THE STRUCTURE OF ATOMS AS INTERPRETED BY MODEL MECHANICS

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Introduction

A new model of the current universe called Model Mechanics has been formulated. Model Mechanics proposes that all the forces and processes (including the processes of life) of nature are the results of absolute motions of objects in a stationary, elastic and structured light-conducting medium called the E-Matrix. The unique structure of the E-Matrix leads to the discovery of a new repulsive force called the CRE force that exists between all objects in the universe. The CRE Force, in turn, leads to a new theory of gravity called Doppler Theory of Gravity (DTG) and unites gravity with the electromagnetic and nuclear forces naturally [1, 2]. Model Mechanics also leads to a complete theory of motion called IRT (Improved Relativity Theory) [3]. IRT includes SRT as a subset. However, unlike SRT, the equations of IRT are valid in all environments…including gravity. Model Mechanics also leads to a new interpretation on the structure of atoms and the mechanism by which atoms emit light. This paper gives detailed description of the processes involved in the formation of the various atoms from the Basic Particles.

Model Mechanics Description of the Current Universe

Model Mechanics supposes that a stationary substance, called the 'E-Matrix', occupies all of pure-space (void) in our Universe. Subsequently, we perceive the E-Matrix as space. The E-Matrix, in turn, is composed of 'E-Strings', which are very thin three-dimensional elastic objects, of diameter estimated at 10^{-33} cm. The length of an E-String is not defined. Away from matter, the E-Strings are oriented randomly in all directions. This means that a slice of the E-Matrix in any direction will look the same. Near matter, the E-Strings are more organized: some emanate from the matter, and the number of these passing through a unit area followed the well-known inverse square law of physics. The E-Strings repel each other. This means that there is an unknown outside force that is compacting them together. The repulsive force and the compacting force are in equilibrium. This state of the E-Matrix allows massive matter particles to move freely within it. The motion of a matter particle or particle system in the E-Matrix is called 'absolute motion'. The absolute motion of matter in the E-Matrix will distort the local E-Strings. The E-Strings will recover to the non-distorted state after the passage of the matter particles. Light consists of wave-packets in neighboring E-Strings. On its way toward its target, a wave-packet will follow the geometry of these neighboring E-Strings. This description of light embodies 'duality', *i.e.* light possessing properties of a mass-bearing particle as well as a wave packet.

With this description of the E-Matrix (space), the next relevant question is: What is matter? All stable and visible matter is made from three basic particles: the electrons, the up quarks, and the down quarks. The protons and neutrons in the nuclei of all the atoms are made from the up quarks and the down quarks. The electrons orbit around the nuclei to complete the picture of all the atoms. The three basic particles are, in turn, made from one truly fundamental mass-bearing particle, called the 'S-Particle'. An S-Particle is a three-dimensional spherical object. It is repulsive to the E-Strings surrounding it and therefore its motion in the E-Matrix is maintained. An S-Particle orbiting around an E-String in the helical counterclockwise direction is an electron.

This motion of the S-Particle is the fastest in the E-Matrix, and it gives rise to one unit of negative electric charge. A down quark is also an S-Particle orbiting around an E-String in the helical counterclockwise direction. The speed of its orbiting motion is only 1/3 that of the electron, giving the down quark a negative 1/3 electric charge. An up quark is an S-Particle orbiting around an E-String in the helical clockwise direction at 2/3 the speed of the electron, resulting a 2/3 positive electric charge.

There is one more stable basic particle: the electron neutrino. An electron neutrino has no detectable electric charge, and therefore it does not interact with the other three charged basic particles. It is composed of an S-Particle orbiting around an E-String in the counterclockwise direction like the electron. However, it is moving in a corkscrew like motion away from the charged basic particles. This means that the distortion in the E-Matrix created by the absolute motion of the S-Particle of the electron neutrino will have already dissipated by the time the charged basic particles are ready to interact with it. This is the reason why the electron neutrino does not interact electromagnetically with the charged basic particles.

This simple description of all stable visible matter can answer the thorny question: What *is* the mass of a basic particle? The answer is: mass is the evidence of the orbiting diameter of its S-Particle. Those S-Particles that are not in a state of orbiting motion do not possess any electric charge and therefore they will not interact with the basic charged particles electrically. They will, however, interact with them gravitationally. They are the dark matters predicted by the astronomers.

The next relevant question is: what are the processes that give rise to all the forces between matter particles? The proposed answers to this question are as follows:

1) All the processes of Nature are the result of matter particles reacting to the geometries of the E-Strings (*i.e*. distortions or waves) to which they are confined because of their orbiting motions around these E-Strings.
2) Absolute motions of two objects in the same direction in the E-Matrix will cause the objects to converge to each other--an attractive force. Absolute motions of two objects in the opposite directions in the E-Matrix will cause the objects to diverge from each other--a repulsive force.

This completes the Model Mechanical description of our current universe. All the particles, all the forces and all the processes of nature can be derived from this one description. Model Mechanics replaces the math constructs of space-time and field/virtual particle with the E-Matrix and the distortions or waves in the E-Matrix. This enables us to use the math of Quantum Field Theory (QFT) in combination with the interpretations of Model Mechanics to explain all the processes of nature.

