A Proposed Physical Model for Our Mathematics

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Introduction

In the past 100 years theoretical physics and cosmology development have been conducted almost exclusively on a mathematical basis, leading to non-physical objects or processes such as fields, space-time, curvature in space-time, time dilation, length contraction, virtual particles, action at a distance, curled-up dimensions, Entanglement, Dark Energy, Dark Matter....etc. It is posited that these non-physical mathematical objects must have their origin from one physical model of our universe. A new technique for doing physics called the Pyramid Technique enabled me to find this physical model. The result is Model Mechanics. Model Mechanics gives valid physical processes to replace all the abstractive mathematical objects of the current theories. In addition, it gives rise to a new theory of relativity called IRT and a new theory of gravity called DTG. IRT in combination with DTG can be used to replace SRT and GRT in all applications. In addition the unification of DTG with the electromagnetic and nuclear forces of nature become feasible.

The Peril of Mathematics without Physical Constraint

Mathematics is a powerful tool that we use to describe the processes of nature. However, mathematics without physical constraint may not lead to the true physical description of the processes involved. For example let us examine the simple equation of \( \frac{x}{y} = 2 \). If \( y \) represents people and \( x \) represents apples, this equation implies that every person gets two apples. This equation contains all the possible real initial conditions—even number of apples and whole number of persons. This equation also contains all the non-real initial conditions—odd number of apples and fractional number of persons. These are non-existing initial conditions because a fraction of a person doesn't exist in our universe.

The peril of mathematics begins when there is no known physical constraint available to guide our interpretations of our mathematics. Take the case of Schrödinger's equation —physicists invented the concept that a particle such as an electron can become a probability wave front as it leaves the source. This probability wave front will re-collapse into a particle electron when it hit the detector. The location where it hits the detector is dependent on the probability amplitude at that location. These interpretations of the Schrödinger equation is carried forth to other future development of theoretical physics and that, in turn, leads to more complicated models. This method of doing physics is carried forth to this day. The super string theories are the prime example of such developments. The most promising super string theory posits the existence eleven dimensions of space and one dimension of time. Since we only see three dimensions of space, string theorists assert that the other seven dimensions of space are curled up and making them undetectable experimentally.

It is likely that mathematical development alone will not lead to a true Theory of Everything. This led me on a search for a physical model of our universe that can provide physical interpretations for our mathematics. The Pyramid Technique is used for this search and the result is the physical model of Model Mechanics. The rules of the Pyramid Technique are as follows:

1. There are three dimensions of space and one dimension of absolute time. No abstract mathematical object is allowed.
2. Search the literatures and identify the major problems of current theories. The result of this search identified the following major problems of the current theories: The lack of a physical explanation of gravity; The observed accelerated expansion of the universe; The Horizon problem; The Flatness Problem; The Galactic rotational curve problem; Dark Energy and Dark Matter.
3. Formulate a physical model that can account for these problems. The formulator is free to assume any physical model of the current state of the universe. The assumed physical model must be capable of explaining all the forces and processes of nature. In addition, the mathematics of the current theories must be derivable from this physical model.

4. Use this physical model to develop a new theory of gravity that is compatible with the other forces of nature and derive a complete theory of relativity from this physical model that is compatible with quantum field theories.

5. Formulate a new theory of relativity that avoid all the paradoxes of the current Special Relativity Theory.

The *Pyramid Techniques* enabled me to go through a number of possible states of the current universe quickly. The first model that was somewhat successful posits that space is filled with a substance called the E-Matrix (the prefix "E" represents elastic). The E-Matrix exerts a repulsive force on all the matter particles within it. In other words, a particle in the E-Matrix is much like a droplet of oil emulsion in water—it feels the repulsive force of the water from all sides. When the E-Matrix is distorted, it will recover itself to the original non-distorted state quickly. Light is waves in the E-Matrix and time is absolute, not flexible, as postulated by the Special Relativity Theory (SRT). This model of the universe explains the propagation of light but it was not capable of explaining the various force interactions without resorting to abstract processes; therefore, it was not a successful model.

As a means of increasing the scope of this model, I visualized that the E-Matrix is composed of E-Strings. These E-Strings are three dimensional elastic strings and they are oriented randomly in all directions. The motions of matter particles in the E-Matrix will distort the geometry of the E-Strings locally. On the other hand, matter particles will follow the local geometry of the E-Strings (due to orbital confinement) as they travel in the E-Matrix. This modified model brings General Relativity into the fold. However, it lacked the processes to describe the electromagnetic, nuclear weak and strong forces. It was evident that additional modifications were needed to explain these interactions. The next idea that I added to the above model is one of the most important ideas of Model Mechanics. This idea posits that all the forces of nature are the results of absolute motions between the interacting particles or particle systems. These modifications completed the modeling process and yield the physical model of Model Mechanics.

