Doppler Phenomena Determined by Photon-Cosmic Field Interactions

Viraj Fernando
100, Mornelle Court, #1100, Toronto, Ontario, M1E 4X2, CANADA
e-mail: virajplf@yahoo.co.uk

This paper concerns a new field of study – Energy Mechanics. It is discerned that all systems are open and there is an ingress and egress of energy from particles and photons into the cosmic governing field in all interactions. And all phenomena are determined by algorithms which regulate the ingress and egress of energy. Doppler shifts, aberration, and Fresnel's formula for motion of light are all explained as photon cosmic field interactions determined by algorithms.

Keywords: Energy interactions, natural coordinate systems, constancy of coordinate volume, cosmic governing field, information, algorithms, ingress and egress of energy to the field, induction of energy.

1. Introduction

Ever since the introduction of the theory of relativity, physics has been under a spell of a belief in a mysterious connection between the motion of light and motion of particles. A consequence of this is that our vision towards both these branches of study has become blurred, and confusion has ensued. The reason behind this confusion is due to the way the appearance of the value c in the expressions of relativistic phenomena of motions of particles has been attempted to be accounted for by the relativity theory. Namely, due to the circumstance that the velocity of light (in vacuo), coincidentally happens to have the same value c, the 'detectives' have misconstrued fatally that motion of light is 'guilty by association' and it is the sole 'culprit', for the appearance of c in relativistic expressions. And as a consequence, a whole mathematical theory has been contrived to obtain such results on the basis that space and time are connected and that this connection is mediated by the motion of light. The detrimental consequence of this makeshift mathematical theory is that by the false elevation of light to a role that it does not really play, the understanding of the Nature of Light itself has been obscured.

On the other hand, as a form of energy, photons have features analogous to the behavior of particles in motion and under gravitation. And particles in turn have features analogous to behavior of energy in a thermodynamic system. These similarities prompt us first to inquire first into the behavior of a simple thermodynamic system, and then apply that to a dynamic system, and finally come to an understanding of the Nature of Light by discerning the extent to which photons behave in a manner somewhat analogous to a dynamic system under gravitation.

On the basis of these similarities and differences encountered with different types of energy we embark on a new field of study – Energy Mechanics.

2. Energy Mechanics

2.1 Energy Mechanics - Why the Value *c* Appears in the Expressions of Relativistic Phenomena.

This paper discerns the appearance of the value c in relativistic expressions to a multiplicity of interrelated reasons. The reasons are:

A) In order that applied energy Q that moves a body (of mass M and 'rest energy' $E = Mc^2$) at velocity v, both Q and E have to first of all bond together. Just like when an electron and a positron bond together they both lose a fraction each of their internal energy in equal proportions, both Q and E also lose fractions in equal proportions. Q loses Q $(1 - 1/\Gamma)$ and what remains is Q/Γ, where $\Gamma = 1/(1-v^2/c^2)^{1/2}$, and the body loses from its internal energy E the fraction $E(1-1/\Gamma)$ and therefore the internal energy of the moving body becomes E/Γ. The whole architecture of relativistic phenomena pivots on this fractional loss of energy for bonding (see fig. 1). And this architecture is determined by a geometric algorithm which we explain in sec 2.10. This makes it implicit that it is the loss of fractions of energy in the above manner that makes the gamma-factor to appear in the expressions of phenomena.

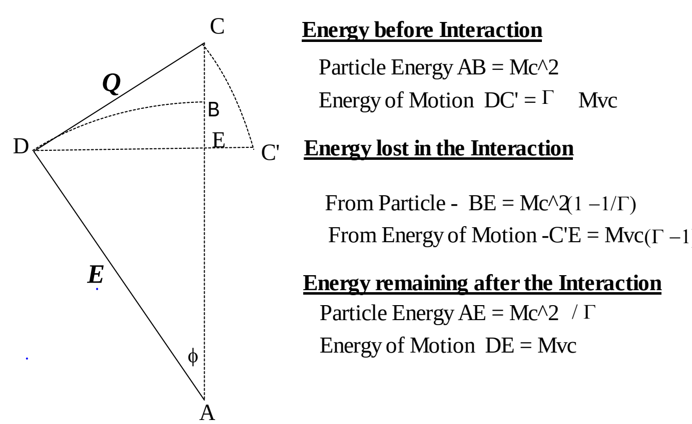

Fig. 1. Loss of fractions of energy for bonding.