Unification of Physics

Special Relative Theory (SRT) rejects the notion of absolute time and space. Also, SRT advanced the concept of energy and mass equivalency, which includes the idea that mass is convertible to energy and vice versa. These two concepts have been the foundation of theoretical physics developments for the past century. The results of these theoretical developments gave rise to the two pillars of modern physics: General Relativity Theory (GRT) and Quantum Mechanics (QM). GRT describes the large-scale universe including gravity while QM describes

the microscopic universe including the electromagnetic and nuclear forces. Efforts to unify the electromagnetic force with the nuclear force have had some successes. The electro-weak theory unites the electromagnetic force with the nuclear weak force. However, this unification remains dubious because it depends on the existence of a hypothetical particle called the Higgs particle. So far, physicists have not been able to find this hypothetical particle in the accelerators around the world. In fact, physicists at CERN are coming to the conclusion that the Higgs does not exist. There were also some successes in the effort of unifying the electro-weak force with the nuclear strong force. The resulting theory is called Grand Unification Theory (GUT). GUT predicts that the proton is not permanently stable. This led physicists around the world rushed to find evidence of proton decay. However, so far no evidence of proton decay was found. Attempts to unify gravity with the electromagnetic force and the nuclear forces were complete failures. There is no viable theory of quantum gravity.

The unification problems described above are the direct consequences of the foundations of modern physics, which deny the existence of absolute time and physical space (absolute space). The irony is that both GRT and QM contain math constructs that resemble physical space. The math construct space-time in GRT and the math construct field/virtual particle in QM are such examples. The difference between these math constructs and physical space is that the math constructs have no physical constraints. This lack of physical constraints leads to the infinity problems that plagued both GRT and QM. In GRT the lack of constraint leads to the infinity problems at the singularity where the theory breaks down completely. The other problem is that GRT gives no explanation why the force of gravity is capable of action-at-a-distance. In QM the lack of physical constraint leads to infinity problems during the formulation of the theories of electromagnetic and nuclear forces. This was especially true in the case of the theory of quantum electrodynamics (QED). In QED the electric change of a particle is resided within the particle. This leads to the infinity problems during the early development of QED. The infinity problem of QED was resolved by a dubious mathematical procedure called renormalization. A number of physicists, including Paul Dirac consider the renormalization technique a mathematical trick. He made the following comments during a lecture given in New Zealand in 1975:

> *"I must say that I am very dissatisfied with the situation, because this so-called 'good theory' does involve neglecting infinities which appear in its equations, neglecting them in an arbitrary way. This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small."*

Model Mechanics replaces the math constructs of space-time and field/virtual particle with the E-Matrix and the distortions or waves in the E-Matrix. It gives rise to the following postulates:

1) The E-Matrix is a stationary and structured light-conducting medium. It occupies all of pure space (pure void). It is comprised of very thin and elastic E-Strings and these E-Strings are repulsive to each other. There is an unknown compacting force that compresses these E-Strings together to form the E-Matrix.
2) The S-Particle is the only truly fundamental particle exists in our universe. The different orbiting motions of the S-Particles around the E-String(s) give rise to all the visible and stable particles in our universe.
3) All the processes of nature are the results of absolute motions of S-Particles or S-Particle systems in the E-Matrix.
4) All the forces of nature are the results of the S-Particle or S-Particle systems reacting to the distortions or waves in the E-Strings to which they are confined. The distortions or

waves in the E-Strings, in turn, are the results of the absolute motions of the interacting S-Particles or S-Particle systems in the E-Matrix.

5) All the stable and visible matters are the results of orbiting motions of the S-Particles around specific E-Strings.

These postulates eliminate all the infinity problems that plagued both GRT and QM. It has the same mechanism for all the forces of nature and thus it unites all the forces of nature. It gives an explanation why the force of gravity is capable of acting at a distance. It explains the provisions of the Uncertainty Principle. It explains the weird results of all quantum experiments [3]. It eliminates the need for the undetectable force messengers in QM. It eliminates the need for the hypothetical and undetected Higgs particle. It explains the mass of a particle. It explains the charge of a particle. It leads to the discovery of the CRE force, which, in turn leads to a new theory of gravity. In short, Model Mechanics gives us a unique way to achieve the elusive goal of unifying all of physics.

IRT: Improved Relativity Theory

Special Relativity Theory (SRT) posits that the speed of light is a universal constant in all inertial frames, but suppose the speed of light is not a universal physical constant as asserted by the SRT, but rather a constant mathematical ratio as follows:

$$\frac{\text{light path length of rod}\left(299,792,458\,\text{m}\right)}{\text{absolute time content of clock second co-moving with rod}}$$

This new interpretation for the speed of light revives the discarded notion of absolute time and physical space. It also makes the notion of absolute time and space compatible with SRT. Based on this interpretation for light speed, a new theory of relativity has been formulated for motion: Improved Relativity Theory (IRT). IRT includes SRT as a subset, but its equations are valid in all environments—including gravity. The following is a description of IRT:

The Postulates of IRT:

1. The laws of physics based on a clock second and a light-second to measure length are the same for all observers in all inertial reference frames.
2. The speed of light in free space based on a clock second and a light-second to measure length has the same mathematical ratio c in all directions and all inertial frames.
3. The laws of physics based on a defined absolute second and the physical length of a rod is different in different frames of reference.
4. The one-way speed of light in free space based on a defined absolute second and the physical length of a measuring rod has a different mathematical ratio for light speed in different inertial frames. The speed of light based on a defined absolute second and the physical length of a measuring rod is a maximum in the rest frame of the E-Matrix.

The Consequences of these Postulates:

1. The speed of light is not a universal constant. It is a constant math ratio as follows: Light path length of rod (299,792,458 m)/the absolute time content for a clock second co-moving with the rod. The detailed explanation of this new definition:
   By definition the speed of light in the rest frame of the E-Matrix is as follows:

Light path length of rod in the E-Matrix frame = 299,792,458 m.
The absolute time content for a clock second in the E-Matrix frame:
= 1 E-Matrix frame clock second
Therefore the speed of light in the E-Matrix frame is:
299,792,458 m/1 E-Matrix clock second.
Speed of light in any frame moving in the stationary E-Matrix is determined as follows:
The light path length of rod in the moving frame = (F_{aa}/F_{ab}) (299,792,458 m).
The absolute time content for a moving clock second:
= (F_{aa}/F_{ab}) (E-Matrix clock seconds).
Therefore, the speed of light in any moving frame in the stationary E-Matrix is:
(F_{aa}/F_{ab}) (299,792,458m) / (F_{aa}/F_{ab}) (1E-Matrix clock second)
This is reduced to a constant math ratio of: 299,792,458m/1 E-Matrix clock second
Note: The terms F_{aa} and F_{ab} are defined in the later section.

