativity Theory, time can be translated into distance and visa versa. Also, from Relativity Theory, there is not an absolute time, time is relative to the frame of reference of the observer. Two observers in two different frames of reference will experience time differently. When they meet again they will see that they have aged at different rates.

So, time may not absolutely have to forward only, there is not an absolute time, and time can be converted into distance. What does this mean? Let's look at the frame of reference used in Relativity Theory. The frame of reference refers to an inertial system. An inertial system consists of energy and/or matter, and an observer so we can observe, that is undergoing velocity, acceleration, or gravitation. This system experiences time differently from another system of energy and/or matter that is experiencing a different velocity, acceleration, or gravitation.

It seems like the inertial system is an important aspect of time. What might this mean to our understanding of time? Well the observable universe is a very large inertial system that, excluding exotic species such as black holes and energetic particles, has generally a very similar time line. This gives us the advantage of having a reasonable idea of the age of objects at the edge of our vision in the universe. It is possible, if not probable, that the direction of time that we experience is solely a function of the inertial system that we are in. If we were to change inertial systems, we might experience time either stopping, reversing, or going sideways (however, that may feel).

However, it may not be possible to create the conditions to experience time in anything but a forward direction. If you succeed in getting an observer, person or clock, to drastically change inertial system, you have only succeeded in changing the conditions that the inertial system consisting of the person or clock is in. The observer is always their own inertial system which is not being changed. Now that inertial system is changing conditions such as strength of gravity, acceleration, or velocity. We change the conditions imposed on the inertial system to a limited degree now. And we have succeeded in showing that time will slow down. The conditions under which we expect to stop time (the speed of light) are out of our reach. And the condition to reverse time (faster than the speed of light travel) may be impossible. Are there any other means to stop, reverse, or move sideways in time? There may be but we will have to see past our own conditioning imposed upon us by our universal inertial system.

The universe is a three/dimensional space. The visible universe may have a certain beginning and may have a specific end. Common theory states that universe is made of one substance that has clumped into various forms as it cooled down. Time is unusual in that it only moves forward. In most mathematical theories there is no difference between forward or backward time.

Why is time one-dimensional when space is three dimensional? Why are there only four dimensions when mathematically we can describe more dimensions. We only see one-dimensional time; however, on the quantum level we see evidence that particles can travel multiple time-lines. The particle has multiple histories. This implies that time is more than one-dimensional. It seems to be at least two dimensional. We are following the line of increasing entropy, one of the indicators of our time-line.

In Relativity, event-light cones are used to show how some events we cannot interact with because the events are outside our light cones. They are too distant for us to ever interact with them (limited by the speed of light). There may be a similar limit in looking at timelines.

Particles can have either wave or particle characteristics. We tend not to see both characteristics at the same time. This implies that the particle has a greater reality than what we see. We can see part of the particle's reality. Depending on how we look we can see one aspect of the particles reality. We are limited in our observation ability. Our awareness/ consciousness determines which aspect of the particle we see. We can set up experiments that give us multiple histories for particles. So history is also a limited aspect of reality determined by our consciousness.

We live in a four dimensional world. However, as we look around us we see the three space dimensions quite well. We recognize that objects have length, width, and breadth; three dimensions. We understand that the fourth dimension is time. Without time nothing would move. Physicists do not imagine a universe without time; however, they can and occasionally do imagine a universe with more than one time dimension. This essay is an exploration into the dimension of time. Time is different than the three space dimensions in several ways.

The most obvious difference with time compared to space is that time has a direction to it. There is an arrow of time racing from the past into the future. We cannot change directions in time and go into the past. Another arrow of time is that of entropy. Entropy is a physical property that many people describe as disorder. Entropy is a measure of how many possible conditions, the physical term is states, can exist. And the rule is that entropy always increases as time passes. Entropy, a measure of the physical system, is linked with our fourth dimension, the arrow of time. Another connection with time is the universe itself. The universe is expanding and has been expanding since the beginning of time. It was once thought that the universe was slowing down and was going to reverse directions and collapse. However, recent evidence shows that the universe is expanding at an ever-increasing rate. So the universe is expanding for all time.

Another difference between time and space is that space appears freely accessible to us whereas time is not. We can move about in space and choose the direction we move in, but time occurs without any ability on our part to change direction in it. It is as if we have a box of space, and time is flowing through it. However, we only have a thin slice of time in the box, that we call the present, or now.

If space behaved as the arrow of time does, then we would be moving through space in some direction such as east, up, or some other arbitrary named direction. Well that is what is happening; however, we can change direction through application of force. The tendency to move in one direction until a force is applied is termed momentum or inertia. The movement through time has an aspect of momentum to it, but we do not have a force to change directions in time.

Time is not actually a monolithic entity. Time actually moves at different rates in different places of the universe. Time moves either faster or slower depending on both the effects of gravity or relative motion of whom is observing the time. This can happen to such a degree that the order of events can reverse themselves to different observers. So time has some texture to it. This texture of time is also connected to the texture of space. Space is curved around massive objects such as stars. Actually, space and time is curved around massive objects. So time shows related properties to space.