The geometry of this interaction is determined as follows. Let Q = MVC. Consider in Fig.1, i.e., Q being represented by the line segment DC (Q = DC) and E being represented by the line segment AD (E = AD) and these two lines to be in a configuration orthogonal to each other. Join AC. Let B lie on AC such that. AD = AB. Let DC′ be perpendicular to AC and intersect the latter at E. Let the angle DAC = ϕ. Let the DE = Mvc such that the velocity of motion of the particle be v. Let DE be the energy of motion left available after bonding. DE = DC cos ϕ = Q$\cos\phi$ = Mvc. (such that v = V$\cos\phi$). The quantity of energy lost for bonding =

$EC' = Q(1 - \cos\phi)$. Since $DE = Mvc$ and $AD = Mc^2$, $DE/AD = Mvc/Mc^2 = v/c = \sin\phi$. Hence $\cos\phi = (1 - v^2/c^2)^{1/2}$. Let $\cos\phi = 1/\Gamma$. Then the fraction that is lost from the applied energy of motion = $Q(1-1/\Gamma)$. Similarly, the particle energy that is lost for bonding is $D'E = Mc^2 (1- \cos\phi) = Mc^2 (1- 1/\Gamma)$. The scaling factor by which the energy is reduced to, to enable bonding is given by $(1 + Q^2/E^2)^{-1/2}$

Bonding of the two quantities of energy Q and E occurs through withdrawal of fractions of energy and scaling them down to Q′ and E′, and thereby making them to share each other's energy. Therefore one of the reasons why we find the term c in relativistic expressions is because the scaling factor for bonding of two energies is determined by the function of the ratio of square of energies $(1- Q'^2 /E^2)^{1/2} = [1 - (Mvc/ Mc^2)^2]^{1/2} = (1 - v^2/c^2)^{1/2}$.

Gamma-factor, is the ratio of energy before and after the interaction $\Gamma = Q/Q' = E/E' = (1 + Q^2/E^2)^{1/2} = (1-v^2/c^2)^{-1/2}$.

B) The second reason for the appearance of c in relativistic expressions is that applied energy $Q = \Gamma Mvc$ that moves a body (of mass M at velocity v) exists as a product of active component x passive component. The active component is what has come to be called as "momentum" $p = \Gamma Mv$ and the passive component is the constant c. Hence active component x passive component = ΓMvc. Therefore, the ratio of applied energy/ momentum = $\Gamma Mvc/\Gamma Mv = c$.

C) The third reason for the appearance of c in relativistic expressions is that the active component (momentum) in turn is itself composed as the product of two components – impedance x mobility. When the mobility component of momentum p is assigned the limiting value c, impedance component assumes the value $p/c = m$. And m is the intrinsic inertia of the quantity of energy Q such that $Q = mc^2$.

D) Fourthly, value c appears in relativistic expressions also due the fact that the ratio of the energy ΓMvc that moves the body and the 'rest energy' Mc^2 of the body is $\Gamma Mvc/Mc^2 = \Gamma v/c$. After the two quantities of energy have bonded by losing fraction $(1 -1/\Gamma)$ each, of themselves to form a system, they become Mvc and Mc^2/Γ. Their ratio too, still remains $Mvc/(Mc^2/\Gamma) = \Gamma v/c$. It is this same ratio $\Gamma v/c$ that serves as the measure.(or the gauge) **for induction of energy from the field** in the process of formation of the system (as we discuss below in sec. 2.11). That is when the net energy of motion is Mvc, a quantity of energy $(Mvc).(\Gamma v/c) = \Gamma Mv^2$ gets **induced from the field** towards .formation of the system. It is this induced energy from the field that underlies the force that appears when a system is in motion. It can take the form of the centrifugal force in the case of a moving particle, magnetic force when a current runs in a conductor or Lorentz force when a charge is in motion.

2.2 Energy Mechanics -Historical View of the Appearance of c in Relativistic Expressions.

If we look back historically, Biot-Savart's law was discerned in 1820, in which a factor having a certain definite value and having the dimensions of a velocity was found to be required to balance the equation of the ratio of magnetic intensity and the electric potential E at any given point in the surrounding field such that $H/E = v/c$ (where v is the velocity of passage of the current in the conductor and that other definite velocity was denoted by the symbol c [1]. Note that there was no association made at this stage between the symbol c and the velocity of light). What was being revealed through this relationship was the Nature's secret, that when a charge of q is moved by electromagnetic momentum qv at velocity v, there is a quantity of momentum that is **induced from the field**, orthogonally to qv and equal to $qv.v/c$ at the conductor, and how the relationship between the two manifests in the surrounding field at a given distance, as the electric potential and the magnetic intensity. Further with deeper implications what this relationship was prompting us was to recognize the following four matters