2. The physical length of a rod remains the same in all frames of reference. However, the light path length of a rod changes with the state of absolute motion of the rod. The higher is the state of absolute motion the longer is its light path length.
3. The rate of a clock is dependent on the state of absolute motion of the clock. The higher is the state of absolute motion the slower is its clock rate.
4. Absolute time exists. The relationship between clock time and absolute time is as follows: A clock second will contain a different amount of absolute time in different states of absolute motion (different frames of reference). The higher is the state of absolute motion of the clock the higher is the absolute time content for a clock second.
5. Simultaneity is absolute. If two events are simultaneous in one frame, identical events will also be simultaneous in different frames. However the time interval for the simultaneity to occur will be different in different frames. This is due to that different frames are in different states of absolute motion.
6. Relative motion between two observers A and B is the vector difference of the vector component of A's absolute motion and the vector component of B's absolute motion along the line joining A and B.

The Math of IRT:

Most of the equations of IRT are converted from existing SRT equations. The conversion factors from observer A's point of view are as follows:

Relative Velocity: $v = \lambda(F_{aa} - F_{ab})$

Speed of light = c = $F_{aa}\lambda$

$\gamma = F_{aa}/F_{ab}$ And $1/\gamma = F_{ab}/F_{aa}$ Where: $\gamma = 1\Big/\sqrt{1 - v^2/c^2}$

In addition, the postulates of IRT allow that the rate of a clock moving with respect to the observer can be running at a slower or faster rate compared to the observer's clock. Also the light path length of a ruler moving with respect to the observer can be longer or shorter compared to the light path length of the observer's ruler.

1. **The clock time dilation (contraction) or expansion equations:**
   A and B are in relative motion from observer A's point of view:

$$T_{ab} = T_{aa}\left(\frac{F_{aa}}{F_{ab}}\right) \qquad [1]$$

OR

$$T_{ab} = T_{aa}\left(\frac{F_{ab}}{F_{aa}}\right) \qquad [2]$$

T_{aa} = A clock time interval in observer A's frame as measured by A

T_{ab} = A's prediction of B's clock time interval for an interval of T_{aa} in his frame.

F_{aa} = Frequency of a standard light source in A's frame as measured by A.

F_{ab} = Frequency of an identical light source in B's frame as measured by A. If F_{ab} is not constant the mean value is used.

Note: Even though T_{aa} and T_{ab} are two different clock time intervals but both of these clock time intervals contain the same amount of absolute time.

2. **The light path length contraction or expansion equations:**

$$L_{ab} = L_{aa}\left(\frac{F_{aa}}{F_{ab}}\right) \qquad [3]$$

OR

$$L_{ab} = L_{aa}\left(\frac{F_{ab}}{F_{aa}}\right) \qquad [4]$$

L_{aa} = The light path length of a rod in A's frame as measured by A.

L_{ab} = The light path length of an identical rod in B's frame as predicted by A.

Note: Even though L_{aa} and L_{ab} are two different light path lengths but these two light path lengths are derived from identical rods that have the same physical rod lengths. The different light path lengths are the results of different states absolute motion of the rods.

3. **The Coordinate Transformation Equations:**

$$x' = \frac{f_{aa}}{f_{ab}}\left[x + t\left(f_{aa} - f_{ab}\right)\lambda\right] \qquad [5]$$

$$t' = \frac{f_{aa}}{f_{ab}}\left[t + x\left(\frac{\left(f_{aa} - fab\right)}{\lambda f_{aa}^{2}}\right)\right] \qquad [6]$$

OR

$$x' = \frac{f_{ab}}{f_{aa}}\left[x - t\left(f_{aa} - f_{ab}\right)\lambda\right] \qquad [7]$$

$$t' = \frac{f_{ab}}{f_{aa}}\left[t - x\left(\frac{\left(f_{aa} - f_{ab}\right)}{\lambda f_{aa}^{2}}\right)\right] \qquad [8]$$

A is the observer's frame (unprimed) and B is the observed frame (primed).

f_{aa} = The instantaneous frequency measurement of a standard light source in A's frame as measured by A.

f_{ab} = The instantaneous frequency measurement of an identical light source in B's

frame as measured by A.

$\lambda =$ The wavelength of the standard light source in A's frame as measured by A.

These coordinate transform equations are valid in all environments--including gravity. This means that IRT will give matching predictions as GRT and at the same time includes SRT as a subset.

4. **Momentum of an object**:

$$p = M_o \lambda (F_{aa} - F_{ab}) \qquad [9]$$

5. **Kinetic Energy of an object:**

$$K = M_o \lambda^2 F_{aa}^2 \left(\frac{F_{aa}}{F_{ab}} - 1 \right) \qquad [10]$$

6. **Energy of a single particle:**

$$E = M_o \lambda^2 F_{aa}^2 \qquad [11]$$

7. **Gravitational Red or Blue Shift:**

$$\Delta F_{aa} = F_{aa} \left(1 - \left(\frac{F_{ab}}{F_{aa}} \right) \right) \qquad [12]$$

A positive value represents a red shift from A's location. A negative value represents a blue shift from A's location.

8. **Gravitational Time Contraction (Dilation) or Expansion:**

$$\Delta T_{aa} = T_{aa} \left(1 - \left(\frac{F_{ab}}{F_{aa}} \right) \right) \qquad [13]$$

A positive value represents gravitational time contraction (dilation) from A's location. A negative value represents gravitational time expansion from A's location.

