Relationship between zero and infinity Theorem by Tolulope Mayomi.

Special thanks to my first physics teacher Mr Alalade for teaching me that physics is the study of matter in relation to energy.

Introduction:

- Talk about current problems in understanding relativity, quantum mechanics and how they work together in harmony

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- Talk about visualizing a 4d plane that encompasses time, mass and space.

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- In such a plane, talk about what is the fundamental aspect of motion(light) because it does not follow relativity.

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- Talk about relativity and how curves can be created as N approaches infinity.
- Talk about straight line motion as an approximation of this fact

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- Talk about quantum mechanics and introduce pilot waves

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- Talk about pilot waves and introduce the model for its behaviour

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- Talk about the model for pilot waves

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- Predictions on electrons and quantum entanglement

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Introduction

Two great theories of science exist. One describes motion on a grand scale and by grand, I mean celestial bodies and superfast speeds. Of course, this theory is relativity; special and general. Now special relativity gives us the correct framework on which to base space and time. That is special relativity introduces us to the concept of space-time, which is generally accepted today and rightly so. In the adoption of special relativity, Einstein deduces that space and time are both relative, hence this leads to one of the most important assumptions that will be used in laying the foundations for the rest of the discussion. That is, we know space and time exist as a continuum that is called space-time. The other aspect of relativity, general relativity, shows us that objects moving in space-time follow straight lines in an otherwise curved space-time, which is the foundation of our modern understanding of gravity.

The second great theory explains the world on a small scale. It is present in the orbits of atoms, molecules and even aims to explain the very nature of light. Of course, I am talking about quantum mechanics. Quantum mechanics is fascinating not only because it correctly predicts quantization, that is photons, energy, etc have discrete value, but it also makes bold predictions such as the fact that particles also behave as waves, known as duality. However, there is a small conflict that arises when we aim to unify both theories to create a little understanding of the way our world works. For example, Quantum mechanics predicts a world in which probability is highly prevalent at small scales and there is a wave function attached to particles, which essentially means that a particle could be here, there and anywhere. Or in other words, no one really understands Quantum mechanics, because it tries to create a picture of a probabilistic world and there is not a complete understanding of probability. Relativity on the other hand is deterministic.

The aim of this theorem is to see if we can unify both theories. And to do that, we might have to make certain assumptions that might not be immediately clear but with time can help us a great deal in understanding both theories further. Furthermore, we will try to modify one of these theories so that it can fit better into this agreement that we seek.

Space -Time (4D plane)

Einstein's observation in general relativity is that space-time is curved and this leads us to concepts such as geodesics, which will not be discussed in detail here, as well as introduce the concept that gravity is a result of curvatures in space-time geometry. That is gravity is a result of curved space-time. To get to this amazing conclusion, however, Einstein insists that all for all objects in space-time, both space and time are relative, but the speed of light is a constant. Thus, we can use photons as a kind of good indicator of events in space-time, which is 4 dimensional because space and time is now treated as a single continuum. Therefore, relativity explains that in the presence and we should emphasize 'presence' here for detail of mass, spacetime gets curved. And as we explained, we shall continue along this line, so let us assume that spacetime is indeed flat, and when it meets mass, it becomes curved. Therefore, our general understanding of matter as being anything that has weight and occupies space should be modified to mean anything that has curves space-time. Using this definition, let us create for simplicity a spacetime model using Euclidean geometry where mass is assumed to simply be an imaginary number, space an integer and time any real number X. Such a space would resemble a typical Euclidean space but with a complex plane inside of it. Now the implication of the numbers in the imaginary plane is that they curve real numbers inside their own dimension. So, we assume that motion in spacetime in our plane is best described using a complex number, that is a real number but with some curve to it.

Observation: Any object moving in space-time is moving in a straight line but in a straight line in a curved space-time. But why?