**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 of a particle 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 of Relativity Theories and the fields/virtual particles of Quantum Field Theories with the E-Matrix and the distortions or waves in the E-Matrix. This enables us to use the math of Quantum Field Theories (QFT) in combination with the physical interpretations of Model Mechanics to explain all the processes of nature.
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 different absolute motions of the S-Particles or S-Particle systems in the E-Matrix.
4) All the forces of nature are the results of the S-Particles 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-String(s).
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. It eliminates the need for the undetectable force messengers in QM. It eliminates the need for the hypothetical 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.

**Improved Relativity Theory (IRT)**

The Model Mechanics description of the current state of our universe gives rise to a new theory of relativity called Improved Relativity Theory (IRT). IRT eliminates the SRT constant light speed postulate in all inertial frames. This, in turn, eliminates all the paradoxes derived from these postulates. The equations of IRT are valid in all environments, including gravity. Therefore IRT can be used to replace GRT in all applications.

**The IRT Postulates:**

1. Every object in our universe is in a state of individual absolute motion in the E-Matrix.
2. Relative motion between two objects in the E-Matrix is the vector difference of their absolute motions along the line joining them.
3. The measured wavelength of a standard elementary source is a universal constant in all frames of reference.
4. Time is absolute. However a clock second does not represent the same amount of absolute time in different frames.
5. The speed of light in the frame of the standard elementary source is isotropic.

The consequences and the math of IRT are available in the Technical Endnotes Section.

**The Model Mechanics Concept of Forces**

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.

![Diagram of currents in parallel wires](image)

**Fig.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.
Fig. 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.

Cosmological Repulsive Effect (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 confinement of the interacting objects to the diverging structure of the E-Matrix.

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 are 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.

The Force 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. However, GRT also encounters problems with some current observations as outlined in the next section of this paper.

As a mean to resolve the problematic observations encounter by GRT a new theory of gravity called Doppler Theory of Gravity (DTG) is formulated. Like Newton’s theory of gravity, 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 in the E-Matrix 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.
3. The force of gravity between A and B is the combined result of items 1 and 2 above. 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.

4. The above description for gravity suggests that the Newtonian equation for gravity can be modified to make it consistent with observations as follows:

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

(14)

The dot product \((j_a \cdot (\pm j_b))\) in Eq. (14) 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 motions of expansion are attracted to each other, but those objects that have absolute motions of expansion in the opposite directions exert a repulsive force on each other. Assuming the Big Bang model is correct then the dot product of the unit 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. This is the reason why the far reached regions of the Universe are in a state of accelerated expansion.

The DTG description of the force of gravity uses the same mechanism as that for the electromagnetic and nuclear forces. This enables Model Mechanics to achieve the elusive goal of uniting gravity with the electromagnetic and nuclear forces naturally.

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 Nuclear Strong Force

This force is responsible for the 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 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 \( (V_{\text{abs}} \text{ and } V_{\text{rel}}) \) 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 stacked 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.
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. 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. Therefore, 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.

Conclusions
Mathematical development of theoretical physics and cosmology without physical constraints leads to non-physical abstractive mathematical objects. The Pyramid Technique provides a new way of doing physics and the result is Model Mechanics. Model Mechanics provides physical explanations for all the non-physical mathematical objects invented to explain the mathematics of our current theories. Model Mechanics gives rise to a new theory of gravity called DTG. DTG is compatible with the electromagnetic and the nuclear forces. In addition, Model Mechanics gives rise to a new theory of relativity called IRT. The math of IRT includes the SRT math as a subset. The equations of IRT are valid for use in all environments, including gravity and therefore they are valid for use to replace SRT and GRT in all applications. The successes of the Pyramid Technique suggest that it should be used for all future development of theoretical physics and cosmology.

Reference:
Technique Endnotes

The Math of IRT:
The existing SRT equations are converted to IRT equations when the observed frame is in a higher state of absolute motion than the IRT observer. New IRT equations are developed when the observed frame is in a lower state of absolute motion than the IRT observer. The conversion factors from observer A’s point of view:

\[ \nu = \lambda_a (f_{aa} - f_{ab}) \quad \text{Relative Velocity} \]
\[ c = \lambda_a f_{aa} \quad \text{Local speed of light} \]
\[ c' = \lambda_a f_{ab} \quad \text{Incoming speed of light} \]
\[ \gamma = \frac{F_{aa}}{F_{ab}} \quad \frac{1}{\gamma} = \frac{F_{ab}}{F_{aa}} \]

\( \lambda_a \) = Wavelength of the standard elementary light source used as measured in observer A’s frame.
\( f_{aa} \) = Instantaneous frequency measurement of A’s standard elementary light source as measured by A.
\( f_{ab} \) = Instantaneous frequency measurement of B’s standard elementary light source as measured by A.
\( F_{aa} \) = Frequency of a standard elementary light source in A’s frame as measured by A.
\( F_{ab} \) = Transverse Doppler Frequency of an identical standard elementary light source in B’s frame as measured by A.