What would happen if we treated time as we do spatial dimensions, saying that the entire dimension currently exists? Well, in that scenario, there is no apparent source of motion. There would be one big four-dimensional space, rich in texture and detail, but no motion. Objects would form long three-dimensional cords along the time dimension. An object such as a table would form a long table shaped cord, on one end of the cord would be cords representing the legs and top joining together to form the table cord. On the other end the table cord is broken into several other cords as the table is broken apart. This description is actually similar to the description of sub-atomic particles as described by string theory.

Do we have to view time as only a thin slice of that dimension, or can we view time as a complete dimension? If we try to view time as a complete dimension, how can we have movement? To have movement, we need to change positions along at least one dimension line, so it seems that to have motion we can only have a thin slice of a dimension. To have motion in a complete four-dimensional space, you may have to be a disembodied spirit or consciousness with the ability to move or focus your consciousness in different areas of the space.

If we have some type of momentum that moves us through this slice of dimension that we call time, does time have to be a unique type of dimension, or can time be like another space dimension, but one that is not fully available to us? We could be a three dimensional space with a momentum pushing us through other spatial dimensions. This movement through other spatial dimensions gives us the motion we observe in this three dimensional space. I used the plural in saying we are moving through other spatial dimensions, not dimension. We have a belief that the future contains many paths, there is not a single future. If time represents a single dimension, that would imply that there is one and only path to follow through time. If the future truly has multiple paths, then time represents more than one dimension, either multiple time dimensions or multiple spatial dimensions that are not fully available to us.

We have a good understanding of many of the properties of how we can move around in the observed space-time space. However, we are still working on the concepts of non-observable dimensions and their possible effects on the observable universe. This is a slow and complicated process and it may take us many decades before we feel that we have a workable understanding. The concept of time does give us additional concepts to ponder that may lead to an increased understanding of the shape and function of the observable and non-observable universe.

Time has the characteristics of inertia. Inertia is the resistance to a change of direction or velocity. Time has this characteristic; time moves in one direction with a constant velocity.

This is actually somewhat surprising to some scientists, outside of our experience of it. Physics generally does not require a specific direction to time. In some cases, it does not make sense that there is one specific direction to time.

Now, there are a number of properties that have a specific direction in time. Entropy is one example, where entropy always increases as time moves forward. That entropy increases is a statement of what is observed. There is no fundamental reason for entropy to only increase.

Some views of the universe (i.e. block time) take the past, present, and future as already existing. But then humans experience an inertial aspect of time.

Where could in inertial aspect of time arise? Well, inertia is a property of matter. Actually, that is one of the ways to measure the mass of matter, by how much inertia it has. Inertia is the mass of matter.

Well, humans are identifies with the mass of our bodies and the matter of the surrounding planet. Well, humans move about the earth, the earth circles the sun, the sun circles the galaxy, and the galaxy moves through the universe. Is there a common source of inertia? A common source of inertia is the energy and motion of the big bang. This energy is apparent throughout the universe in the expansion of the universe. The whole universe is sharing a common source of motion and inertia.

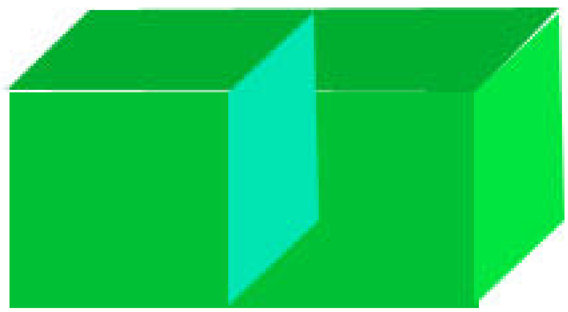


Figure A. Four Dimensenal Block-Time

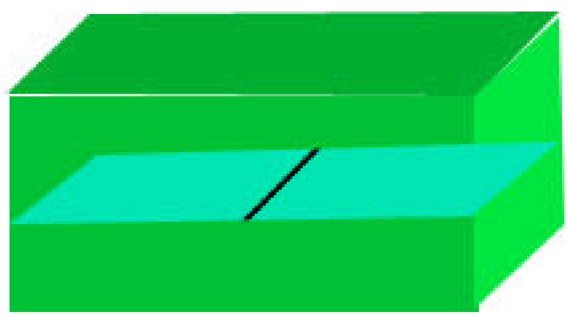


Figure B. Five Dimensional Block-Time

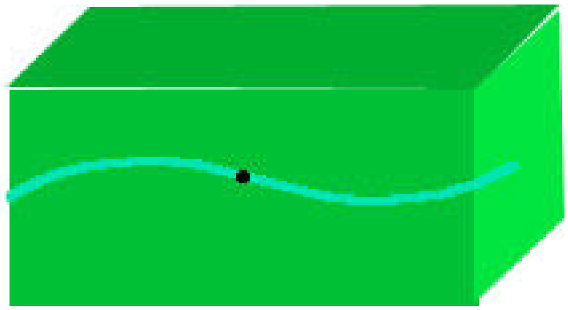


Figure C. Six Dimensional Block-Time

One way to look at our four dimensional universe is that of block-time. In this view, which makes sense mathematically, there is a four dimensional space that is whole and complete. There is no special time called "now". We can expand this view to include the higher dimensions that we expect to exist. Our four-dimensional space is one of many possible line through this higher dimensional space. And again, there is no special time called "now".