9. **Doppler Shift Equations:**

Doppler shift equation for an approaching source:

$$f_{ab} = f_{aa} \sqrt{\frac{2F_{aa} - F_{ab}}{F_{ab}}} \qquad [14]$$

Doppler shift equation for a receding source:

$$f_{ab} = f_{aa} \sqrt{\frac{F_{ab}}{2F_{aa} - F_{ab}}} \qquad [15]$$

10. **The IRT procedure for determining the perihelion precession of Mercury without recourse to GRT is:**

a) Set up a coordinate system for the Sun and Mercury.
b) Use the IRT coordinate transformation equations to predict the future positions of the Sun and Mercury.
c) The perihelion shift of Mercury will be revealed when these future positions are plotted against time. Also, the value of the shift can be determined from the plot.

IRT includes SRT as a subset. However, unlike SRT, the equations of IRT are valid in all environments, including gravity. The equations of IRT have an unlimited domain of applicability and therefore they can be used to replace GRT in cosmological applications.

Forces Based on Absolute Motions

The idea that absolute motion of interacting particles in the same direction gives rise to an attractive force, while absolute motion of interacting particles in the opposite directions gives rise to a repulsive force, is derived from the familiar electric current experiments in parallel wires. These experiments show that when electric currents are flowing in the wires in the same direction, the wires are attracted to each other, and when the currents are flowing in the opposite direction, the wires repel each other. Figs. 1 and 2 illustrate these experiments graphically. The absolute motions of the electrons in the same direction cause a distortion in the E-Matrix that pulls the wires together--an attractive force. Conversely, the directions of absolute motion of the electrons in the opposite directions will cause a distortion in the E-Matrix that pulls the wires apart–a repulsive force.

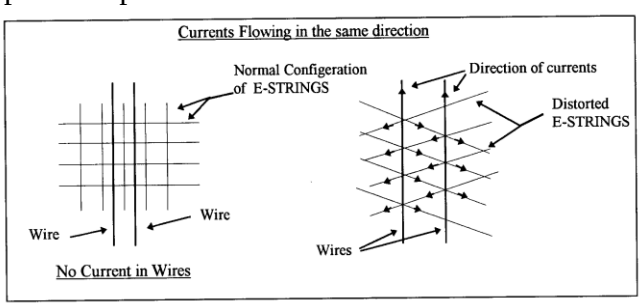

Figure 1. Currents (electrons) in the wires are flowing in the same direction, and therefore the force between the electrons is attractive. The right diagram that shows that the tension created in the E-Strings by the absolute motions of the electrons is pulling the wires together.

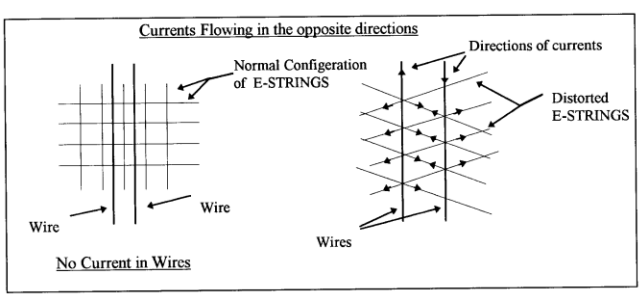

Figure 2. Currents (electrons) in the wires are flowing in the opposite direction, and therefore the force between the electrons is repulsive. The right diagram shows that the tension created in the E-Strings by the absolute motions of the electrons is pulling the wires apart.

Extending this interpretation of the electric-current experiments to include the orbiting motion of the S-Particles will enable us to explain all the nuclear forces between the interacting up quarks and down quarks [1,2]. This interpretation becomes the most important concept of Model Mechanics and it enables Model Mechanics to unite all the forces of nature naturally.

The CRE Force

Current physics posits that there are four forces of Nature: the electromagnetic force, the nuclear weak and strong forces, and gravity. Model Mechanics posits that there is a fifth force of Nature; the new force being the CRE force. As the name implies, the CRE force between any two objects is repulsive. While the CRE force is new to physical theory, it is not new to experience; it is what we commonly refer to as 'inertia'. In other words, the resistance between two objects to change their state of absolute motion is the CRE force between them. The CRE force between any two objects is always repulsive, and it is derived from the diverging structure of the E-Matrix.

To understand the CRE force, recall the inverse square law of physics. This law states that the intensity of light, gravity and electromagnetic force decreases with increasing distance r from the source is inversely proportional to r^2. The geometry of neighboring E-Strings emanating from any two objects also obeys the inverse square law. This means that each object will follow the diverging geometry of these neighboring E-Strings. Therefore, their path of motions in the E-Matrix will have a tendency to diverge from each other. This repulsive effect is identified as the CRE force. The CRE force between any two objects is not constant; it increases with the square of the distance between the objects. The CRE force is not the cosmological constant that Einstein inserted into his original GRT field equations. Although the cosmological constant is repulsive, it is not the CRE force predicted by Model Mechanics for the simple reason that it is constant.

The CRE force played an important role in the formation of our Universe, and is continuing to do so today. The repulsive CRE force, along with the attractive electromagnetic force between gravitating objects shaped the primeval Universe into the Universe that we see today. The CRE force also played an important role in the manifestation of the nuclear weak force. Without the CRE force, there would be no nuclear weak force. It is the CRE force that initiates the radioactive decay of atoms. Perhaps, the most important function of the CRE force will be a role, in combination with the electromagnetic force, in the processes of life.