The Behavior of Cocks A and B in Relative Motion:

\[ \Delta T_{ab} = \frac{F_{aa}}{F_{ab}} \Delta T_{aa} \quad (1) \]
This equation applies when the observed clock B is in a higher state of absolute motion than observer A’s clock. It shows that the passage of an interval of clock time \( \Delta T_{ab} \) on the observed B clock corresponds to the passage of \( (F_{aa}/F_{ab}) \Delta T_{aa} \) on observer A’s clock. However, both clock time intervals shown represent the same amount of absolute time. This means that the rate of passage of absolute time is independent of the absolute motion of the clock.

\[ \Delta T_{ab}^* = \frac{F_{ab}}{F_{aa}} \Delta T_{aa} \quad (2) \]
This equation applies when the observed clock B is in a lower state of absolute motion than clock A. It shows that the passage of a clock time \( \Delta T_{ab}^* \) on the observed B clock corresponds to the passage of clock time interval of \( (F_{ab}/F_{aa}) \Delta T_{aa} \) on observer A’s clock. However, both clock time intervals represent the same amount of absolute time. This means that the rate of passage of absolute time is independent of the relative or absolute motions of the clocks.

It is noted that only one of these two equations is valid for any pair of clocks in relative motion. If the observed clock B’s absolute motion is higher than the observer A’s clock then Eq. (1) is used and if the observed clock B’s absolute motion is lower than observer A’s clock then Eq. (2) is used. In accelerator design applications Eq. (1) is used exclusively. The reason is that acceleration will increase the state of absolute motion of the accelerated particle.

Light Path Length of a Moving Meter Stick:
The light path length of observer A’s meter stick is defined to be its physical “or material length. The following equations predict the light path lengths of B’s meter stick. When B is in a higher state of absolute motion than A the following equation is used to predict the light path of B’s meter stick.
When B is in a lower state of absolute motion than A the following Eq. (4) is used to predict the light path length of B’s meter stick.

\[ L'_{ab} = \frac{F_{ab}}{F_{aa}} L_{aa} \]  

(4)

It is noted that the physical or material length of a meter stick is a universal constant in all frames of reference. However the light path length of a meter stick moving with respect to the observer is observer dependent. Also it is noted that only one of these two equations will provide the correct prediction. If the state of absolute motion of B compare to A is not known then both calculations are made and the result that agrees with observation is chosen.

**IRT Coordinate Transformation Equations:**

Equations (5) and (6) are used when the observed frame B is in a higher state of absolute motion than observer A.

\[ \Delta x'_{ab} = \frac{F_{aa}}{F_{ab}} \left[ \Delta x_{aa} - \lambda_a \left( f_{aa} - f_{ab} \right) \Delta t_{aa} \right] \]  

(5)

\[ \Delta t'_{ab} = \frac{F_{aa}}{F_{ab}} \left[ \Delta t_{aa} - \frac{f_{aa} - f_{ab}}{\lambda_a f_{ab}^2} \Delta x_{aa} \right] \]  

(6)

Equations (7) and (8) are used when the observed frame B is in a lower state of absolute motion than observer A.

\[ \Delta x'_{ab} = \frac{F_{ab}}{F_{aa}} \left[ \Delta x_{aa} + \lambda_a \left( f_{aa} - f_{ab} \right) \Delta t_{aa} \right] \]  

(7)

\[ \Delta t'_{ab} = \frac{F_{ab}}{F_{aa}} \left[ \Delta t_{aa} + \frac{f_{aa} - f_{ab}}{\lambda_a f_{ab}^2} \Delta x_{aa} \right] \]  

(8)

**Momentum of an Object:**

\[ p = M_o \lambda_a \left( f_{aa} - f_{ab} \right) \]  

(9)

**Kinetic Energy of an Object**

\[ K = M_o \lambda_a^2 f_{ab}^2 \left( \frac{f_{aa}}{f_{ab}} - 1 \right) \]  

(10)

**Energy of a single particle:**

\[ E = M_o \lambda_a^2 f_{ab}^2 \]  

(11)

**Gravitational Time Dilation:**

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

(12)