But, we experience time sequentially. And we experience time as an inertial event. It appears that we are experiencing a thread of consciousness that is associated with the three dimensional matter inertial system of the observable universe.

In the four-dimensional block-time, both the future and past are fixed. If this were true, it would invalidate the understanding that we cannot predict the outcome of quantum events.

If we are in a higher dimensional block-time but only occupy a four-dimensional line in this block time, then again we would have a fixed future.

Can we have a system that does not require a fixed future? Yes, if we have a higher dimensional block-time but don't require that we exist on only one four-dimensional line.

If we have a variety of four-dimensional lines that we could occupy in this higher dimensional block-time, then the future is not fixed.

But if there is not a special moment called "now", how can there be multiple four-dimensional lines? Well, it would mean that all of the lines would exist, and actually, that they already exist in their entirety.

But we experience time sequentially? We are apparently a consciousness that is associated with the matter of this world in such a way that we see a three dimensional slice of it. And we are following the inertial system through the higher dimensional space.

Following this logic we see that the future already exists, and has always existed. But that there are many futures, not just one fixed future. But, we see from quantum experiments that various lines are interconnected, they can split from each other and join each other. So our consciousness gets to choose the lines that we travel.

Is our consciousness truly as limited as we experience it? This we may never know. We do not know the nature of consciousness. Is our consciousness truly limited to a three dimensional point? Can it reach beyond the standard expectations of understanding?

We have signs that it is not as limited as normally thought. Some people have future sight. We normally classify this as a psychic property. What does it show? Well, even with psychics, we expect that the future they see is not fixed. But it shows that it is possible for the consciousness to extend beyond a three dimensional point. Consciousness can extend to nearby spaces showing potential future paths.

But we still do not know the extent, or potential extent of consciousness. Does consciousness truly exist around a three-dimensional point? Does consciousness exist along a four-dimensional line, but "riding" the inertia of the line to give us a three dimensional experience? Or does consciousness exist in a higher dimensional space, but is focused on a three dimensional inertial system?

Exploring consciousness seems to be the way to explore these questions.

The Wave Function is Extended in Time

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. We have done this with particles, treating them as points with no extent. This makes the theory easy or doable, but it also makes the theories into approximations of better, future, theories since we know that all particles have extent in space and time.

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.

We can see this in the Heisenberg Uncertainty Principle, where one form says that energy multiplied by time is greater than a certain value. This means that we cannot know too about time and energy together. The more we know about one means the less we know about the other.

Another way to view it is that we can borrow a certain energy for a certain time. And the more we borrow, the quicker we have to return it. Or, we can borrow a certain time for a certain energy. The more time we want to borrow, the less energy it costs us.

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, their 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 gave 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.

The Past is Not Fixed

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.

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.

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???

The Arrow of Time

Time is one of our four dimensions, yet it is different from the other three space dimensions. Time has been shown by the Theory of Relativity to be connected with the space dimensions. Relativity has also shown that there is not a single arrow of time. Time is a dimension that shows many permutations. Essentially every object in space has its own arrow of time, although closely aligned objects share a similar arrow of time. We like to view history as linear; one event follows after another. Time is not so linear. Depending on location and relative movement in space-time, event "B" follows event "A" for one person and event "A" follows event "B" for another. There is no consistent sequence of events. In our linear thinking we like to say that event "A" causes event "B". But since event "B" also occurs before event "A", cause and effect are called into question.

The Theory of relativity was developed by considering that all frames of reference are equally valid. What happens if we consider that all dimensions are equal? Well, time appears unique to us compared to the space dimensions. Time is the only dimension that is unidirectional. We can move in different directions in space; left, right, front, back, up, and down. In time, we can only move from past through present into future.

When we contemplate more dimensions than the known four, as in string theory or M-theory, we often only have one time dimension with many space dimensions. Occasionally, a theorist will propose multiple time dimensions. We need at least one time dimensions to give us the sense of motion. What happens when we say time is no different from space? If we use our four dimensions, then all of our existence would already exist in the four dimensions. The beginning of the universe would co-exist with the end of the universe along with all the events within the universe. None of these events would be before or after the other. The sense of time could be caused by the motion of awareness or consciousness through this four dimensional space. The momentum of this movement of awareness creates the arrow of time. The momentum of movement keeps us moving in one direction. A force would have to be applied to shift the direction of this movement. And we do not yet know what forces work on awareness or consciousness on this scale.