Model Mechanics predicted the repulsive CRE force in 1993. However, it was not discovered until 1998 when two independent groups of astronomers discovered that the Universe at the far reached regions is in a state of accelerated expansion. This observation is in direct conflict with the prediction of GRT. In order to explain this observation astronomers are now re-introducing the discarded repulsive Cosmological Constant to the GRT equation. The CRE force eliminates the need for this *ad hoc* approach.

Doppler Theory of Gravity (DTG)

Newton posited that gravity is a force, but he did not provide a mechanism for it. Newton's gravity model involved the unexplained phenomenon of action at a distance, which was troublesome for the physicists of his time. Also, Newton's equation for gravity was eventually found to be slightly inconsistent with observations. Recognizing the deficiencies in Newton's theory, Einstein formulated GRT, which is not a theory of force, but rather a theory of space-time, amounting to an extension of SRT to include gravity. IRT is a completed new theory of

relativity. It includes SRT as a subset and its equations are valid in all environments…including gravity. It gives the same correct predictions for gravity as does GRT, but it avoids the following problematic predictions of GRT:

1) The expansion rate of the Universe as predicted by GRT does not match what is currently observed. GRT predicts that the expansion of the Universe is slowing down, and yet observation confirms that the expansion is speeding up.
2) The galactic rotational curves as predicted by GRT do not match those that are currently observed.
3) The path of travel of Pioneer 10 as predicted by GRT does not match what is observed.
4) GRT predicts the existence of black holes and singularities. If these absurd objects exist, they should be as abundant as the stars, and yet none them have been positively detected.
5) GRT fails to predict the existence of dark matter and dark energy.

Model Mechanics also gives rise to a new theory of gravity called Doppler Theory of Gravity (DTG). Like Newton's theory, DTG also treats gravity as a force but with an identified mechanism. Based on the provisions of Model Mechanics, the mechanism of gravity between two objects A and B moving in the stationary E-Matrix is as follows:

1) If both A and B are moving absolutely in the same direction, this gives rise to an attractive force because A's absolute motion distorts the surrounding stationary E-Matrix and B's absolute motion is confined to follow the distortion created by A; conversely, B's absolute motion distorts the surrounding stationary E-Matrix and A's absolute motion is confined to follow the distortion created by B.
2) The global structure of the stationary E-Matrix is divergent. Both A and B are confined to this global divergent structure as they travel in the stationary E-Matrix. This gives rise to the repulsive CRE force between A and B globally.

The force of gravity between A and B is the combined result of items (1) and (2). It is noteworthy that gravity is the sum of an attractive and a repulsive force acting on both A and B. This explains why the force of gravity is so weak compared to the electromagnetic and nuclear forces.

The above description for gravity suggests that the Newtonian equation for gravity can be modified to make it consistent with observations. The following is a modified Newtonian equation based on the above description for the force of gravity:

$$F = \left(\frac{F_{ab}}{F_{aa}}\right)\left(\frac{G * M_a M_b (j_a)\cdot(\pm j_b)}{r^2}\right) \qquad [14]$$

F = The force of gravity between A and B as determined by A
G = Universal gravitational constant m^3/s^2*kg
M_a = Mass of object A in kg
M_b = Mass of object B in kg
$(j_a)\cdot(j_b)$ = Dot product of the directional vectors j_a and j_b. [Note: This dot product can be positive or negative.]
r = Distance in meters between A and B
F_{aa} = Frequency of a standard light source in A's own frame as measured by A.

F_{ab} = Frequency of an identical standard light source in B's frame as measured by A. If F_{ab} is not constant, a mean value is used.

The dot product $(j_a)\cdot(j_b)$ in this new equation expresses the concept that not all objects in the Universe attract each other gravitationally. A positive dot product represents an attractive force, but a negative dot product represents a repulsive force. Those objects that have the same direction of absolute motion are attracted to each other, but those objects that have absolute motions in the opposite direction exert a repulsive force on each other. Assuming the Big Bang model is correct then the dot product of the vectors for all local regions of the Universe is +1. This means that gravity in the local region is attractive. The dot product for a distant region, say beyond the radius of the observable Universe, is -1. Therefore, gravity for all those distant regions is repulsive.

The Electromagnetic Force

This is the force observed between charged particles. It was determined that like-charged particles exert a repulsive force on each other while unlike charged particles exert an attractive force on each other. The reader will recall that a charged particle is the result of a clockwise or counterclockwise orbiting motion of its S-Particle around a specific E-String. A clockwise orbiting motion of the S-Particle gives rise to a positively charged particle. A counterclockwise orbiting motion of the S-Particle gives rise to a negatively charged particle. The charges between the interacting particles determine whether the force between them is attractive or repulsive. The following diagrams describe the electromagnetic force in Model Mechanical terms:

Interaction Between Negatively Charged Particles

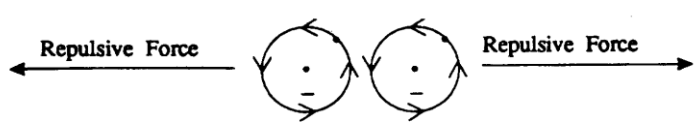

Fig. 3 The force exerts on each other by two negatively charged particles. In this case, the S-Particles are traveling in the opposite directions and therefore the force between these particles is repulsive.

Interaction Between Positively Charged Particles

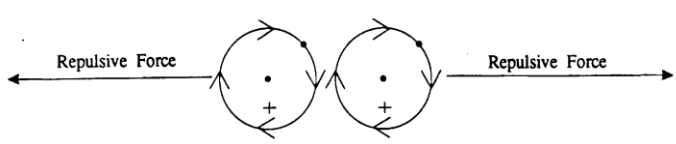

Fig 4 The force exerts on each other by two positively charged particles. In this case, the S-Particles are traveling in the opposite directions and therefore the force between the resulting particles is repulsive.