REFERNCE POINT

Newton in his explanation of gravity tries to create a reference point, however it seems that in relativity reference points do not exist. Also, a slight digresses, there is an insistence on explaining things as occurring in Euclidean geometry. This might seem simplistic but bear with me. In relativity, there is no reference point, but we can take comfort in the fact that the speed of light is a constant for all observers in Einstein's relativity, so let us assume that in our 4d Euclidean space where masses and space motion are best described using complex numbers in polar form, which means that there is a straight line magnitude and a curve that describes motion. Therefore, in our 4d space, objects can move in straight lines but in curved directions(polar). Also, we will introduce an absolute reference point to this plane.

The reference point in this plane is not the speed of light, but rather the nature of light's motion, that is in this plane, all wave-like motion is a reference. Using this rule, let us create a basic wave-like motion that will serve as a reference point for all objects to follow in this plane.

$$e^{ix} = \cos x + i \sin x$$

$$\left(e^{ix}\right)^n = e^{inx}.$$

$$e^{inx} = \cos nx + i \sin nx.$$

$$(\cos x + i \sin x)^n = \cos nx + i \sin nx.$$

where i=mass, n=space and x=time

Essentially what we are saying is that the wave-like motion is more fundamental than space-time because space-time is not a reference but the wave-like motion described above is. And in our 4d plane, this wave like motion will be used as our reference. Therefore, all particles great or small in our plane follow this type of motion in our 4d plane no matter how long it takes. However, because of relativity, the size, shape, energy, etc of particles all determine the way they follow this motion. For example, celestial objects move in elipses, which is just the limit of this type of motion at extremely large sizes. Also, gravity or the tendency of objects to fall back down is a relativistic effect of this type of motion depending on the speed of the object and other factors. The proof for this is presented below and some reasoning behind this is in the appendix

$$e^{ix} = \cos x + i \sin x$$

When $\pi = nx$, then

$$e^{i\pi} = e^{inx}$$

Observation: Basically, what we are saying is that there is a fundamental type of motion in space-time, and because of relativity larger objects can move in all manner of ways, but they still must follow this fundamental type of motion; which means that they must curve space-time to do so.

Quantum Realm

Okay, now that we have established a reference for the behaviour of matter on large scales in our complex plane, it is time to look down into the quantum scale, which is still another part of our original complex plane (4d scale). Today, the governing idea surrounding the quantum scale is quantum mechanics. Quantum mechanics is interesting today and there are three broad phenomena that we need to examine if we are to consider the quantum realm. Using the general understanding of quantum mechanics, they are:

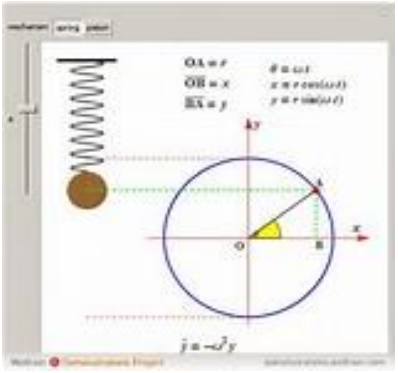
1. Quantization, or the fact that energy, momentum and other quantities have discrete values.
2. Objects have characteristics of both particles and waves (wave-particle duality)
3. There are limits to the precision with which quantities can be known.

Although the last one strikes me as odd because photons which pass the first two tests do not seem to follow the uncertainty principle. That is, we can tell the position of a photon and its speed at the same time, but I digress. The reason we are considering all three axioms for the quantum realm is that we are trying to connect the dots between them and relativity, hence we need to modify quantum mechanics a little bit, without of course kicking down any of the principles listed above. To do this, we introduce Pilot-wave theory, or better yet, De-Broglie-Bohm theory. This theory is very similar to quantum mechanics and in this theory, the positions and momenta of the particles are considered to be hidden variables and a collection of particles has an associated matter wave which evolves according to Schrodinger's equation. Why is the Pilot- wave theory important?

