On the Fractal Nature of the Universe

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Introduction

The Universe is currently thought to be governed by four fundamental forces: Gravity, electromagnetism, strong nuclear, and weak nuclear. These forces are currently described using two incompatible theories: Quantum Mechanics, which describes the electromagnetic, strong, and weak forces, and General Relativity, which describes gravity. These theories are incompatible due to the fact that the model of gravity from General Relativity falls apart on the sub-atomic scales which Quantum Mechanics describes. This paper describes a mechanism for a repulsive force which is based on the Doppler effect of Special Relativity in which geodesics of Space-time have wavelike properties. Aside from the fundamental forces, the second law of Thermodynamics, expansion of the Universe, dark matter, and the results of the double slit experiment from quantum mechanics are examined in the context of this repulsive force. Furthermore, the Newtonian law of universal gravitation is shown to follow from the theory for near-earth low speed conditions, and the nature of the magnetic field is shown to be the result of the ordered motion of high-speed bodies (with no requirement for a separate electric charge property). The orbital structure of the atom is discussed and explained using this new model. Finally, the Universe is shown to have a fractal nature as a result of this model.

A Brief Discussion of Time

To begin, we must first examine the nature of 'Time'. In physics, a system is often described in terms of positions in space and how those positions change over time. But the idea of both position and time are, in reality, only tools we've (consciously and unconsciously) created to analyze the world. We create position by choosing one object as the center (ourselves perhaps), and then assign positions to other objects based on their distances and directions relative to us. The distances between objects in the Universe are constantly changing as a result of the forces acting on them (they are changing relative to *each other*). So we observe the 'positions' of objects constantly changing. We then create time by comparing the change in the position of one object to the change of position in other objects. This is how we use clocks. For example, we can calculate the change of something with respect to 'time' by saying that a pendulum swings back and forth over one unit of time (the swinging is a succession of changes in distance), and then measure the changes in the positions of other objects relative to that change. That's how we calculate speeds and accelerations. Therefore, it is postulated that the idea of time as a fundamental property of the Universe has been misinterpreted, and as will be shown in the following section, the time dimension in the Space-time of Special Relativity is in fact a spatial 'sub-dimension' of 3-dimensional space.

Special Relativity and the Relativistic Doppler Effect

The theory of Special Relativity models the Universe as a flexible 4-dimensional 'Space-time' whose dimensions stretch and compress in order to make the speed of light constant regardless of the speed of the source. There are two consequences of Special Relativity which drastically altered our picture of the Universe which was previously described by Newtonian mechanics:

1. The length of an object travelling relative to a stationary observer will appear to shrink in the direction of motion (from the perspective of the stationary observer). This is known as 'Length Contraction'
2. The time dimension of an object travelling relative to a stationary observer will stretch relative to the stationary observer. This is known as 'Time Dilation'.

These phenomena follow directly as a result of the constancy of the speed of light. Let's first examine length contraction. This effect is often described as an observer looking at a fast moving object and seeing that the object shrinks to a 'pancake' as it approaches light speed. This effect is not an optical illusion; it is an actual compression of space according to Special Relativity. But a more interesting example is a spaceship moving near the speed of light relative to the surrounding galaxies. In this case, an observer on the space ship would see the *entire Universe* compress itself in the direction of the travelling spaceship. Again, this is a real contraction. In theory then, a spaceship moving close enough to the speed of light could contract the Universe to a length smaller than itself. This seems unreasonable, but given the current interpretation of Special Relativity, that is the implication.

As was discussed in the previous section, time is simply a tool used measure changes in one system by comparing them to changes in another. But the time dimension in Space-time seems to be much more concrete and tied to space itself. The effect of time dilation as currently interpreted in Special Relativity is that time 'slows' for someone moving relative to a stationary observer. This leads to effects like the relativity of simultaneity which implies that two events which occur simultaneously as observed by one person may not be observed to occur simultaneously by another observer. Therefore, there is no universal 'present' and something that happens in one person's future may occur in another person's past. This is an astonishing, though well-known implication.

As a result of the non-intuitive consequences of the current interpretations of length contraction and time dilation, we will now construct a new model from Special Relativity which is more intuitive and free from the apparent paradoxes mentioned above. Let's start with one consequence of Special Relativity which has been confirmed by experiment: The relativistic Doppler effect. According to Special Relativity, the wavelength of an emitted photon (wave of light) is decreased when a source and receiver approach each other at a certain speed. This is depicted in Figure 1 below.

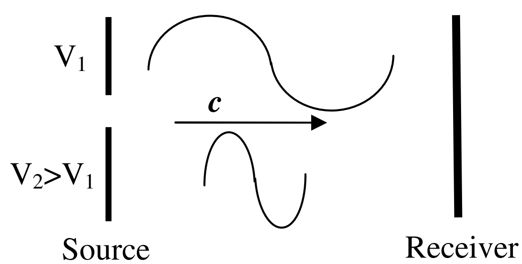

Figure 1 – Wavelength Contraction

It is well known that light from a source measured at a receiver is 'blueshifted' (the wavelength decreases) when the source approaches the receiver. The magnitude of the wavelength change is a function of the velocity of the source. We can therefore propose that the equation for length contraction is actually describing the change in the *arc length* of one wavelength of the wave, while the equation for time dilation is describing the change in the *frequency* of the wave (if the waves propagate at constant velocity *c*, the frequency of the wave is inversely proportional to the wavelength of the wave). But if the length contraction and time dilation just represent dimensions of the light wave, what exactly is being held constant in the transformations of Special Relativity? Consider the relativistic Doppler effect depicted in Figure 2 below.