a) that there are **no closed systems** as envisaged in classical physics but that **all systems are open** and that in all interactions (of both charged and inert particles) there is an exchange of energy between the empirical interactants and the field **without exception.**

b) that nature's innate relationship between energy and momentum is:- energy = momentum x c,

c) that when the energy E of a particle (in the form of a mass or a charge) interacts with a quantity of energy of motion Q, on the one hand, both empirical interactants E and Q lose a fraction each of their original values by the factor $(1-1/\Gamma)$; and on the other hand a further quantity of energy gets **induced** from the field equal to $Q^2/\Gamma E$. If this concerns a 'mass-particle' of mass M, $Q^2/\Gamma E = \Gamma Mv^2$ and if it concerns a charge q, then $Q^2/\Gamma E = \Gamma qv^2$. [where $\Gamma = 1/(1-v^2/c^2)^{1/2}$].

d) that the interaction between empirical interacants and the concomitant induction of energy from the field are determined geometrically by an algorithm of a definite relational structure, which includes all the above elements, in a feed-back loop [2]. And by this algorithm, the interconnection between all phenomena is revealed. (see figs. 8 & 9)

2.3. Energy Mechanics: Property Coordinates in place of Space-Time Coordinates

In the current paradigm in physics, the underlying belief is that every physical entity is ultimately constituted by a combination of the physical units of mass length and time as their primitive categories. In classical theory and in relativity, velocity and acceleration are not considered as property aspects of energy, (in the same way volume, pressure and temperature come to be considered as properties of heat energy in thermodynamics). Velocity and acceleration are considered only as mathematical entities, as the first and second derivatives respectively of space coordinate with respect to time. (In the present theory, velocity and acceleration are identified as property co-ordinates in the two forms that energy configures itself into, depending on circumstance, in interactions. In one form the net energy of motion $Q' = Mvc$ and in the other form $Q' = Ma(dx)$).

Further in the theory of relativity, it is only the space and time that are considered as the structural elements that form the four-dimensional co-ordinate system, while mass as a primitive physical unit has no co-ordinate function whatsoever in that system. That is, changes of states are considered as functions of length and time co-ordinates in a 4-D co-ordinate system where the dimension of mass has no co-ordinate function. Mass is relegated to the background, and the contention of relativity theory, of mass increase with the increase of velocity gets no co-ordinate interpretation. Hence the concept of mass increase is now abandoned by most adherents of relativity. And this makes it implicit that according to relativity theory, mass remains constant in interactions, while the space and time co-ordinates vary.

2.4 Energy Mechanics – Property Co-ordinates in Thermodynamic Systems

In thermodynamics, we have a natural co-ordinate system which is operative in bringing about states of changes of energy. A given quantity of energy finds expression as the product of three property co-ordinates. Energy changes from one state to another by the variation of magnitudes of property co-ordinates while maintaining the product of the three co-ordinates – which product, we call as the "co-ordinate volume" constant. In a change of state, the "co-ordinate volume" changes shape as in figure 2, but in magnitude it remains the same.

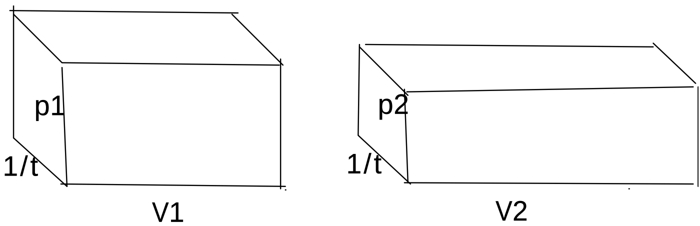

Fig. 2.

If we consider a p-V curve we find that the co-ordinates are constituted by quantities representing the intrinsic properties of the given quantity of energy H which are pressure p, volume V and inverse of temperature t and as such they are property co-ordinates. And in the simplest case of a quantity of energy H being subjected to isothermal changes, the 1/t co-ordinate becomes a hidden parameter, and we have the other two property co-ordinates - pressure and volume co-ordinates conjugately varying against each other as in Boyle's law (as shown in figure 3), where, when V_1 increases to V_2, then p_1 decreases to p_2 such that $p_1V_1 = p_2V_2$.

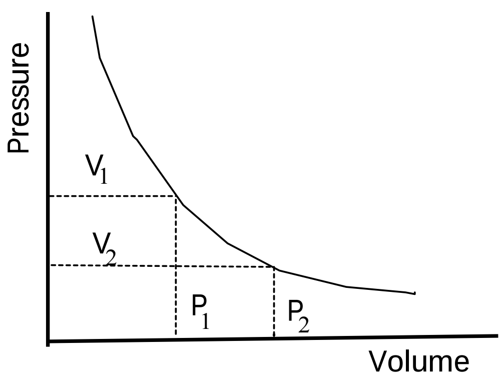

Fig. 3. Volume and pressure as coordinates.