Interaction: Negatively and Positively Charged Particles

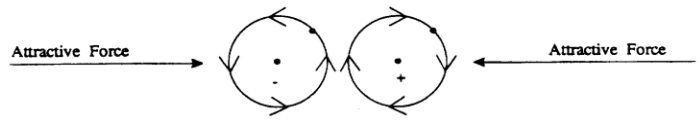

Fig. 5 The force exerts on each other by a negatively and a positively charged particle. At the nearest point of approach the S-Particles are traveling in the same direction and therefore the force between them is attractive.

Note: The net attractive or repulsive force between any two interacting charged particles is not a constant force. The net force is determined by the direction of orbiting motions of their S-Particles at the closet point of approach. When the S-Particles are moving in the same direction at the closest point of approach then the net force between the charged particles is attractive. Conversely, when the S-Particles are moving in the opposite directions then the net force between the charged particles is repulsive. It is noteworthy to point out that the force between any two charged particles is alternating between attractive and repulsive for one complete orbit of their S-Particles. This property of the electromagnetic force is due to the fact that the direction of orbiting motions of the S-Particles is alternating between the same direction and opposite directions. This unique characteristic of the electromagnetic force agrees with Maxwell's equation that the propagation of the electromagnetic force is alternating between the electric field and magnetic field.

The above diagrams illustrate how the electromagnetic force is manifested between charged particles. This force is long range because the distortions created in the E-Strings are long range. This description of the electromagnetic force eliminates the need for the complicated and abstractive quantum mechanical explanation. In addition, this explanation has no infinities to contend with because the electric charge is not within the particle itself. Therefore, there is no need for the dubious renormalization procedure to get rid of the infinities as in the quantum mechanical description of this force.

The Nuclear Strong Force

This force is responsible for binding the protons and the neutrons in the nucleus. At a more fundamental level, this force is responsible for the binding of the quarks of the protons and neutrons to form the nucleus. According to quantum mechanics the nuclear strong force is manifested by the exchange of messenger particles known as gluons.

The Model Mechanical description of the nuclear strong force is very simple. It is caused by the absolute motion (V_{suq} and V_{sdq}) of the S-Particles of the quarks in the protons and neutrons. This description of the nuclear strong force raises the question: Since the quarks in the protons and neutrons are negatively and positively charged particles, how do they manage to stick to each other? The answer is stacked-interaction. When two particles of the same charge are stacked on top of each other, their S-Particles are traveling in the same direction. Therefore, they exert an attractive force on each other. The following diagrams illustrate the stack interaction concept.

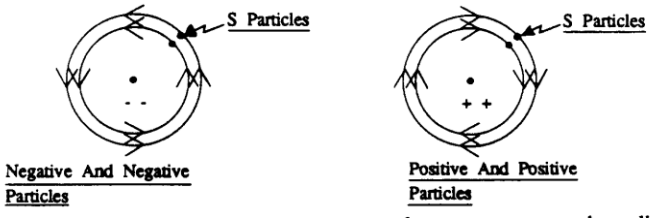

Fig. 6 The stacked interactions of two similarly charged particles. The negative particles would be the down quarks and the positive particles would be the up quarks.

Note: All quarks of the same family have the same orbital diameter. The different orbital diameters shown here are served to illustrate the stacked-interactions. The negative and negative particle interaction is the stacked-interaction of the down quarks. The positive and positive interaction is the stacked-interaction of the up quarks.

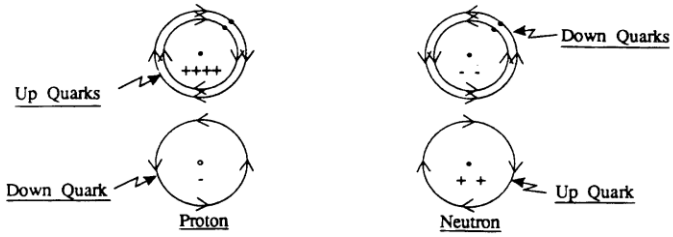

Fig. 7 The stacked-interactions and the electromagnetic interactions in a proton and a neutron.

Note: The proton is formed by the stacked interaction of the up quarks and the electromagnetic interaction between the stacked up quarks and the down quark. The neutron is formed by the stacked interaction of the down quarks and the electromagnetic interaction between the stacked down quarks and the up quark.

It is noteworthy to point out that the attractive stacked-interactions are effective only within a short distance of 10^{-13} cm. At a greater distance than that the stacked-quarks exert a repulsive force on each other. This is the exact behavior of the nuclear strong force that we observed in the laboratory. Another peculiar property of the nuclear strong force is that it becomes stronger when the interacting particles are being pulled apart. This peculiar property is also predicted by Model Mechanics as follows: When the stacked particles are pulled apart the E-Strings surrounding them becomes more distorted and they will try to recover to the non-distorted state by pushing the orbiting S-Particles together. This means that the energy required to pull them further apart will be increased accordingly.

The Nuclear Weak Force

Quantum Mechanics describes this force as the force that causes the decaying processes of all the unstable particles through time. The quantum mechanical process for the weak force involves a process called the spontaneous breaking of symmetry. This process gives rise to the weak force messengers W^+, W^- and Z^0. These are virtual particles whose brief existence is financed by the uncertainty of energy and time relationship. Also, this description of the nuclear weak force depends on the existence of yet another class of particles known as the Higgs particle. The Higgs particle is necessary because it is the mechanism that imparts mass to the weak force messengers.

Model Mechanics gives a much simpler description of the weak force. In the case of a heavy nucleus, such as a uranium nucleus, the decay is the result of the de-coupling of the stacked-interactions by a combination of neutron captures follow by the repulsive CRE force. The processes involved are as follows:

1. A free neutron is captured by a decaying nucleus
2. The stacked interactions at the site of neutron capture are weakened. This enables the repulsive CRE force to de-couple the weaken stacked-interactions and give rise to the nuclear weak force.