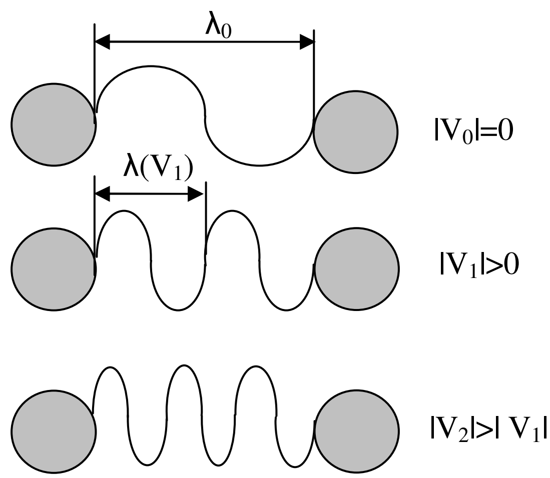

Figure 2 – The Relativistic Doppler Effect

Imagine a tiny particle that travels along the arc length of the waves shown in Figure 2. When the relative velocity of the two objects is zero, the tiny particle travels along the wave at the speed of light, *c*. As the relative velocity increases, the particle travels the wave with a speed of *c-V* (we subtract the velocity here because when two bodies are approaching, their relative velocity *V* is negative). So an increase in the relative velocity gives the particle additional velocity, but it also increases the distance it must travel according to the relativistic Doppler effect. So what Special Relativity guarantees is that regardless of the relative velocity of the bodies, the total arc length divided by the total velocity is constant (i.e. the 'tiny particle' emitted from the left body will arrive at the right body at the same instant in all 3 cases shown in Figure 2. This can be easily demonstrated using the equations for the relativistic Doppler effect and length contraction.

$$\lambda(V) = \lambda_0 \sqrt{\frac{1+V}{1-V}} \Rightarrow \frac{\lambda_0}{\lambda(V)} = \sqrt{\frac{1-V}{1+V}} \tag{1}$$

$$L = L_0 \sqrt{1-V^2} \tag{2}$$

In the above equations, λ_0 is the wavelength of the wave with zero relative velocity (top of Figure 2) and L_0 is the arc length of that wave. λ(V) is the wavelength of the wave when there is a relative velocity between the bodies (middle of Figure 2), and L is the arc length of *one wavelength* of the compressed wave. In the second part of equation 1, we see the ratio of the original wavelength to the compressed wavelength as a function of velocity (this is the equation for the relativistic Doppler effect). So that equation tells us how many arc lengths of the compressed wavelength are required to reach from the left body to the right body. Therefore, the total arc length of the compressed wave between the bodies is given by:

$$L_{tot} = L_0 \sqrt{\frac{(1-V^2)(1-V)}{1+V}} \tag{3}$$

So the tiny particle will arrive at the same instant for all cases as discussed above if the following relationship is true (note that V will vary between -1 and 1 where V is negative when the bodies are approaching and positive when they move apart):

$$\frac{L_0 \sqrt{\frac{(1-V^2)(1-V)}{1+V}}}{c-V} = \frac{L_0}{c} \tag{4}$$

If we set c=1 and rearrange the equation, we get:

$$\sqrt{\frac{(1-V^2)}{(1+V)(1-V)}} = 1 \Rightarrow \sqrt{\frac{(1-V^2)}{(1-V^2)}} = 1 \Rightarrow 1 = 1 \quad (5)$$

Therefore, the relationship holds, confirming our interpretation of the mathematics of special relativity (that length contraction refers to the change in the arc length of one wavelength of the wave and the time dilation gives the information regarding the wavelength change). The apparent 'slowing of time' due to the time dilation can be understood by looking at Figure 3 below.

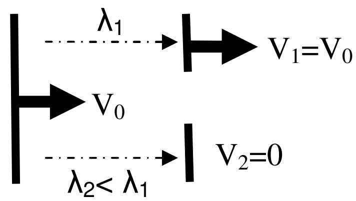

Figure 3 – Apparent 'Slowing of Time' in Special Relativity

In Figure 3 there is a source moving at speed V_0. This source is emitting photons with wavelength λ_1. This will be our 'clock'. There are also two receivers. The top receiver is moving at the same speed as the clock and will therefore measure the photons as having wavelength λ_1 (the top receiver and clock are 'at rest' with each other). The bottom receiver is not moving and therefore there is a relative velocity between the clock and the receiver (the clock is approaching the bottom receiver). The photons measured by the bottom receiver will therefore have a shorter wavelength according to the Doppler effect discussed above ($\lambda_2 < \lambda_1$). So over a specified period, the clock will appear to tick at a rate inversely proportional to λ_1 for the top receiver and λ_2 for the bottom receiver (each 'tick' corresponds to a peak of the wave hitting the receiver). Since $\lambda_2 < \lambda_1$, the bottom receiver will record more 'ticks' than the top receiver over the same period. Thus, it appears that the top receiver's clock is running slower than the bottom receiver's clock. But note that there is no actual change in some fourth ‘time dimension’. The apparent slowing of time has nothing to do with the physical evolution of either receiver; it is merely the consequence of using light waves, which are subject to the relativistic Doppler effect, as clocks. Therefore, it has been shown that the equations of Special Relativity do not describe the distortion of physical distances between bodies or the stretching of some fourth ‘time dimension’, but rather they describe how the light wave itself changes as a function of relative velocities.

The relativistic Doppler shift also tells us something else about two particles moving relative to each other. The energy of a photon is given by Planck’s law:

$$E = \frac{h}{\lambda} \tag{6}$$

Where h is Planck’s constant. So the Doppler shift indicates that there is a change in the energy of the photon. And since the energy of the system must be conserved, this change in energy of the photon must be accompanied by a change in the kinetic energy of the system (assuming the masses remain constant). Therefore, as two objects approach each other, the wavelength of the photon decreases (giving it greater energy), which means that the kinetic energy of the system must decrease. So as the particles move together, they are slowing down. Likewise, as the particles move apart, they must be speeding up. So it appears that the relativistic Doppler effect is describing a force which is a function of velocity which tends to push particles apart.

Suppose we define mass as a vibrating point of space. This vibration will cause waves in the fabric of space which spread out in all directions in 3-dimensions. The wavelength of this wave between any two points is a function the bodies' relative velocity according to the Doppler effect described above. In the top of Figure 2, we see two bodies at rest relative to each other separated by a distance equal to one wavelength of the geodesic wave. This 'rest frame' wavelength is equal to λ_0, which we will assume is a universal constant which we will set equal to 1. As bodies approach each other, this wavelength is compressed according to the Doppler effect.

Our new interpretation of Special Relativity thus far does not seem to limit the speeds of particles (it has been observed that no particle can move faster than the speed of light). In the following section, we will derive a force from the Doppler equation which will be shown to limit the speeds of moving bodies.