In this we have the quantity of energy $H = pV = p_1V_1 = p_2V_2$. H is a conserved quantity, and pressure and volume are internal parameters that vary conjugately against each other. This conforms to Leibniz Internal Principle of 'Multiplicity in Unity' [3]. Although H considered in dimensional units is found to have the form ML^2T^{-2} , in the graphical representation the primitive categories are the property co-ordinates of pressure and volume, where pressure is the intensive co-ordinate and volume is the extensive co-ordinate. (Here space and time co-ordinates are dispensed with).

We are all familiar with the p-V curve. This curve is given by the points traced by the intersection of the abscissa represented by volume V (the extensive property co-ordinate) and the ordinate represented by the corresponding pressure p (the intensive property co-ordinate). If we consider a point on the p-V curve separately (and not the curve as a whole as such), then we find that each such point is defined by a rectangle formed between the two axes and the two co-ordinates. And when we examine these rectangles we find that they are all of equal area. Since in the isothermal condition 1/t co-ordinate remains the same, if we consider the 'co-ordinate-volume' formed by the three co-ordinates, we find the 'co-ordinate-volume' corresponding to each point (on the curve) is a constant quantity.

This is the **geometric statement** of the **principle of conservation of energy**: The quantity of energy changes from one state to another while the product of its property co-ordinates remain the same equal to H.

What this means is that energy H has a geometric structure consisting of a system of rectangular co-ordinates (V, p, 1/t). The co-ordinates vary while maintaining the co-ordinate-volume constant, in accordance with Leibniz Internal Principle. If we subject these co-ordinates to a dimensional analysis we find that the co-ordinate V has dimensional unit L^3, and p co-ordinate has the dimensional unit $ML^{-2}T^{-2}$ and t co-ordinate is dimensionless.

If we go by Galileo's statement that "the Book of Nature is written in geometric characters", we find that Nature's geometric characters are formed by the property co-ordinates such as the pressure, volume and temperature in a thermodynamic system. And that these property co-ordinates are not necessarily reducible to single dimensions of mass, length and time as contended by the space-time theories. All we can recognize is that a quantity of heat energy H or a quantity of energy of motion **Q exists as a product of the three property co-ordinates** of constant co-ordinate volume and that this **product** has the dimension of ML^2/T^2.

This implies that energy Q that is applied to move a body of mass M, too has an analogous geometric structure – a co-ordinate-volume, consisting of three property co-ordinates.

2.5. Energy Mechanics: Property Coordinates of Energy of Motion

Energy of motion Q exists as a product of inertia co-ordinate x translational velocity co-ordinate x oscillatory velocity co-ordinate (as shown in fig 4a). Similar to an isothermal interaction, where the temperature co-ordinate remains 'frozen' and inactive (passive), in energy of motion, the oscillatory velocity co-ordinate remains permanently inactive and it invariably has the value c. Therefore just as in an isothermal interaction, heat energy H changes state by conjugate variation of the values of the extensive property co-ordinate (volume) and the intensive property co-ordinate (pressure), while the neutral co-ordinate (temperature) remains inactive, in energy of motion Q too, the changes of state occur by way of conjugate variation of the values of extensive co-ordinate (inertia) and the intensive co-ordinate (translational velocity) while the neutral co-ordinate (oscillatory velocity co-ordinate) remains permanently locked in at the value c.

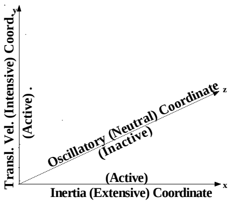

Fig. 4a- Energy organised geometrically as the product of 3 co-ords

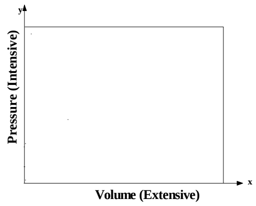

Fig. 4b- Active Component of Heat as the product Volume and Pressure.

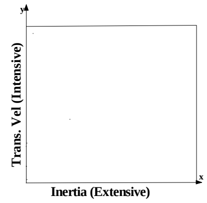

Figure 4c- Active Component of Energy (Momentum) as the product of Inertia and Translational Velocity.