When we include other dimensions than the known four, we could potentially have more time dimensions than just one. What is a time dimension? It is a dimension that does not manifest extent in space, yet it is a dimension/direction that we can move. If we decide that string or M-theory are correct, we will have more space dimensions, yet these dimensions will not manifest extent in our universe; although, they will shape the properties of this universe. If there are more dimensions that fit the description of time dimensions, then there are more directions that we could move in time. However, to change directions in time would require a force. What is that force?

All at once/The Eternal Now

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.

Quantum entanglement means that the universe acts as a unified whole over distance. Particles that share a common history respond to each other regardless of distance. And since particles have been interacting in such a fashion since the beginning of particles, there is a vast web across the universe of particles that respond to each other. However, general relativity shows that time is a relative quantity and can be both forward and reverse at once depending on how you look at it. Combining this relativity of time with quantum entanglement, we see that quantum entanglement not only plays across space but that it will also play across time. Events in the past will affect events in the future, and events in the future will affect events in the past. Actually there is a sense that the universe is a holographic whole not only across space but also across time. In a sense, all of the universe has happened at once.

If the whole universe has already happened, does this mean that the future is predestined? No, since we only experience a thin slice of the universe, and this is a thin slice of space as well as time, we are not limited to a single future but a numberless selection of possible futures.

Quantum entanglement across time

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.

We know that wave functions extend in space and time. We tend to describe it as being very small for macroscopic items. This is based on the use of the deBroglie Wavelength. However, the wavelength is not a description of the extent of the wave functions. Wave functions can extend a varying number of wavelengths. We see this in the double slit experiment where the electrons make multiple wave forms on the detector, showing the wavelength of the electron over many wavelengths. And this from single electrons.

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.

All is One

Entanglement/Quantum Connections

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.

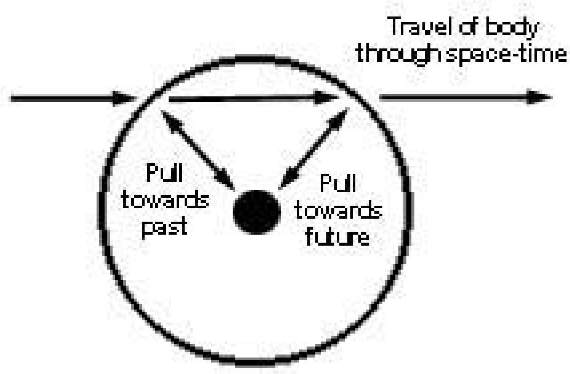
We are in constant connection with a significant portion of the universe through exchange of innumerable quanta's of energy. We can ask, what information can be passed through these exchanges. The exchanges with the universe consists of electromagnetic light and gravitons (the carrier of gravity, the existence of which has not yet been proven). There is also a low level of interactions with neutrinos. And there may be significant interaction with other esoteric particles whose interactions are not known or well understood. How much information is carried by light?

A quanta of light carries two basic pieces of information; frequency and direction. There is additional information carried in a collection of quanta. That additional information that a collection carries, which an individual quanta cannot carry, includes information derived from which frequencies are present or which frequencies are absent, the total amount, or flux, of quanta, and how the collection of quanta is changing in time. The collection of quanta carries more information than just the sum of the individual quanta. We have used the light from the heavens to give us a good understanding of the universe.

How do we perceive this light? We primarily see light with our eyes. We have also have made instruments that act as extensions of the eyes to see even more of the light spectrum and to see more sensitively. We also experience light through our skin giving us some warmth, the ability to produce Vitamin D, and a healthy color. Some forms of electromagnetic light pass through our bodies, some with little interaction and others with more interactions. We do not consciously experience all these interactions; however, they are still creating changes in us.

The other main quanta interactions are with the graviton. The graviton carries at least the information of direction. It also carries a pull in that direction. The exchange of gravitons The earth is the body with which we exchange the most gravitons. This pulls us towards the earth and pulls the earth towards us. This exchanges occurs with all masses. It occurs with other people, cars, buildings, and the like. The strength of the pull is not enough for us to consciously feel, but it is there. We don't feel the pull of the moon, but we can see the effect on the earth creating tides in the oceans. The more distant planets, stars, and galaxies also pull on us even though we don't consciously feel the pull. The connection is always there. As with electromagnetic light, we can expect that there is more information in the collection of gravitons than just the sum of the information carried by the individual gravitons. We do not yet have instruments that can detect this information. However, the information affects our bodies, how much of it is available to us on the unconscious level? Also, how much other information is there besides mass and location?

The gravitons also pull us in the direction of where masses were in the past. It takes time for gravitons to travel distance, so their pull is always to a past location of a mass. However, the quantum mechanical description of an exchange of quanta is that it is a complete interaction at both ends of the exchange. So the graviton from another star pulls me towards the star, it also pulls the star towards me. So I am pulled towards a location in the past. The star is pulled towards a location in the future. Actually, since the exchange is two ways; gravitons from me reach the star around the same time that gravitons from the star reach me. One stream of the gravitons pulls me towards the location of the star in the past and the other stream of gravitons pulls me towards the location of the star in the future. The average of these effects may be close to a pull in real time, that is close to instantaneous gravity without the speed of light being violated.