In the case of a subatomic particle, the decaying process is different. The best-known subatomic particle-decaying process is the neutron decay, also known as the beta decay. Quantum Mechanics does not specify when a free neutron will decay or why it will decay in about sixteen minutes. On the other hand, Model Mechanics is capable of describing the neutron decay process in detail. The following diagrams will help the reader to visualize the processes involved.

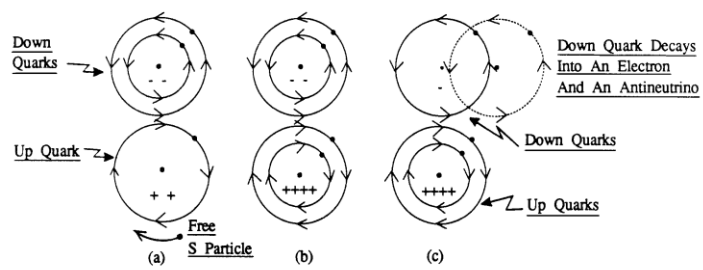

Fig. 8 Schematic diagrams for the neutron decay process (Beta decay)

a) The up quark in an unbounded neutron exerts an attractive force on any free S-Particles that are traveling in the same direction as its S-Particle. When a free S-Particle follows the orbit of the orbiting S-Particle of the up quark, it becomes an up quark. This new up quark immediately forms a stacked interaction with the original up quark.
b) The down quark between the two-stacked up quarks is pulled closer to them because it feels the force from both of them.
c) This has the effect of moving the stacked down quarks laterally relative to each other. When the lateral movement is greater than the radius of the down quark, the force between the stacked down quarks becomes repulsive. This causes the down quark that feels less attractive force from the two-stacked up quarks to peel away. The peel away down quark will then interact with a free S-Particle to give an electron and an antineutrino.

The decaying process for a subatomic particle such as a muon is different from that for a neutron. It was found that a muon at a speed closed to that of light would have a much longer decay length than that of a muon at the rest frame of the laboratory. When these decay lengths are converted to decay times they agree with the SRT time dilation equation. This led physicists to claim that the muon decaying process is a proof of the time dilation concept of SRT. The Model Mechanical explanation of the muon decay process is as follows:

1. The orbit of the muon's S-Particle is unstable and it will decay into a stable orbit of the electron.

2. In the rest frame of the Lab a muon decays in 2.2 microseconds.
3. In the rest frame of the cosmic muon it has a decay time of 2.2 microseconds.
4. However, the cosmic muon's 2.2 microseconds is worth $(2.2*10^{-6})(F_{aa}/F_{ab})$ seconds on the Lab clock..
5. Therefore from the Lab point of view the decay length for a cosmic muon is:
   $v(2.2*10^{-6})(F_{aa}/F_{ab})$ meters
   Where v is the relative velocity between the Lab and the traveling muon.
   This Model Mechanical prediction for the decay length of a traveling muon agrees with experimental observations.

The Structure of Atoms

Current physics' description of an atom is as follows: The nucleus of an atom is composed of protons and neutrons. The protons and the neutrons are, in turn, composed of quarks. The force that holds the nucleus together is the nuclear strong force. The nuclear strong force is manifested by the exchange of messenger particles (gluons) among the quarks. The electrons of an atom exist as waves surrounding the nucleus and these waves can exist only in specific allowed orbits. The reason is that the electron waves are in phase at those orbits. This abstract description of the structure of an atom is, in theory, capable of calculating the allowed orbits of all the electrons of any atom. However, in practice the calculations involving more than a few electrons become so complicated that we cannot do them.

The Model Mechanical description of the structure of an atom is non-abstractive. The nucleus of an atom is formed by the stacked and electromagnetic interaction of the S-Particles of the up quarks and down quarks. The question for this Model Mechanical description is: How an electron manages to maintain an orbit around the nucleus? To answer this question, let us examine the simplest of all the atoms, the hydrogen atom. The nucleus of a hydrogen atom is a proton that is shown schematically in Fig. 7. Now let us introduce an electron to the proton--now it becomes a hydrogen atom Fig.9. Within the nucleus, the down quark is in an orbiting motion around the up quarks. The direction of the orbit is such that it is the same as that of the S-particles (clockwise direction) of the stacked up quarks. Similarly, the direction of the orbit of the electron is the same as that of the down quark. Now let us examine the forces that these particles exert on each other. The stacked up quarks exert an attractive force on the down-quark and the electron, and the down-quark exerts a repulsive force on the electron. At ground state, the attractive and the repulsive forces acting on the electron are in equilibrium and thus, it is allowed to orbit at this energy state. There is only room for one more electron at the ground state orbit. The reason is that the electrons exert a repulsive force on each other and therefore, they must maintain a proper distance from each other: The ground state orbit is the diameter of the hydrogen atom. This orbiting scheme, by the way, does not violate Pauli's exclusion principle that two electrons cannot have the same quantum state. The S-Particles of these electrons are orbiting in the opposite direction. In quantum mechanical terms, they have the opposite spin..

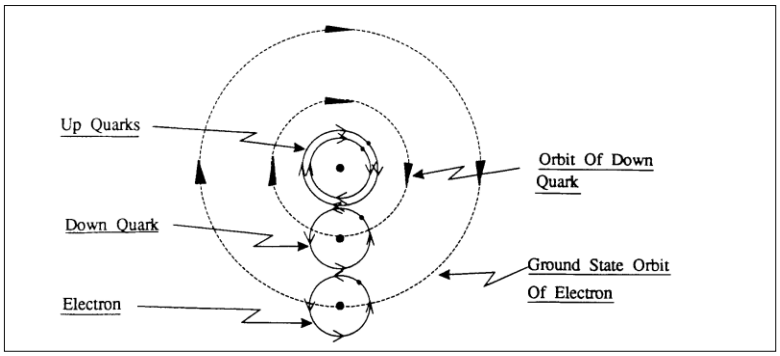

Fig. 9 Schematic diagram of a hydrogen atom according to Model Mechanics, the nucleus of a hydrogen atom is a proton and the proton is composed of two stacked up quarks and the stacked up-quarks are interacting with the down-quark with an attractive electromagnetic force.