2.6 Energy Mechanics: The Relationship between Energy and Momentum

Consider the dimensions of momentum p which is [MLT^{-1}] and the corresponding quantity of energy Q which is [ML^2T^{-2}]. When we analyze this relationship further, we make the following empirical observation (as against an assumption). We find that a given quantity of energy of motion Q is composed as the product of two components – an active component and a neutral component (oscillatry velocity co-ordinate), such that Q = active component x neutral component. And we identify the active component as 'momentum' p and we also recognize that the neutral component **invariably** has the constant value c such that Q = pc. We also recognize that by virtue of this invariability of the neutral component, c is actually a **universal constant**. Hence this constant is what acts as the **determinant** of the active component (momentum) that is inherent in a given quantity of energy such that p = Q/c. Thus we must note that energy Q and momentum p are not two unconnected, separately existing, independent, conserved entities, but that in a given conserved quantity of energy, there is an inherent active component (momentum), which is itself a conserved quantity.

2.7 Energy Mechanics: Energy of Motion in the Pre-empirical "Platonic Form"

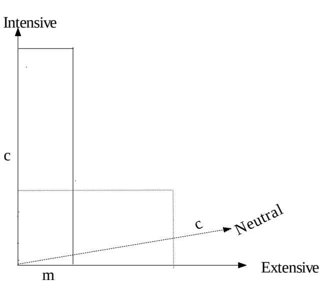

Figure 5a- Energy as Motion in pre-empirical form m*c*c (Platonic form) prior to interaction.

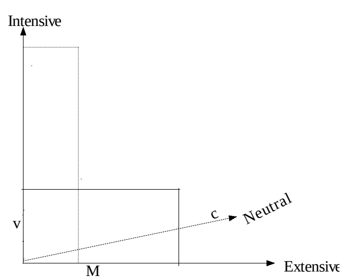

Figure 5b- Energy of motion in empirical form upon interacting with particle energy Mc^2

Further we not only find that the active component p (momentum) is a conserved quantity but that in turn, it is composed of the two components configured as the product of inertia co-ordinate and translational velocity co-ordinate (representing the two opposite tendencies: a tendency of impeding motion – immobility; and a tendency of facilitating motion - mobility). The limiting value for the translational velocity co-ordinate is c. When the conserved quantity p is divided by the limiting value of the translational velocity co-ordinate c, (i.e. p/c) it gives the intrinsic value m of the inertia co-ordinate of the quantity of energy Q. This value of intrinsic inertia co-ordinate m is also a conserved quantity. Thus a quantity of energy Q has its value given as $Q = pc = mc^2$. It must be noted that the value m of this intrinsic inertia, which is the conjugate of c in the constant product m x c = p, is the co-ordinate value-form which is permanent and invariable (hence conserved) in that quantity of energy Q. It is for this reason that we call this co-ordinate value-form the 'intrinsic inertia' of energy.

In this form in which $Q = mc^2$ (Platonic Form) we may also note that the active component - momentum p = mc. We call momentum considered in this value-form (p = mc), the 'Platonic momentum form'. The word 'Platonic' is used to mean, the IDEAL form it would have if it were to purely exist, hypothetically by itself, prior to interacting with a matter particle. (But we know that just as much as a matter-particle cannot exist on its own without being in motion, energy of motion Q cannot exist on its own without being in a state of acting on matter.). So the Platonic form is a mere geometric form without an empirical counterpart. However, when Q acts on a particle of matter, the geometric structure of Q transforms from the Platonic form to the empirical form.

2.8 Energy Mechanics: Energy of Motion in the Empirical-Interactive Form

For the sake of simplicity, let us first consider as true, the classical contention that in order to move a particle of mass M at velocity v, the momentum that needs to be applied is p′ = Mv. The interaction (simplistically considered) occurs in a manner similar to an isothermal change of state. When the cylinder volume is changed to V, the volume occupied by the molecules is V. The energy H **changes its extensive co-ordinate** to assume the value V by mimicking the volume occupied by the molecules , and consequently the intensive co-ordinate of H changes to H/V = p (pressure). Under this empirical condition H has the geometric structure defined the three property co-ordinates having the values V, p and 1/t. Analogously to heat energy, when momentum p′ is applied to a particle of mass M, p′ changes its extensive co-ordinate to assume the value M by mimicking the mass of the body, and consequently the intensive co-ordinate changes its value to p/M = v (translational velocity co-ordinate). In this empirical situation, energy of motion Q has the geometric structure defined by the three property co-ordinates having the values M, v and c (where c = oscillatory velocity co-ordinate which remains inactive).