Pilot-Wave Theory

Before we consider the importance of pilot-wave theory, let us create a simple model that we can use to analyse pilot-waves. Fortunately for us, pilot-wave theory seems to be approximated to a very good degree in fluid-dynamical systems. For example, if you consider Pilot-wave Hydrodynamics by John W.M Bush, you will see that a millimetric droplet sustained on the surface of a vibrating fluid bath may self- propel through a resonant interaction with its own wave field. However, for purposes of simplification, we will use an even simpler model for pilot-wave theory, Simple Harmonic motion, henceforth abbreviated as SHM.

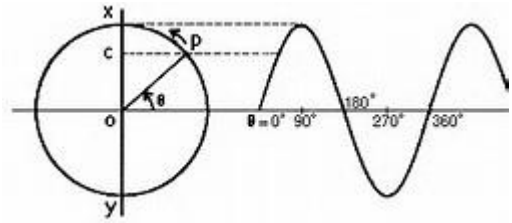
Simple Harmonic motion(SHM) is a periodic motion or oscillation where the restoring force is directly proportional to the displacement and acts in the direction opposite to that of the displacement. In reality, Simple harmonic motion can be modelled as some mass(m) attached to a massless spring. Recall that earlier on, in our discussion of gravity, we mentioned that the only pure reference was a wave-like motion. Well if we assume that pilot-waves act as the true basis for the fundamental reference frame for the movement of space-time, then we can model our massless springs as such pilot-waves. Our particle, electron, neutron, proton, etc, then becomes our known mass. Okay, so this is all fair and good, but the real implication of this model is highlighted when you throw in a flat space-time. So, in order to create a complete model, let us add a flat space-time to our picture. It will look something like this:



Using this complete model, we can now make predictions on light fundamentally as well as Quantum entanglement and dark matter. But first let us create our model and dive into light and electromagnetic waves.

Model for Pilot-Waves

In the paper on Pilot wave hydrodynamics, John W.M Bush describes Terwagne et as having developed a relatively simple mass-spring-dashpot model to represent a millimetric drop bouncing on a bath as part of pilot-wave hydrodynamics. We can take this model and further simplify; that is using Simple Harmonic motion. Actually, quantum particles in nature do follow Simple Harmonic Motion so that gives us further confidence to build our model based on this. The model will look like this:



Mathematically, the restoring force F in such a model is given by the equation below:

$$\mathbf{F} = -k\mathbf{x},$$

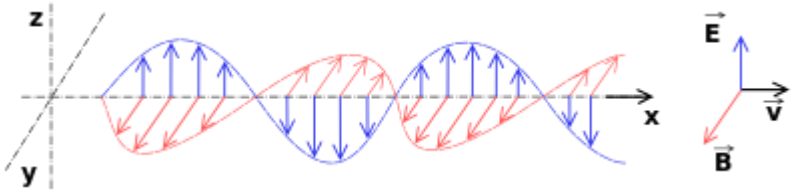
K in this sense serves as a quantized value that controls the level of proportionality. For our model, we will assume that K only takes up 8 distinct values. Also, simple harmonic motion follows a sinusoidal function below:

$$x(t) = x_0 \cos(\omega t) + \frac{v_0}{\omega} \sin(\omega t)$$

Hence, we can say that the fundamental type of motion that we described earlier is still present and because of the mass, speed or other relativistic effects, they actually have to follow this motion without any relativistic attributes unlike larger objects, because time is different at their scale, so they do not have to bend space-time.

But all matter interacts with space-time distinctly; in fact, we can define matter as anything that follows the fundamental type of motion and in so doing interacting with space-time in interesting ways. Even small particles do interact with space-time and even if they do not bend space-time such as large bodies to follow the fundamental motion, they oscillate space-time and interact with space-time such that it follows their type of motion distinctly. Also, they cause pilot-waves to vibrate fundamentally with space-time and in this interaction, E.M waves are created.