It is interesting that inside the ground state orbit the electron will feel a repulsive force, while outside the ground state orbit the electron will feel an attractive force. These unique properties enable the electron to absorb and emit energy in discrete packets. The following diagram will help us to visualize how energy and radiation are being absorbed and emitted by a hydrogen atom.

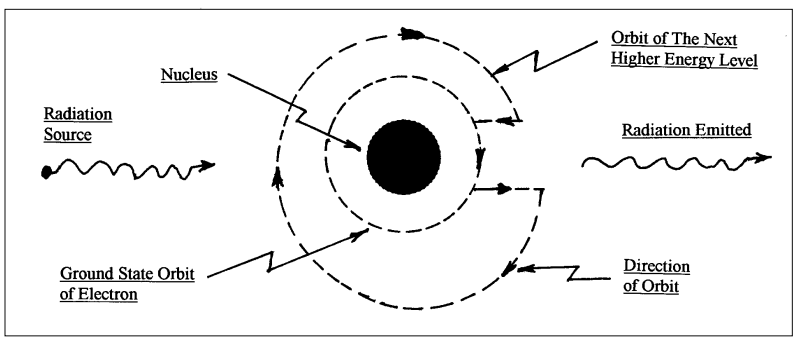

Fig. 10 A schematic diagram illustrates how a hydrogen atom absorbs and emits radiation in discrete packets.

The above diagram explains why an atom produces sharp spectrum lines. The step-by-step process is as follows. Previously, I have illustrated that at the ground state orbit there is no net force exerted on the electron by the quarks in the nucleus. However, when an electron is exposed to a quantum of energy, it will absorb that specific energy immediately. This will elevate it into a higher orbit. At this higher orbit, the electron will feel a net attractive force from the nucleus. This net attractive force will cause the electron to lose energy gradually as it spirals inward toward the ground state orbit. As the electron orbits behind the nucleus, it is cut off from the energy source completely. This causes it to lose all of its absorbed energy and drop back to the ground state orbit immediately. The energy emitted by this process will appear to us as discrete and lumpy, and that is exactly what was found.

The gradual loss of energy by the electron gives rise to its unusual shifted orbit. With quantum mechanics, this shifted orbit is interpreted as the maelstrom of activities of the virtual particles that buzz around the electron. Clearly, the above Model Mechanical explanation is much more preferred. Willis Lamb discovered the shifted orbit of the electron experimentally in 1947 and it is called the Lamb's shift. He was awarded the Nobel Prize for this finding.

It was postulated previously that the nucleus of an atom is formed by the stacked interactions of protons and neutrons. Therefore, looking at a nucleus sideways, it will appear to be cylindrical, instead of the normal concept that it is spherical. The rules governing the orbits of the electrons in a heavy atom are much more complex than that for hydrogen because the repulsive forces among all the electrons must also be considered. It is beyond the scope of this book to deal with this subject in detail. However, the structures of helium, lithium, beryllium and boron are shown as follows:

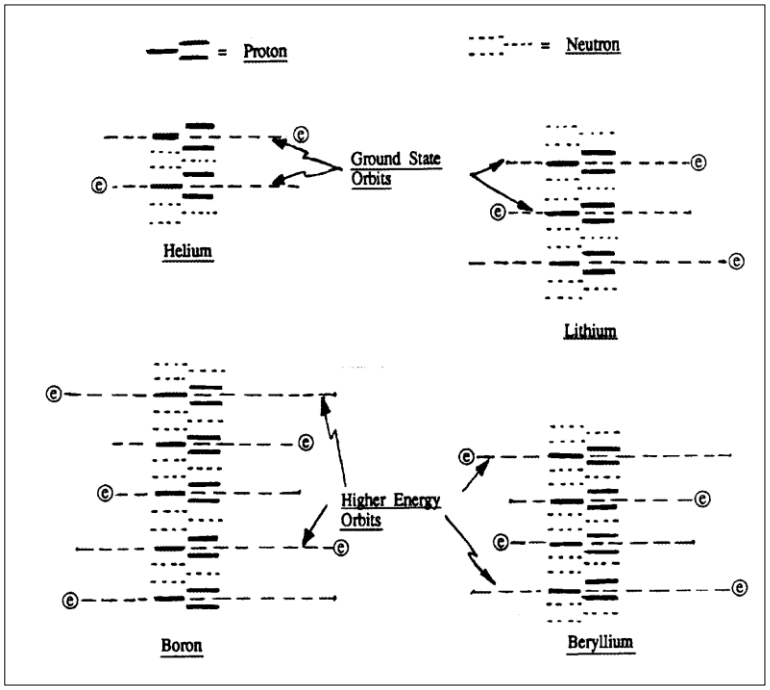

Fig 11.Schematic diagrams show the stacked interactions of protons and neutrons in the nucleus of helium, lithium, beryllium and boron. Also, the electromagnetic interactions between these nuclei and the electrons surround them to form the final atoms.

The above Model Mechanical description of atom formation is valid for all the atoms in the universe. It eliminated the need for the complicated hypothetical strong force. It shows the physical mechanism how an atom absorbs and emits light. It explains the experimentally observed Lamb's shift. In addition, Model Mechanics provides a physical mechanism for the unification of all the forces of nature. In short, Model Mechanics is a natural candidate for a theory of everything.