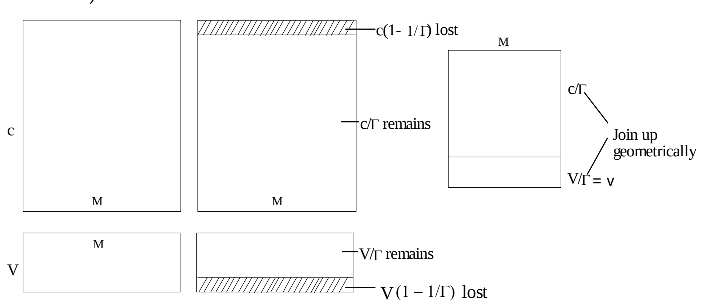

Figure 6- Interaction between particle energy and energy of motion

Let us now consider what happens in the actual situation, when this same quantity of energy Q (consisting of active component i.e. momentum p) is applied to a particle of mass M. The classical contention is that the active component p assumes the form Mv, such that p/M = v (where v is the velocity of motion). This would be true **if the system is closed** and there is no exchange of energy with the field. However, as it was observed above, that in an interaction between energy of motion Q = pc and energy of a particle $E_0 = Mc^2$, both interactants lose* fractions of themselves by the factor (1-1/Γ). (*Note: the opposite is true when there is a fission of quantity of energy into two parts. Then they both gain a fraction, by the scaling up their values by Γ).

We note that conventionally, we are accustomed to consider that when a particle of mass M moves at velocity v, that the momentum concerned is Mv. Since this is the net momentum after the interaction, subsequent to a fraction $p(1 - 1/\Gamma)$ getting transferred to the field, then this (Mv) has to be $1/\Gamma$ fraction of the original momentum p. That is, net momentum after the interaction is $p/\Gamma = Mv$. Hence gross momentum before the interaction has to be $p = \Gamma Mv$. On the other hand, we are accustomed to consider the energy of a particle before the interaction as $E_0 = Mc^2$ ('rest energy'). Hence after the interaction this will be scaled down to Mc^2/Γ. In the fig. 6, we have shown only two co-ordinates (inertia and translational velocity co-ordinates) and the oscillatory velocity co-ordinate is not shown and remains unchanged. On the left we have shown the two quantities of energy before the interaction. In the middle, the shaded areas show the fractions that are lost from both quantities. And on the right the remaining two quantities of energy that join up under Pythagorean rule (see sec 2.10 and fig. 10 for a more accurate representation).

As a prelude to the interaction, energy Q is found to have adapted the form $Q = MVc = \Gamma Mvc$. In this form ($Q = \Gamma Mvc$), M is only incidental to the interaction that p is momentarily involved in. It (M) is only the **mimicked value** of M acquired by p as its extensive co-ordinate, for the purpose of the interaction with the particle of mass M. (Note: This is similar to a quantity of heat energy H mimicking its extensive co-ordinate to be identical with the volume V occupied by the gas that it acts on, such that $H = pV$ where p is the resulting pressure. The value of the extensive co-ordinate is adjusted to be identical with that of the matter that it acts on, and the intensive co-ordinate assumes the conjugate value $H/V = p$. Hence always H = intensive co-ordinate x extensive co-ordinate. = constant).

Considering energy of motion Q, the active component p, (momentum) has two co-ordinate value-forms. It has the universal (Platonic) value-form mc and the particular ephemeral value-form, MΓv.

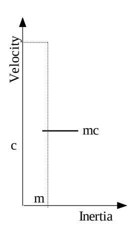

Figure 7a- Platonic Form

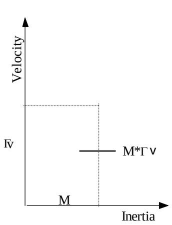

Figure 7b- Ephemeral Form

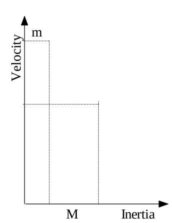

Figure 7c - p exists as a duality of Platonic and Ephemeral forms

In the (ideal – Platonic), pre-empirical form, its momentum content has the universal co-ordinate value-form mc (and intrinsic inertia = m), and in the momentary empirical, interactive form it has the adapted ephemeral co-ordinate value-form MΓv (by virtue of the adapting the value of inertia M of the particle, that p is interacting with). Since it is one and the same thing that appears in these two different co-ordinate value-forms we can write their identity by the following equation.

$$mc = M\Gamma v \tag{1}$$

Hence from Eq. (1) we get the relationship

$$m/M = \Gamma v/c \tag{2}$$

We can re-write the same equation as:

$$m/M = (\Gamma v/c)/1 \tag{2a}$$

Now we note that M is the particular ephemeral co-ordinate value of inertia that p adapted for the purpose of interacting with particle of real mass M. The particle's energy is Mc^2 and its active component – 'internal momentum', therefore is Mc. Considering the ratio of intrinsic momentum mc of the applied energy Q, and the internal momentum Mc of the particle that it interacts with, we have $mc/Mc = m/M$ and therefore this ratio (i.e. mc/Mc) is also equal to $\Gamma v/c$.