The Universal Force

According to Planck's law, the amount of energy of a photon is inversely proportional to its wavelength. The wavelength of the rest frame geodesic is λ_0 and because the wave spreads out in three dimensions from the source, the energy at a given distance from the source is reduced proportional to the inverse square of the distance. Also, equation 6 gives the energy for one wavelength, but the distance between any two bodies is some multiple of the wavelength (s/λ_0), so the energy between the bodies is scaled by that factor. Therefore, the total energy between two bodies moving with a relative velocity is equal to:

:

$$E = h\frac{s}{\lambda_0}\cdot\frac{1}{s^2}\cdot\frac{1}{\lambda_0}\sqrt{\frac{1-V}{1+V}} = \frac{h}{s}\sqrt{\frac{1-V}{1+V}} \qquad (7)$$

Note we've set λ_0=1. We can generate an expression for the force between two points in space by taking the derivative of the energy function above with respect to distance, noting that the energy decreases as the distance increases:

$$F = -\frac{\partial E}{\partial s} = h\left[\frac{1}{s^2}\sqrt{\frac{1-V}{1+V}} + \frac{1}{s}\frac{1}{\sqrt{(1-V)(1+V)^3}}\frac{\partial V}{\partial s}\right] \qquad (8)$$

Note that h is a universal constant and can be set to 1. So as one point in space moves toward another, it 'bunches up' the space between them, increasing the potential energy. But what about photons, which so far we have said travel along the geodesics? *There are no photons which travel along the geodesics*. The electromagnetic radiation is the geodesic wave. This is not a new concept, except that rather than there being an electromagnetic field *within* space, it turns out that they are the same thing. The photoelectric effect tells us that in order to knock an electron out of an atom, you require a specific maximum wavelength photon (bombarding the electron with many longer wavelength photons would not expel it from the atom). This makes sense without a need for a discretized photon because as the wavelength decreases, the force on the electron increases. Therefore, the minimum force needed to remove an electron will occur at a specific wavelength.

Figures 4 and 5 below show how this repulsive force (which we will call the 'Universal Force') varies with distance (at constant velocity) and velocity (at a specific position with no acceleration).

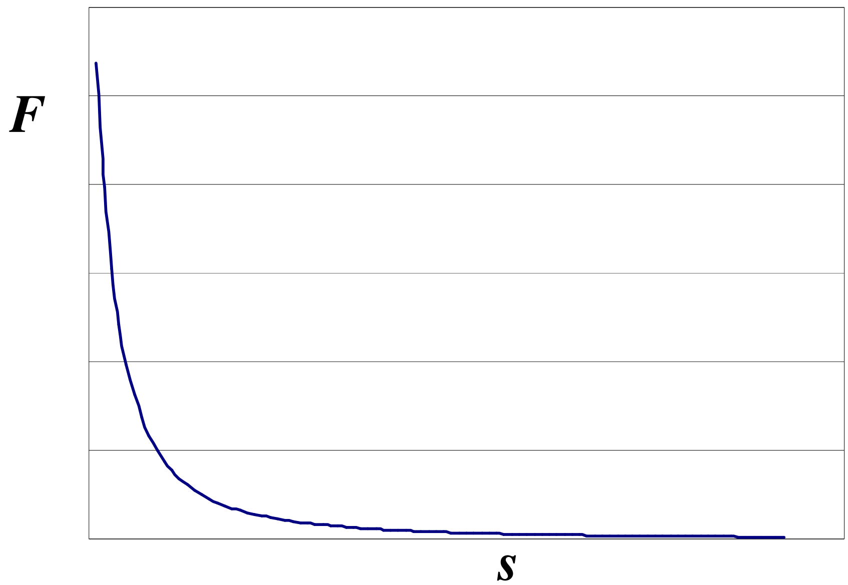

Figure 4 – Universal Force vs. Separation Distance

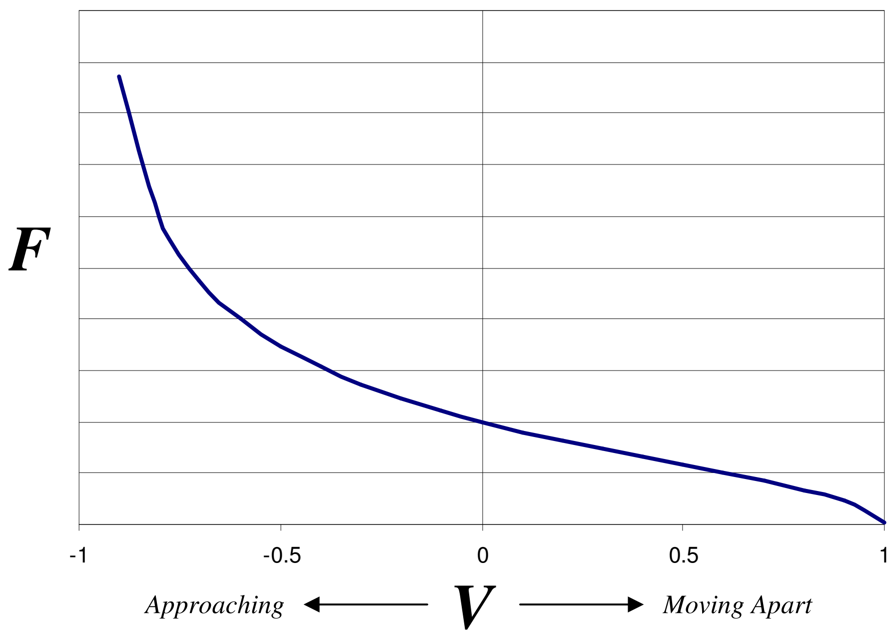

Figure 5 –Universal Force vs. Velocity

Thus, no point of space can approach the speed of light in the observable Universe because no matter what direction you move in, you will be approaching something else, and as the approach speed increases, the force (which acts opposite to the direction of approach) goes to infinity. The force described so far has been between two points in space, but the objects we perceive are made up of multiple points of space. If we assume that each point in one body interacts with every point in the other body, we can say that the total force between two bodies is scaled by the product of the points which make up each body. We will call the 'number of points' in a body the mass 'M' of the body.

$$F = M_1 M_2 \left[\frac{1}{s^2}\sqrt{\frac{1-V}{1+V}} + \frac{1}{s}\frac{1}{\sqrt{(1-V)(1+V)^3}}\frac{\partial V}{\partial s} \right] \tag{9}$$

Note that this is a slight over-approximation of the force since some of the points in one body will not have a clear 'line of sight' to every point in the other body. However, we know that the atom, for instance, is almost completely empty space, and therefore we can logically assume that the vast majority of the points in both bodies will have a direct line of sight to the points in the other body.

In the next section, we will examine how this repulsive force can still explain gravitational attraction, and even the electric charge and the strong and weak forces in the atom.