Non-local

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 instanteously 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 polorization 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 aroung 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 than 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 intantaneously 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 infinitesmally small probability, the quanta interacts with a system in such that it's 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 percieve 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-existant even though we cannot verify its existance 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 is 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.

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.

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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.

Unification

The Holographic Universe

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.

The universe has been shown by experiments to be non-local. The term non-local means that actions can happen at a distance that would be otherwise prohibited by the speed of light.

This action at a distance can happen after a process called entanglement occurs. Entanglement happens when particles interact. They can interact by collision or exchange of photons and they can end up with a shared pair of states [states can be energy levels, spins, vibrations, electron levels, etc.]. These entangled particles remain entangled after they separate regardless of the distance of separation. Then, an action that requires one of the particles to select a state, will cause the other particle to simultaneously select the pairing state, again, regardless of distance.

This means that different parts of the universe can simultaneously be responding to our actions here. The universe acts as a holographic whole, and not as a bunch of separate parts.

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.

Consciousness in the universe

Consciousness

So we see from quantum experiments, that conscious awareness shapes physical reality. We see at least two types of shaping of physical reality occurring. The decision or action of "looking" at something causes that object to select a state to be in. So our action causes a selection to occur. We also decide what information comes out of that selection process. It gives a physical state that corresponds to what we are looking for. If we look for energy, we find a certain energy level. We cannot predict which energy level will be found. But we know that we will find a set energy level. If we look for spin, we find spin, if we look for location, we find location, if we look for velocity, we find velocity. And often finding one of these properties, makes us lose information about another property.

Our decision to look at physical reality, causes the reality to select a physical state that corresponds to what we look for.

Physical reality is shaped by our actions. However, quantum physics does not go beyond this area. It does not describe in any way, how we decide to do anything. How our consciousness may work, or the extent of how we shape physical reality.

However, other areas of study may add to the understanding.

We find studies that show that prayer can contribute to another persons health, even if they do not know that they are being prayed for. So this is not the self mind-body effect or placebo effect. Since the person being prayed for was not aware of the study. So this prayer study shows mind at a distance action. Regardless of the source or mechanism of action. One person puts intention, thought, or attention on a subject or request, and a demonstratable effect can be produced on a distant subject. This shows that our attention and desires shapes physical reality. They cause some result to happen, and the outcome is in the direction of our desires.

We have shown in a couple ways that human awareness shapes physical reality. We see that how the reality is shaped depends on what we look for, and what we want to happen.

So, we have multiple, parallel realities that are shaped or at least selected by our thought and actions.

The Conscious Observer

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.

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 the Many Worlds interpretation, 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 of 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 to 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.

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 an self, other, inside, outside, I, you, us, them, energy, matter. The property of complementary 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. Complementary 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 require, 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 complimentary 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 or 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 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 so 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 that 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.

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.

Sense in the Extended Universe/Perception

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-existant even though we cannot verify its existance 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.

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.

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 hologram 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.

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.

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.

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.

Conscious Interaction/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.

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.

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.

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.

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.

Manifest Reality

There is something very real about the manifest reality, while there is also something very real about the unmanifest reality. We manifest this reality by our awareness of its existence. And through our choices and actions, shape this manifest reality.

However, our manifest reality does not preclude the possible existence of other parts of ourselves [other copies of ourselves, if you will] manifesting vastly different realities.

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. It two high parts of the waves overlap, an extra high area is produced. If two low parts of the waves overlap, then and extra low area results. If a high and low portion overlap, then and 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 form 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.

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.

Can we increase perception?

The Opening of a new sense

If we develop the ability to sense these expanded aspects of reality, it will be the opening of a new sense. It would be a bit of a holographic sense seeing all the supported associated realities. In the past animals have expended their sense of sight by going from seeing only in black and white, and then adding the color red, and then the other colors. And recently humans have expanded their analytical/cognitive sense. The cognitive sense developed slowly over generations. People in each generation were able to push their abilities a little further. Following generations learned that ability easier and then pushed ahead.

When animals started seeing the color red, it also probably occurred over generations. First some animals noticed that some things like wildfires and some flowers looked different, they stood out somehow, and were richer in detail. This became more obvious over generations, and other colors started standing out also.

We can expect a similar thing to happen if we open up to an ability to sense the expanded set of realities. Some people will experience more of the reality than others. When these people are in the minority, they could be expected to be designated as being sick. Unless, they learn how to use the new sense to some advantage. As more people start to sense additional things, more sense of this new information could be made. This will help others to move up to that level faster, priming it for someone else to move even further along.

Subtle Energy

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.

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.

Quantum Reality

What does it mean to live in a quantum universe, where we see/experience only a thin slice of the whole reality? We are in thin slice of three/four dimensions, with multitudes of parallel slices, each subtle different.

Sure, there are radically different realities. Those realities may be somewhat "distant", or maybe not, at the same time.

We will examine the realities that are close to us, and how we might interact with them.

So, do we really believe that the universal wave "collapses" innumerable times but only for certain "special" interactions that involve large scale interactions or interactions with conscious "observers"

What are these observers, and how do they shape reality.