2.9 Energy mechanics: Interactions of Energy Regulated by Algorithms

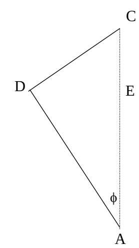

Figure 8a- First pair of orthogonal line segments

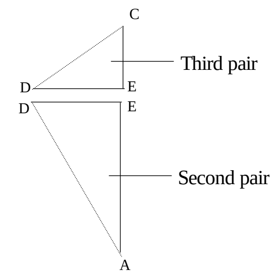

Figure 8b- Second and third pairs of orthogonal line segments

As indicated previously, the interaction between particle energy Mc^2 and the energy of motion ΓMvc, is structured geometrically by an algorithm. The algorithm is constituted by three sets of pairs of line segments, in which one line-segment of a given pair is orthogonal to the other line-segment forming the pair. Also each line segment represents a quantity of energy. And each pair of line segments bears the same relationship 1: (Γv/c) between them.

Thus we find that the relationship 1: (Γv/c) between the pairs of line-elements of the algorithm constitutes the DNA or the genetic fabric of the system in motion.

Now let us nest the three pairs of line segments as in Fig. 9 From this it will be seen that $CD/AD = \Gamma v/c = \tan\phi$,. We also find that $ED/AD = Mvc/Mc^2 = v/c = \sin\phi$. Hence, since $v/c = \sin\phi$ and $(\Gamma v/c) = \tan\phi$, we find that $\Gamma = \sec\phi = 1/(1 - v^2/c^2)^{1/2}$.

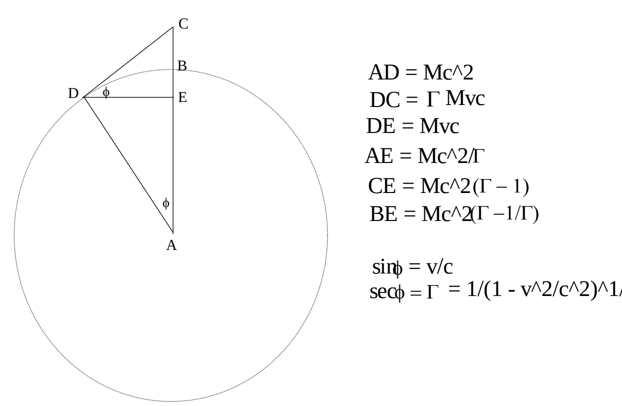

Figure 9- Algorithm made up by fusion of 3 pairs of orthogonal line segments

2.10 Energy mechanics: Fusion of energy of motion ΓMvc to particle energy Mc^2 to form a subsystem

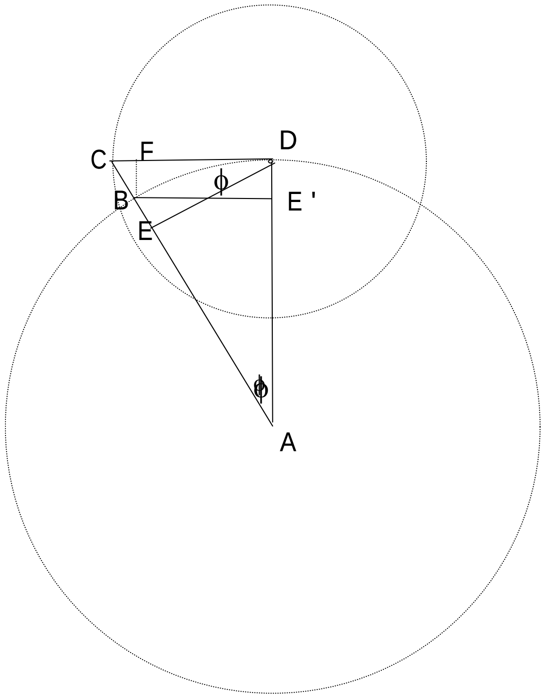

Fig. 10. Relationship between binding energy and gamma-factor

As discussed, when energy of motion $\mathrm{DC} = \gamma Mvc$, is applied to the particle energy $\mathrm{AD} = Mc^2$, they form a sub-system, by fusing together as shown in fig. 10 below. The interaction is similar to what occurs when an electron and a positron fuse together, where fractions of their energy is usurped as 'binding energy'. In the present interaction between the quantities of energy $\mathrm{DC} = \gamma Mvc$, and $\mathrm{AD} = Mc^2$, from each quantity, a fraction proportional to $(1-\cos\phi)$ is usurped. Thus $\mathrm{DC} = \gamma Mvc$ loses $\mathrm{CF} = \gamma Mvc(1-\cos\phi)$: and since $\cos\phi = 1/\gamma$, what is left is $\gamma Mvc\cos\phi =$ DF = DE $= Mvc$. And at the same time $AD = Mc^2$ loses E′D = $Mc^2(1-\cos\phi)$ and what is left is $Mc^2\cos\phi$ = AE′ = AE = Mc^2/γ.