Newton's Apple, Einstein's Singularity, Coulomb's Charge, and Rutherford's Nucleus

If the only force in the Universe is repulsive, why did Isaac Newton observe the apple fall toward the earth? Looking at the apple and earth in isolation will not explain this observation. In order to explain it, we need to consider the effects from the entire Universe. The cosmological principle states that on a large scale, the Universe looks the same for all observers. Let's apply this principle and imagine the earth is in deep space in a Universe (depicted in 2D) which is homogenous and isotropic:

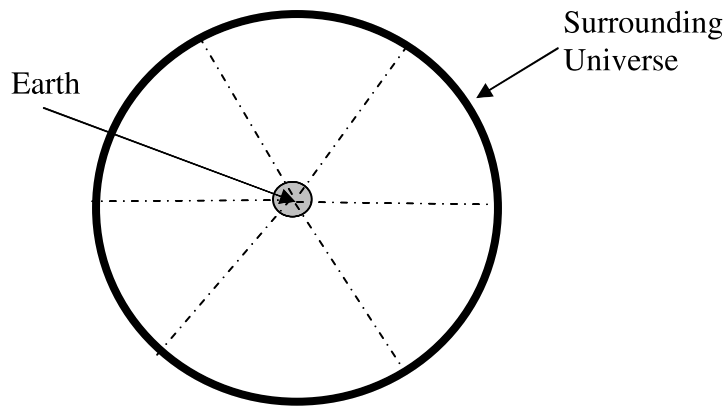

Figure 6 – Earth in Equilibrium

If the cosmological principle applies, the repulsive force (dashed lines) from the matter in the surrounding Universe will act equally on the earth in all directions and the net force on it would be 0 (so the earth wouldn't move). Now let's add an apple to the picture:

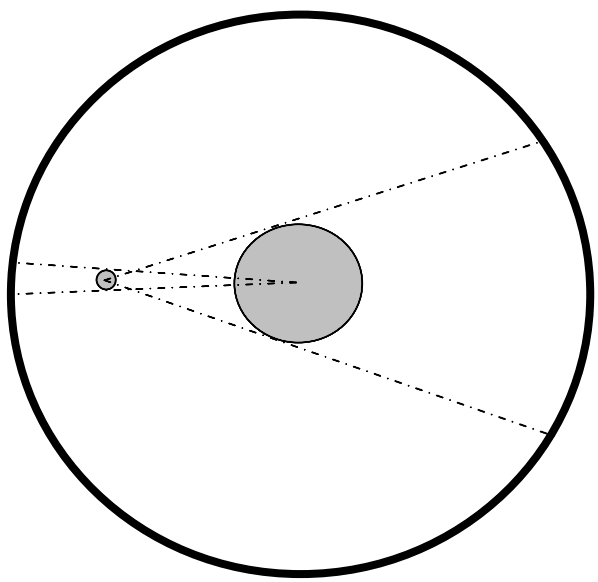

Figure 7 – Earth and Apple

Now that the apple is near the earth, how have the forces changed? The amount of repulsion from a line of force is proportional to the total mass and separation distance of the bodies according to the equation for the Universal Force. The surrounding Universe is at a much greater distance to the apple and the earth than the apple and earth are to each other, but it is also much more massive. If the large mass of the surrounding Universe more than compensates for its distance to the earth and apple, a line of force coming from the outside Universe would be stronger than a line of force between the earth and apple. So the earth is blocking some of the lines of force between the apple and Universe (the apple does the same to the earth, but because of its smaller size, it blocks fewer lines between the earth and Universe). Note that, as discussed in the previous section, the matter we see is mostly empty space, and the earth and apple are not completely 'opaque'. Therefore, on a sub-atomic scale, they are somewhat transparent and so the number of lines of force they block is a function of their masses and densities.

When one body blocks a line of force between the other body and the Universe, it is replaced by a line of force proportional to their masses and separation distance, resulting in a lower force (recall that we are assuming the mass of the surrounding Universe compensates for its large distance). They are, in effect, casting 'shadows' on one another. Therefore, for the case shown in Figure 7, there is a net force on the apple toward the earth and a net force on the earth toward the apple. However, the shadow of the earth on the apple is significantly greater than the shadow of the apple on the earth, so the net force on the apple will be greater than the net force on the earth. Therefore, both the earth and apple will move toward each other, but the apple will move much more than the earth. This is why the apple accelerated toward the earth. As the bodies get closer together, the net force between them (which is attractive) increases, but if they separate far enough, the effect of the shadows becomes negligible (To overcome this net attractive force, the apple needs to get far enough away from the earth so that the earth recedes into the surrounding universe (dark circle), at which point the apple enters the state depicted in Figure 6). When the apple falls to the earth, it stops at the surface because the apple and earth are made of atoms, and the electrons surrounding those atoms repel each other until equilibrium is reached (we'll look at that shortly). We can see how this model would reduce to Newtonian gravity for the case of the apple falling to earth. In this case, there is a net force from the Universe on the apple toward the earth and a force from the earth pushing the apple away from it. Since the apple is moving at low speed (relative to light), we get the following expression for the force on the apple:

$$F = \frac{M_u M_a}{s_u^2} - \frac{M_e M_a}{r^2} = \frac{M_e M_a}{r^2}\left[\frac{r^2 M_u}{M_e s_u^2} - 1\right] \tag{10}$$

Note that due to the shadowing effect, the effective mass of the Universe, M_u will vary proportionally with the mass of the earth (or sun if the law is being applied to the solar system) because every time you add a 'point' to the body, it will block a line of force from the Universe. It will also vary inversely to the square of the distance *r* (approximately). Thus the bracketed term will appear constant if you apply the law to the earth or the solar system. Newton called this bracketed term the 'Gravitational Constant', *G*. Note that the force appears attractive (the positive direction in the above equation is toward the earth) as long as the quantity in the bracket is greater than 0 (i.e. $r^2M_u>s^2M_e$).

Modeling gravity as an attractive force (models from Newton & Einstein) leads to a problem. In General Relativity (the current theory of gravity), we find that if enough mass is concentrated densely enough in space, the equations generate infinities which are called singularities. When you model gravity as an attractive force, it allows for an object to pull mass into it and get heavier, giving it a greater force to pull more mass in, and so on, until it squeezes itself into an infinitely small space. This is called a singularity. To resolve this problem let's look a scenario with two bodies having identical masses and densities.