Well, the observers are obviously just another aspect of this multiverse. The multiverse is observing itself.

So the multiverse, observing itself, collapses down to only a thin slice of its full self. The rest of the multiverse does not cease to exist. So the observer is only observing a slice of the whole. Maybe that is the purpose of the observer, to observe a part of the whole, but only a part.

Well, we are obviously some type of observer. We know the universe responds to us in a variety of ways. As observers in experiments, we see that the process of observing requires a selection to be made. The universe gives us the selection in ultimately an unpredictable fashion. However, at the same time, we do select the output of the selection in that we select the type of information that we look for. The universe gives us an answer based on what we look for, but always with a degree of uncertainty. That uncertainty is a sign of the crossing realities in the multiverse. There is always selections being made, which are always unpredictable, hence, the uncertainty.

If we look for position, we see position, but loose some information about momentum. We were holding onto position in the multiverse, so we flowed along a position answer.

If we look for energy, we see energy, but loose some information about time. So we flowed in the direction of an energy answer.

Also, when we see energy, the level of energy that we find, was not predictable before looking. So we decide what we see, but we cannot predict its value, and we loose information about a related property.

So when we make a experimental measurement, we line up with the multiverse that has that property defined. We land on one of the innumerable possible value, based on probability. The shift makes a related property less defined.

So the observer is seeing a physical world of matter particles. A world where the future is limited by the present. Where the future is limited by the inertia of time.

Time is the only factor that limits the future. Because from any "now", a path can be found to any other "now". But time states the only certain paths can be followed. But, wait a minute. We know that time is relative and unique for each and every observer. But we know already that the observer is only seeing a thin slice of the multiverse. And we see that time is the factor that is limited and limiting. We seem to have limited time and time is only allowed to move in limited directions.

So the universe collapses to manifest a reality, but all of reality is collapsing and manifesting its own version of reality. We are not manifest and the rest unmanifest. It is either all manifest, or all unmanifest. And these alternative views may need each other. All of the other possible realities exist. All are valid. The experience that we are having, or each one of us individually, is not the only manifest reality.

So all the nearby sections of this universe are real. And we flow from one "now" to another. There is a directional push from the inertial time. But we can obviously change directions within limits. And, we don't know what our limits are. How much shift in the direction in time is possible.

So, we live our lives. We have many experiences, some large, most are minor and are often overlooked.

With each experience, we are on the cross roads of many directions, many directions. Each experience is not the selection process of one event/choice. But the selection process of innumerable choices and directions. We are continually flowing from one to many existences. And we are flowing from many existences to a few or one. And we are flowing from many existences to many.

So each moment can be influenced by many intentions. Intentions the select many of the innumerable options. The intentions that flow us into a new now, a new place. But every action will be layered with multiple layers of intentions and other choice. Those intentions align us up with certain flows, and we flow in that direction until new directions are intended.

We are greater than the thin slice the observer observes. The observer now knows that the observer is only observing part of itself. The observer is part of a greater observation. It is a "greater" observation just because it contains more information.

The observer is always in intimate contact with its immediate past, future, and alternative actions (side time).

The greater observer includes connection with the past, future, and side times.

The measurement of matter and energy gives a result based on the probability of the wave function. When we experience a decision point, we have the apparent ability to choose, to create new experiences that cannot be predicted by any probabilities. At least not yet.

So in the quantum reality, there is innumerable parallel universes, that are splitting from our and remerging. So, when we have an experience, we don't have to experience a single experience, but it is possible that we could experience multiple actions, multiple experience. This would include multiple locations, multiples actions, multiple intentions, multiple histories, multiple outcomes. But there will be merging of outcomes. There will be twisting of paths, to follow each other, and interact with each other, even repel each other.

To experience this multiple experiencing, we would need to expand our sensing. Probably we would need to experience a new type of sensing. Each sensing gives us a limited information, possibly hiding other types of information in the process. A new sensing will give more information to use. It will by necessity also be a thin slice of reality. However, when we acquire a new sensing, it should feel like such an expansion of experience/reality.

At an expanded sensing level, we might experience ourselves doing multiple different actions and experiencing multiple different sense realities. Our choice of where and how to look, will influence the direction of flow through this reality.

What we see and experience is a result of the sense of the size of the "I", the observer. If the observer senses themselves as being in a three dimensional world, pushed along by time, then that is all they see. Other information, being lost in the process.

If the observer senses themselves of a being of 5 or more dimensions. Then they would experience multiple possibilities or multiple actions.

Can we become observers of the multiverse? We might look towards the masters, saints, sages, avatars, enlightened people to answer this question. We cannot just accept any prophets statements, because even if they see in more dimensions, we each have our own view of the multiverse. But these people may show tools to expand our sense/experience to include more of the multiverse. So we experience our own greater self.

The Experiments

Let's start with describing some of the fascinating experiments that lead us on our journey. Science is built on the concept of the validity of reproducible experiments. Well, some of these reproducible experiments produce some very unusual results which challenge our view of the universe.