Imagine, as the mass is creating a wave like motion on space time, pilot-waves are also doing the same. In that scenario, space-time would look like this:



Now as the particle causes space-time to move up and down, it also resonates with pilot-waves and both pilot-wave motion and space-time motion when seen together can be viewed aa light or electro-magnetic waves. These waves are quantized because K has 8 discrete values, that we know of; hence pilot-waves and space time together can be seen as light.

Another interesting assumption we can make is if we assume that pilot-waves are independent of space-time; that would mean that they preserve cause and effect perfectly and there is no difference from the point of view of pilot-waves between a cause and an effect, both occur simultaneously. Also, pilot-waves can be assumed to be one entire body that spans the entire universe. Using these assumptions, we will see that electrons are simply the result of pilot-waves and space-time and positive and negative charges refer to points in time

Electrons and Quantum Entanglement

Let us assume that pilot-waves are indeed one giant body spanning the entire universe and that it is not affected by space and time. **An implication of this would be that for pilot-waves, causes and effects are always preserved, and this means that if pilot-waves meet an effect, they must create a cause; and in a certain way pilot-waves are programmed to force a cause.**

So, if pilot-waves that preserve cause and effect meet a photon, what do they do? They know that part of the cause of that photon is a particle interacting with itself, so whenever they see a photon, if part of the pilot-wave is resonating at the same frequency it was when the photon was created, it automatically creates a particle. Now, this particle created is an electron.

Now another interesting thing about pilot-waves is that if two particles are vibrating in the same way or manner, because a pilot-wave preserves their cause and effect and because they are exactly the same body, that is because pilot-waves are the same throughout the universe, it will not be able to tell the difference between the two particles. That is the pilot-waves would entangle both particles, but because one of those causes must have occurred first, the pilot-wave will cause one to have a unique value, sort of like how protons are positive because they occurred first; the one particle might spin clockwise while the other particle might spin counter-clockwise. And because pilot-waves are independent of space-time and because it is one body throughout the universe, the pilot waves will interact with the particle faster than the speed of light.

DARK MATTER

We have seen that pilot-waves preserve cause and effect and that they are a single-body in the universe existing outside space-time. So, what happens when a gravitational wave caused by a large body moving in space interacts with the pilot-wave.

Well, pilot-waves must obey cause and effect, hence if they interact with gravitational waves caused by mass, they must create mass, which we refer to as dark matter. This dark matter just as electrons are fundamentally linked to electromagnetism because that is how they are created; dark matter is linked to gravity.

So why do pilot waves exist? I offer one prediction

It seems that in the complex plane, there is mass, space and time, but there is also an in-balance between the three. Pilot-waves help account for gravity, light, electrons, dark-matter, etc, but it seems that what they are actually doing is to create a balance between all the interactions of mass, space and time with a little help from relativity.

I conclude with this, pilot-waves are programmed to force a cause and an effect relationship in the universe? Why? I am not sure, but it is more probable that they do. We can only get the answer to that question I believe from the maker of pilot-waves.

FOOTNOTES

- **We assumed 4D Euclidean geometry to present the present the reference frame behaviour. However, objects depending on their size do not exist in Euclidean space, that is the bigger an object, the higher it's dimensions and hence, it deviates from living in Euclidean space.**
- **Therefore, the fundamental motion described earlier based on De-Movrie's Formula apply only to pilot-waves or rather an approximation of pilot-waves in Euclidean space.**
- **In higher dimensions, non- Euclidean geometry takes hold, and this means that the type of motion in Euclidean geometry is completely different from Non-Euclidean geometry.**
- **That is why relativity matters, because it does not use Euclidean geometry for celestial objects and even normal sized objects.**
- **So, the wave like motion expressed in Euclidean geometry is the elliptical motion and falling motion in Non-Euclidean geometry which we ascribe to gravity.**

CITATIONS

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