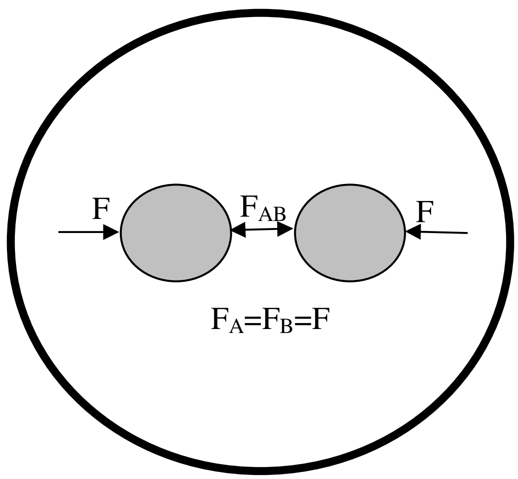

Figure 8 – Particle Equilibrium

In Figure 8, the forces acting on the bodies from the universe are always equal and opposite (they cast the same size shadows on each other). There exists a force F_{AB} between the particles at which an equilibrium is reached and the particles will not move relative to each other. This force is simply the average of the external forces:

$$F_{AB} = \frac{F_A + F_B}{2} \tag{11}$$

The singularity can never happen with this model because as the particles approach one another, even if they pass the equilibrium distance, the repulsive force increases exponentially, preventing the collapse seen in General Relativity.

The arguments given above to explain the gravitational force also explain the apparent charges of the electron and the proton. The proton is much larger than the electron, and it is also more massive. The result of this is the same as the apple and the earth, the electron will be pushed towards the proton (unlike charges attract). And the like charges repelling would correspond to the case shown in Figure 8. If every electron has the same size and mass, they will always repel each other if they try to pass the equilibrium distance. The same logic applies to the repulsive force between two protons. The strong nuclear force is in fact the force between protons when they are at the equilibrium point. So if a neutron is fired into the nucleus and is able to disrupt the equilibrium position of the protons, the force may become repulsive, splitting the nucleus (fission). Also, as the size of an atom increases, its equilibrium may be more vulnerable to disruption from stray particles in the universe, making it appear to decay spontaneously. In a later section, we will discuss the structure of the atom (i.e. electron orbitals).

General Relativity and the Distortion of Space by Mass

General Relativity describes the distortion of Space-time geodesics due to the presence of mass. Looking at the equation for the Universal Force, we see that the masses of the bodies scale the force. Since the force is modeled as a wave, we can model this scaling factor as a modulation of the amplitude of the wave. Equation 9 suggests that the amplitude of the entire wave is proportional to the product of the masses and inversely proportional to distance. Figure 9 below shows 3 bodies whose diameter is representative of their mass.

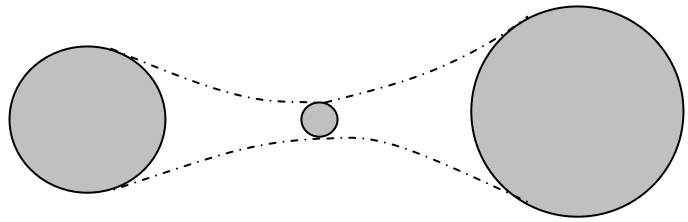

Figure 9 – Geodesic Wave Amplitude Modulation

The dashed lines represent the envelope of the geodesic wave between the bodies. This resembles the distorted Space-time described by General Relativity. The amplitude is maximized at the masses and varies with the inverse square of the distance. This geodesic distortion will also cause deflections in the geodesics perpendicular to the page near a massive body in the same way that is predicted in General Relativity (i.e. the observation that light bends when passing a massive object).

The Magnetic Field

It has been understood for some time that a moving charge generates what has been called a magnetic field. We will now examine how the Universal Force can be used to explain the magnetic field as a result of the bulk motion of fast moving electrons in the conduction band of materials.

First, let's look at why a bar magnet has two poles and why the opposite poles attract while like poles repel and why both poles attract metallic objects. Consider Figure 10 below:

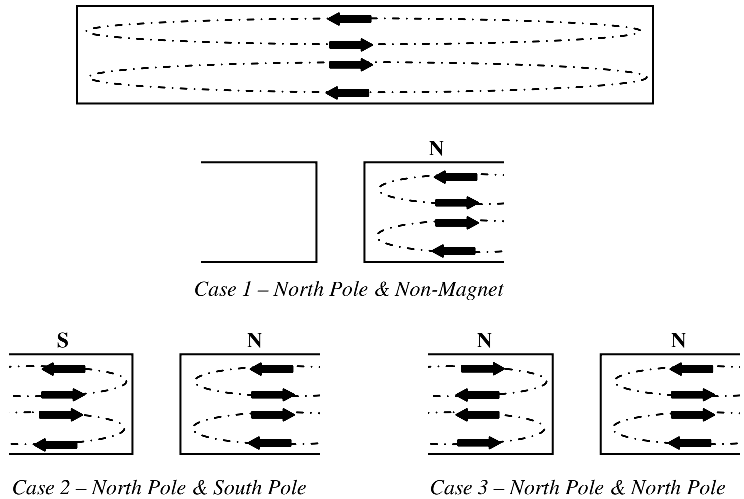

Figure 10 – Magnetic Force

At the top of Figure 10, we see a bar magnet with electrons in the conduction band circulating in two loops as shown with high velocity. In case 1, the north pole is brought near a reference object with no circulating electrons such that the two pieces are at rest. For simplicity, let's assume the circulation bands are wide enough (vertically) such that we only need to consider the relative velocities of electrons in line with each other (collinear arrows). Looking at case 1, we can say that the force between the two bodies is approximately:

$$F_1 = 2F(+V) + 2F(-V) \tag{12}$$

Where F(+V) means the force evaluated at +V. If we examine cases 2 and 3 in the same way, we get the following forces:

$$\begin{aligned} F_2 &= 4F(0) \\ F_3 &= 2F(+2V) + 2F(-2V) \end{aligned} \tag{13}$$

When evaluating these forces, we find that F_2 ends up less than F_1 and F_3 is greater, and the differences are proportional to the electron speed. So if F_1 is a repulsive force which keeps the two pieces at rest, than in case 2 where the force is lower, the poles will be attracted because the force from the rest of the Universe will be greater than the repulsive force. Similarly, in case 3 where the force is greater, the poles will repel one another. Note that if a piece of metal with a conduction band that has no ordered motion is brought close to either pole of the magnet, the electron flows in the magnet will induce the opposite flow in the metal's conduction band. So the metal becomes an opposite pole and will therefore be attracted to either pole of the magnet. Thus, it has been demonstrated that the Universal Force model provides a mechanism for the magnetic field without a need for the concept of a 'charge'.