Double Slit Experiments

An experiment has been conducted using a wall with two parallel slits and behind the slits is a second wall coated with a phosphor screen or photographic film as a detector. This experiment was designed to probe the particle-wave duality of nature. If light, photons, or a stream of electrons are projected at the slits, they will pass through one or the other of the slits and register on the phosphor screen or film. After a sufficient number of photons or electrons register on the detector an alternating series of light and dark bands appear on the detector. The light bands are the areas where the electrons or photons are concentrated in high density and the dark bands are where few electrons or photons impacted. The alternating light and dark bands form as a result of the wave nature of photons and electrons. As electrons or photons pass through both slits, they spread out from each slit in a circular pattern. Where the expanding circles of photons or electrons from each slit overlap, they interact such that where they are in phase, the wave strengthens and where the waves are out of phase they cancel each other out. This creates the light (in phase) regions and dark (out of phase) regions. This experiment provides a clear example of the wave nature of particles.

If one of the slits is covered over, you end up with a diffuse circular spot on the detector behind the open slit. This spot has no banding from wave interference. This experiment has been cited as an example of the particle nature of matter.

Actually, both parts of this experiment shows both the particle and wave characteristic of electrons and photons. Any single electron or photon forms a single, well defined, spot on the detector. This is the particle nature, electrons or photons will not produce a wave smear on the detector. They produce particle dots. However, as the particle dots build up in the two slit experiment, they form the alternating light and dark bands of waves. The diffuse circular spot formed using one slit is also in agreement with the wave nature of photons and electrons, there just is not source of interference in this example.

These results were not too surprising. However, as the experimental conditions were varied, some more unusual results appeared.

If the number of electrons or photons directed at the slits is slowed down until they are sent one at a time at the double slits, the wave pattern of alternating light and dark bands still forms on the detector. The electron still shows the wave characteristic. Now this is somewhat unexpected because if a single electron passes through one slit, there should be no other electron for it to interfere with. However, it appears that a single electron can be aware of a second slit at a distance from the slit it passes through. This is a strange result. It implies that the electron is passing through both slits simultaneously and then its own wave characteristic is interacting with itself on the far side of the slits.

The concept of an electron being in two positions at once is a little unsettling for us, so we played with the experimental set-up some more to explore this situation.

Now in the experiments above, we do not know which of the two slits any of the electrons pass through. If we rig a way of measuring which slit the electrons pass through, a strange things happens, the pattern on the detector changes. Instead, of alternating light and dark bands of wave interference, we get two diffuse spots behind each slit. These spots show not wave interference patterns from the two slits. So if we know what slit the electrons pass through we get what we call particle behavior. If we do not know what slit the electron passes through, then we get wave behavior. Alternatively, if we measure what slit the electron passes through then it behaves as thought it passed through that slit. If we do not measure the slit it passes through then it appears that the electron passes through both slits simultaneously. Our knowledge of which slit the electron passes through determines the pattern the electron forms on the detector.

A delayed choice version of this can be created in the lab, where after the quantum particle has potentially taken two paths. The choice can be made to detect it in a fashion which will show a particle effect from travelling only one path or interference effects from travelling two paths simultaneously. From these delayed choice experiments, it can appear that our action determined the past.

One of these experiments was conducted with a beam of laser light. The beam passes through a beam splitter and is sent on two separate paths. These separate paths are then rejoined and sent to a detector. The detector reveals an interference pattern in the rejoined light beam. An ultra-fast switch can be installed on either of the paths. When the switch is activated, the photons are directed off the path into a separate detector. The switch and detector combination can determine which path the photon is travelling. The switch can be activated after the photon has passed the beam splitter and potentially is in both paths. When we look for the photon, we find it in one path and it behaves as though it travels one path only by not forming an interference pattern. If we do not look for the photon, then it behaves as though it travels both paths. But our affect on the experiment is after the photon passes through the beam splitter. So we tend to say that we caused the photons to choice a path after it already did. (Actually, that is not quite correct, the photon choices both paths and travels both paths until we force it into one path.)

Polarized light

Another experiment works with the polarization property of light. The experiment takes left circularly polarized light and using a calcite crystal, separate the light into vertical and horizontal components. A second crystal can combine these components back into left circularly polarized light. Again, if we send single photons through this system, we get unexpected results. At the first crystal, the photon would get selected into either a vertical or horizontal polarized photon. The second crystal should not be able to produce a left circularly polarized photon from a vertical or horizontal photon, but it does. A detector can be used to confirm that the photon can be found taking only one path. However, blocking one path (as one does with a detector) prevents left circularly polarized light from forming at the second crystal and only vertical or horizontal light is emitted. The photon behaves as if it knows both channels are open. It appears that the photon travels both paths simultaneously even though we can detect it in only one path at a time.

The Aspect Experiment

A setup can be created using a cesium atom to emit linked pairs of photons. An excited state of cesium can be created that will emit a cascade of two photons. The total angular momentum of the two electrons must be zero based on the excited state used and the ground state the atom ends up in. However, because of the intermediate state the atom goes through, we know that the photons must be in opposite states of circular polarization.