Next, let's examine the effect of current in a wire. It is well known that if metal filings are scattered on a piece of paper which has a wire running perpendicular to it, they will align themselves concentrically around the wire such that their long axis is aligned tangent to the circles when a current is applied to the wire. Consider Figure 11 below:

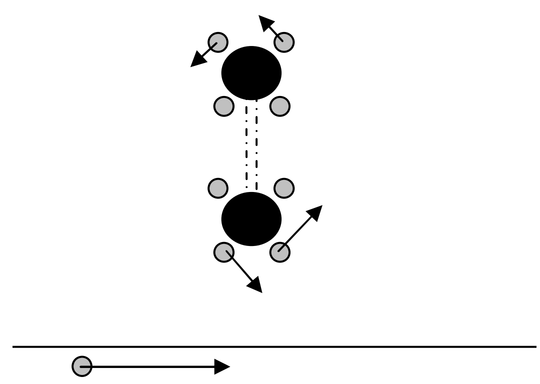

Figure 11 – Alignment of Filings Due to Electric Current

Figure 11 shows two ends of an iron filing and a wire with an electric current. Each end has a 'solid core' which is surrounded by electrons in a conduction band which are free to move tangentially, but restricted in the radial direction. Imagine the filing is pointed out of the page (i.e. the top end is farther away from the wire than the bottom end and the top end is **outside the plane of the page**. When the current flows in the wire, the moving electrons will create a force on the conduction bands of the filing (due to the relative velocity) causing the electrons in the electron band of the filing to revolve around the core. The closer the filing's electrons are to the wire, the faster they will revolve (i.e. the force is greater). So the end of the filing closer to the wire has faster moving electrons and the velocity has a component pointed radially toward the wire. This means there is a radial component of force on each end of the filing proportional to the velocity of the electron band. Thus there would be a torque on the filing (about an axis parallel to the wire) which would cause it to align tangentially to the wire (at which point all electrons in the filing would revolve at equal speed) until equilibrium is reached. As the filings are farther and farther away from the wire, the force weakens with the inverse square of the distance.

<u>The Double Slit Experiment</u>

The results from the double slit experiment (for particles) may be explained as follows. If you fire an electron through a slot, there will be a repulsive force between the sides of the slots and the electron. This will cause the electron to deflect as it moves through the slot. In order to pass straight through the center of the slot and hit the screen directly in front of the slot (centered on the slot) the electron would need to be perfectly oriented and perfectly centered as it passes through. The probability of this is very low. So it is much more likely that the electron will be off center and deflected as it passes through. These regions of high probability are illustrated by the dashed lines in Figure 12 below.

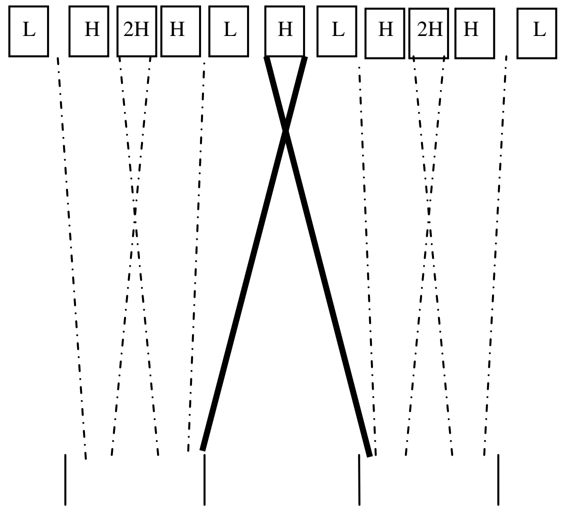

Figure 12 – Double Slit Experiment

Note that those dashed lines overlap at a position centered with the slot, meaning that when many electrons are fired in succession, it actually becomes likely that you will see a high concentration of electrons centered with the slot (the odds of a single electron being centered is small, but when multiple electrons are fired, there will be a buildup of electrons there). As you increase the angle relative to those regions of high probability, the probability of an electron hitting at that location goes down. When you put the two slots together, the regions of low probability overlap at a certain location (the 'H' region between the dark lines). Those regions of low probability add up to make a region of higher probability than the adjacent region. Thus, even when you shoot one particle at a time, an interference pattern can develop without needing the concept of a particle 'interfering with itself'. Thus, there is no need for the wave-particle duality of quantum mechanics to explain this experiment. An electron is no different than any other piece of matter and it behaves like a particle. Note that although the slot width is very large relative to the size of the electron and the electron mass is very low (which would suggest the repulsive forces from the slots would be small), the electrons are moving at very high speeds, which would tend to increase the force.

Electron Orbitals

We will now apply the Universe Force model to the atom in order to explain the existence of electron orbitals and valence electrons. Consider two particles rotating at high speeds and approaching one another horizontally for two cases shown in Figure 13 below.

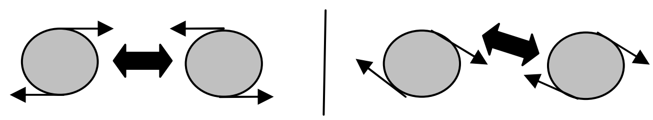

Figure 13 – Effect of Angular Momentum

In Figure 13, we see particles rotating in the same and opposite directions. In the first case, where the particles have opposite rotations, there is an increase in the repulsive force caused by the rotation (velocity vectors are opposed) in line with the direction of motion. The same effect is seen when particles are rotating in the same direction as shown on the right side. However, in this case the force has a vertical component which would deflect the path of the electrons. Now let's imagine two electrons with opposite spins orbiting a nucleus (the mechanism for keeping the electron in orbit is the same as the one used to describe gravity, except that the electrons are at the equilibrium distance from the nucleus). Figure 14 shows this in 2 dimensions.

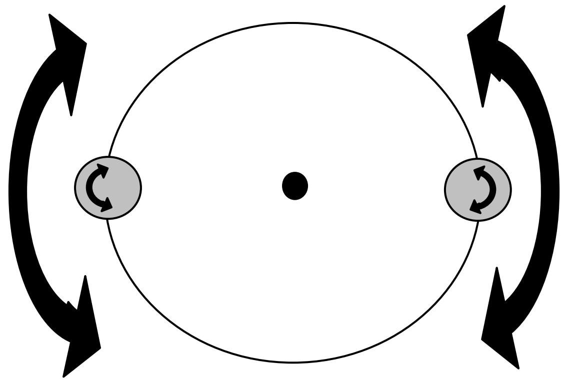

Figure 14 – Electrons Orbiting Nucleus

The most stable way for the electrons to orbit is in a plane through the two electrons and the nucleus (orbital plane), so two electrons with opposite spins will oscillate in both trajectory and rotation as shown in Figure 14 (in 2D). If you try and add a third electron, it will have the same spin as one of the two electrons already in orbit. As a result, there will be a force between the two electrons with the same rotation in a non-tangential direction, which would push the electrons out of the equilibrium distance from the nucleus, thus scattering the electrons (ionization). Therefore, the most stable configuration for electrons in an orbital is no more than two electrons per orbital and they must have opposite spins (in quantum mechanics, this is known as the Pauli Exclusion Principle). Once the two electrons are in equilibrium (oscillating around the nucleus) the orbital plane will rotate in a random manner around the nucleus. In a classical sense, it can be thought of as a magnet rotating at high speeds in 3D with the nucleus being the center of rotation. Because there can only be two electrons per orbital and electrons repel one another as discussed in an earlier section, once the lowest shell is full, other electrons will orbit at a greater equilibrium distance (the 'effective mass' of the nucleus increases as a result of the first electron shell surrounding the nucleus, and thus new electrons are in equilibrium farther away from the nucleus). The shapes of subsequent orbitals become more complex (as is well known) as a result of the increased number of interactions.

So the Universal Force model provides an explanation for the structure of the atom without a need for electric charge or wave-particles. It also supports the 'electron cloud' concept for electron orbitals as the electrons are in constant high-speed motion in 3 dimensions.

Dark Matter

The existence of 'Dark Matter' has been postulated in order to explain the observation that the velocities of stars in rotating galaxies are equal at any distance from the center of rotation. General Relativity predicts that the velocities should decrease as the radial distance increases. In order to explain this discrepancy, physicists have postulated the existence of 'Dark Matter' which is matter that has somehow eluded detection. Furthermore, it has been estimated that over 80% of the matter in the Universe would need to be dark matter (i.e. we cannot observe the vast majority of the Universe). Without creating a detailed model, we will examine how the Universal Force model may be able to explain this behavior without the need for this extra mass. The centrifugal force on a star travelling with speed V is given by:

$$F = \frac{M_1 V^2}{r} \tag{14}$$

This force must be balanced by the force of the core of the inner galaxy on the star and the force of the Universe on the star as follows:

$$\frac{M_1 V^2}{r} = \frac{M_1 M_u}{s_u^2} - \frac{M_1 M_G}{r^2} \Rightarrow V = \sqrt{\frac{rM_u}{s_u^2} - \frac{M_G}{r}} \tag{15}$$

Data on the distribution of mass in a galaxy with this behavior is not available to the author. If the mass of the galaxy is distributed such that it increases linearly with r, and the effective mass of the Universe (recall that the effective mass is dependant on the 'shadow' effect discussed previously) varies inversely with r, then the velocity will be constant, and no dark matter would be required to explain the observation.

Antimatter

The author is not very familiar with antimatter or the methods used to detect it, but it is understood (by the author) that a positron in a particle detector traces a path identical to the path of an electron if it were moving backward in time (appears to be attracted to a negative charge). If this is the case, it is possible that the observation of these positrons (or any antimatter) is just matter from the detection equipment being disturbed by the collision inside the detector. The 'explosion' from the collision could create a type of vacuum as a result of the high velocities which would pull electrons off the detection equipment itself. This would present itself as a particle of antimatter. Consider Figure 15 below.

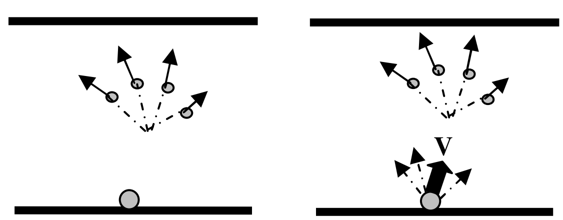

Figure 15 – Illusion of Antimatter

On the left side of the figure, we see inside a particle accelerator at the moment that two particles collide. The grey particle at the bottom is an electron on the detector in equilibrium before the collision. After the collision, imagine that the debris is moving such that the (very high) net velocity of the debris is directed away from the electron. This motion will cause a reduction in the force on the electron coming from inside the accelerator (recall that the Univesal force increases when particles move toward each other and decreases when particles move apart, and the force is a function of speed). This creates a net force on the electron which will tend to push it off the bottom plate with high velocity *V* as shown on the right side of the figure. This high velocity electron will create a 'wave front' of high frequency depicted by the dashed arrows on the bottom right side of the figure (note that this wave front is only seen by the static parts of the detector toward which the electron is moving). This high frequency wave front is the gamma radiation which is observed when two antiparticles 'annihilate'. Thus, we see that the apparent production and annihilation of antimatter is explainable with the Universal Force model requiring only one type of matter.

The Arrow of Time, Expansion of the Universe

So why does there seem to be an 'Arrow of time' which is captured by the second law of Thermodynamics (the second law implies that the entropy of the Universe increases with time, which is why it seems like we travel from the past into the future)? To explain this, let's think about time travel. What would it mean to travel into the past? It would mean that all the objects in the Universe (except the ones in your body and mind, since you are the time traveler) would need to be returned to the exact same configuration that they were in at that specific time in the past (i.e. their relative distances would need to be as they were at that time). But the Universal Force is repulsive, so to return the Universe to a specific previous state, a force would need to be applied which opposes the Universal Force (you need to squeeze the Universe closer together). Since there is only one Universal Force, and it has the effect of expanding the Universe, returning to an exact previous state is impossible. The repulsive nature of the Universal Force resolves the mystery with regards to the accelerated expansion of the universe: the galaxies are in effect pushing off each other. Looking at Figure 6, we see that the earth is also applying a force on the surrounding universe. So if you imagine that the dark circle representing the surrounding Universe is flexible, as it pushes on the earth it also expands outward in all directions. The Universe is expanding at an accelerating rate, which means that the farther away a galaxy is, the faster it moves away from us. Therefore the farther a galaxy is away from us, the lower the repulsive force it exerts on our galactic neighborhood. As the Universe expands, the force from the surrounding Universe on our galaxy will be reduced, at which point the galaxy will push itself apart. And as the galaxy expands sufficiently, the solar systems will likewise begin to expand, and so on, until even atoms begin to expand.