Alain Aspect, et. al. conducted an experiment to measure the coincidence rates between photon pairs. In opposite directions from the source of cesium atoms were placed filters that would separate the photons in to horizontal or vertical polarization. These filters could be rotated to any angle relative to each other. The experiment measured the horizontal and vertical polarization of pairs of photons at different angles of rotation. The results were used to determine a coincidence probability at different angles of rotation. The results were in agreement with what quantum theory predicts. Since the photons are stateless until they are measured, measuring the state of the first photon acts to set the state of the second photon. However, at the time of measurement, the photons are separated by a great enough of distance, that any information transmitted by the first photon would have to travel at greater than the speed of light to reach the second photon prior to its measurement.

This is another example of a non-local quantum system. In this case the system consists of a photon pair. But regardless of the distance involved, the photon pair is a system, and measurement on part of the system affects the entire system regardless of the speed of light. 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 our measurement of the speed of light.

Symmetry/SuperSymmetry

The universe is a very symmetric place. We find symmetries in many places.

First, what is symmetry? There are different types of symmetries. We look at symmetries primarily on their effect on particles. For rotational symmetries, we label these symmetries by how many times a particle looks identical within a full 360 degree rotation. So a rotational 1, R(1), symmetry means that the particle only appears identical after one full rotation, at 360 decrees it appears the same as zero degrees. A rotational 2, R(2), symmetry means that the particle appears identical twice in a full rotation, so the particle at 180 degrees appears the same as 360 degrees and also zero degrees. A R(3) symmetry, the particle will appear the same at 120 degrees, 240 degrees, and 360 degrees or three times during a full rotation. A R(1/2) symmetry means that the particle is only half way to it's identical spot after a full rotation, so it will appear identical to zero degrees only when we rotate it two full turns to 720 degrees. This last one may sound strange but it is the spin symmetry of electrons. It represents a rotation in some type of internal space.

All particles have some type of spin symmetry associated with them. And we classify particles into two broad categories depending on whether they have an integer spin symmetry or half-integer spin symmetry. Integer spin particles are called bosons (Bose-Einstein particles). Half-integer spin particles are called fermions (Fermi-Dirac particles). Bosons are identified as forces or energy in this world and Fermions are identified as matter.

There is also the symmetry of reflection in a spatial plane, reflection in time, reflection of charge (electrical or otherwise), and many more. These reflections don't always produce an identical particle. In chemistry, when reflecting a compound in a spatial plane, if the reflection is identical to the particle, we have mirror symmetry but the result is boring. If the reflection is not identical, the reflection also represents a real compound. A compound that has largely very similar properties to the original compound (melting point, boiling point, etc), but also has some subtle but important differences. The differences can make the reflection of a biologically active molecule biologically inert.

So some symmetries are intrinsic properties of particles and other symmetries produce related particles.

There are four known forces in the universe; electromagnetic, weak, strong, and gravity. Each of these forces represents or is represented by a different symmetry operation. The electromagnetic force has a rotational one symmetry. The weak force has a rotational two symmetry. The strong force has a rotational 3 symmetry. And gravity has a unique symmetry called Lorentz symmetry. This is the symmetry of general relativity describing the shape of space-time, which is shaped by gravity.

The shape of the electron orbitals in atoms take the shape of spherical harmonics, which result from rotational symmetry, the electron must be in phase with itself around the atom. The Octet Rule from chemistry, results from rotational symmetry in a three-dimensional space. In a completely filled principal energy level in an atom, the electron distribution is spherical, the most symmetric configuration possible under rotations.

Every symmetry produces a corresponding conservation law. For rotation (spin) symmetry, we have conservation of spin. The interaction of matter and energy particles is limited in what combinations can occur in order to have conservation of spin. So the conservation laws associated with the symmetries tells us the allowed and disallowed interactions.

So symmetries are useful in describing properties of this universe and also in predicting new particles. For example looking at reflection in time has given us both conservation of energy and also anti-particles. This symmetry predicts that all particles have anti-particles. We have since found most of them. Anti-particles are particles that have most of the same properties of it's original particle except for an opposite electrical charge and it has the tendency to annihilate in a flash of energy in contact with it's opposite.

This practice of predicting particles has been taken to its full extent in super symmetry. Supersymmetry is derived from transformations between particles that require more than four dimensions. This extra-dimensional theory results in fermion-boson pairs of particles. Every classical fermion acquires a supersymmetric boson partner. The hypothetical supersymmetric bosons are given the name of the corresponding fermion, preceded by an 's'.

We haven't seen any of these predicted particles yet. This model has received some recent experimental evidence in it's support. The theory makes some predictions on the energy levels within the nucleus of atoms. An experimental technique was able to measure some of these energy levels. This supports Supersymmetry and the likelihood of additional dimensions. As many as 26 dimensions have been proposed.

It is almost that any symmetry that we look for, we find somewhere. It may be expected that as we develop the higher dimensional theories of string theory or m-theory, that we will continue to find additional symmetries.