The Probabilistic Nature of Quantum Mechanics

The theory and mathematics of Quantum Mechanics are based on probabilities. For instance, we can't know exactly where an electron is at a given instant, we can only give a probability distribution describing where the electron is most likely to be found. While on the surface, this seems like an odd fact, it is actually very intuitive and easy to understand, and it has to do with the relationship between the rate of change of position (velocity) relative to the speed of information (the speed of light, *c*). It can be understood with a simple analogy. Suppose you are standing still and your friend calls and asks you where you are. Since you are not moving, you can give your friend an exact location. Now suppose instead of standing still, you are walking down the street. When your friend calls, you can't give her an exact position because by the time you tell her an exact location, you will be in a different spot. So rather than giving her an exact location, you might tell her that you are in front of a certain house. And if you were riding a bike instead of walking, you would tell her you are on a certain block. If you were driving a car, you might tell her you were going north on a certain street between two cross streets. And if you were on a plane, you would tell her you were over a certain city. So as your speed increases relative to the speed at which you can convey the information to your friend, you have to be more general about your location. This is what is happening when we try to measure the position of an electron. Since we observe the electron moving at a very high speed (perhaps near the speed of light) we can't give it a definite location during a measurement because the speed of the measurement is restricted to the speed of light. So by the time we receive the information regarding the position, the electron is long gone. We can only get a general idea of where the electron is. So the probability distributions of Quantum Mechanics are like the different answers you give to your friend. The faster you're moving, the less accurately your friend can know your true position. The same is true for the electron. The important thing to note is that, although we can't know the exact position of the electron due to its high speed, that doesn't mean the electron doesn't occupy specific positions in space. Your friend may only know that you are flying over Toronto, but that doesn't mean that you are 'spread out' over the entire city, you still occupy specific locations. The locations are just changing quickly relative to the speed at which you can convey the information to your friend. Likewise, the electrons are not 'spread out' over the nucleus, they just move so fast relative to us that we can only say that they are somewhere inside an 'electron shell'. Thus, as discussed in the double slit experiment section, we do not need a wave/particle duality interpretation of subatomic particles. The 'wavelike (i.e. probabilistic) nature' of the particles is an artifact of measurement, not the fundamental nature of the particle itself. Sub-atomic particles are identical to macroscopic objects, they just move very fast relative to us which limits our ability to accurately measure them.

The Fractal Nature of Existence

We now come to the most important implication of this theory. It has been shown that all matter we perceive is identical. The structure of the atom is explained in the exact same way as the structure of the earth and the galaxies. There is nothing special about an electron; it is made of the same 'stuff' as the proton and we are already aware that the matter we perceive is built from atoms. Furthermore, we have defined mass as points of space, meaning that matter as we see it is just a location of space where the geodesic waves appear to converge. The model does not put any restrictions on the scale of the Universe, so there is no definition of the smallest or largest scale which can exist. We have also showed that our concept of time is really just an observation of the relative changes in distance between these points. The Universe is just evolving through various states in which the distances are changing. The constant speed of light c tells us that the largest change in distance that can occur between states is *c*, and the ease with which this change can be made is proportional to the product of the masses of the bodies in question (i.e. the force increases with the product of masses). As the mass (number of points of space) of the system increases, it becomes more difficult to make large changes in distance. Thus, the scale at which you observe the Universe determines how 'fast' things appear to change. For instance, we observe that because of their low mass, electrons move at very high speeds. Likewise, galaxies appear to change very slowly. So the observed speeds a system depends on the ratio of the mass of the system to *c*. And since the interactions between points of space is the same at all scales, it is logical to conclude that the Universe is infinitely small and infinitely large. Therefore, the structure we observe (not just the Universe, but life itself) can exist at all scales. If we were able to look close enough, we might see life and the structures we know inside an electron, but it would appear to us to move extremely fast. Likewise, our universe may be an electron in the DNA strand of a much larger entity, but if we could see it, it would appear to move very slowly. This is the true nature of relativity. Any observer at any scale can claim to have a 'normal' speed (where 'speed' is just a measure of the magnitude of changes in distance). Recall that length contraction in Special Relativity was originally interpreted as space contracting when something moves at high speeds. What Special Relativity was really saying is that as the relative length scale contracts, the observed velocities at that scale will increase. So the idea that life can occur at all scales is not just an imaginative idea, it is a logical conclusion. And since there is no concept of 'beginning' or 'end' in this model, we can say that the Big Bang was not the beginning of the Universe. The Universe is continuously expanding at all scales, and there was no beginning, only a continuous outward expansion from infinity to infinity. This idea can be visualized with a simple analogy. What we perceive as matter is just the source of waves of space spreading outward in 3 dimensions. Imagine looking down at a small patch of water in an infinitely big ocean. Now imagine that some raindrops fell on that patch of water. What was once a featureless, flat patch of water now appears to have structure. Wherever a drop fell, there are circular waves moving outward in all directions. So if three drops fell, it would look like there are three 'things' in the water. But these 'things' are not made of anything special; they are just distortions in the water itself. Suppose now that we start to zoom out. We pull back so far that the patch we were looking at before now just looks like a featureless point. And if we pull back far enough, we might notice that that 'flat' patch of water we were looking at was actually part of a much bigger wave coming from a much bigger source. We didn't notice the fact that we were even on a wave at the beginning because it was so much bigger than the region we were looking at, and any change caused by the wave was so gradual that we couldn't perceive it. And if we keep zooming out, we see not just one bigger source, but many. We can zoom out as far as we want and the same thing will keep happening over and over. We will see the same patterns in the water at any 'zoom'.

This model need not only apply to the realm of the physics. Consider the evolution of societies. We see that as the human population grows and societies become more interconnected, the rates of change in society and technology also increase. The increased interconnectedness represents a contraction in the length scale. A higher population which is more interconnected means that information can be exchanged at a faster rate and can be processed more quickly. The dynamics of information is what causes the changes in society. If an asteroid hits the earth and destroys 99.9% of the population, the length scale would increase and these rates of change would be once again much lower.

Conclusion

With a re-interpretation Einstein's Special Theory of Relativity, a proposal for the fundamental force of nature as waves in the geodesics of space has been proposed. By showing that the attractive nature of gravity and electromagnetism can be explained using a repulsive force we are able to create a model for all four fundamental forces using a single mechanism which does not require 'charges' or 'force carrying particles'. The expansion of the Universe and the second law of Thermodynamics are a direct consequence of the model described here. It has been demonstrated that the structure of the atoms and galaxies are governed by the same fundamental mechanism. The geodesic waves have been shown to be the true nature of light, without the need for a separate electromagnetic field or the concept of a photon. By examining the results of the double slit experiment (with electrons) of quantum mechanics with this theory, we find that there is no need for the concept of a wave-particle duality because the interference pattern can be explained by modeling the electron using only the properties of a particle. Finally, the fractal nature of the Universe implied by this model leads to the conclusion that life can exist at any scale. It also implies that as the length scale of a system decreases relative to the scale of an observer, the observed velocities in the system will increase. The opposite is true as the relative length scale increases.