What happens here is that bonding of the two quantities of energy Mc^2 and γMvc occurs by means of losing fractions of themselves as shown above. But there is no 'binding energy' *as such* that remains in the system. Rather it is **the loss of the fractions of energy,** their **absence** from the system, that brings about their bonding or their cohesion. These fractions of energy get transferred to the governing field.

2.11 Energy Mechanics - Induction of Field Energy to Attain Stability

We find that in fig 1b, that there is a void EC which is equal to DE.tanϕ = Mvc.tanϕ = γMv^2. This void renders the subsystem to be unstable. The stability of the subsystem therefore demands that this void be filled. The stability is attained by induction of energy from the governing field.

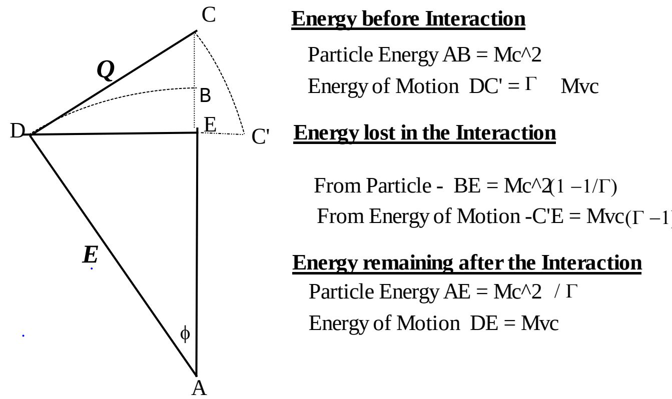

Figure 1b - Loss of fractions of energy for bonding

What happens is that in return for the fractions of energy of the interactants that were transferred to to the governing field, the governing field provides the quantity of energy in the same proportion 1: (Γv/c) = DE :EC. Hence EC = DE $\tan\phi$. = γMv^2

(Thereby Nature solves the Zeno paradox confronted in SPIE -8121-62 section 4.4 [2]. Instead of an infinite series of fractions of energy EE′+E′E″+E″E′″+…, being supplied *ad infinitum*, as required in Figure. 1 therein, the governing field supplies $\mathrm{EC} = Mv\tan\phi$. in one leap.

After the two interactants have transferred the 'binding energy' to the governing field and in return for it the latter has induced energy $\mathrm{EC} = Mv\tan\phi$ to the subsystem, we get the algorithm of motion as shown in Fig. 9.

2.12 Energy Mechanics - The Confusion Surrounding the notion of "Mass Increase".

The misconception of 'mass increase' has created a mental block which has resulted in preventing us from conceiving that what really happens when energy of motion and energy of a particle interact and fuse together to form a subsystem in motion.

The idea that the mass of a particle increases in a certain definite relationship to the velocity has arisen for two reasons. Firstly, contrary to the classical conception, in order to set a particle of mass M in motion to move at velocity v, it has been found that the momentum required is γMv. It has been found that the easy way to account for this greater quantity of momentum is to propose that mass of the particle increases by a certain proportion and therefore as a consequence it requires a greater quantity of momentum by the same proportion. The second reason is that the energy- momentum equation has a term that seemingly confirms the idea of mass increase – namely that energy of the particle increases from Mc^2 to γMc^2. This has created the illusion that the fusion of the two terms on the left side of the Eq. (1) produces the right side term in a single whole γMc^2.

$$(Mc^2)^2 + (pc)^2 = (\gamma Mc^2)^2 \quad (1)$$

But the acceptance of this term in the equation as a single whole is a misconception. Ref. fig. 9, it is actually the sum of two terms.

$$\mathrm{AC} \quad = \mathrm{AE} + \quad \mathrm{EC}$$

$$\gamma\, Mc^2 = Mc^2/\gamma + \gamma Mv^2 \quad (1a)$$

Note: We can also get (1a) algebraically by simply dividing Eq. (1) by γMc^2. So it not only confirms our contention that AC =

AE + EC, but also confirms that the algorithm (as shown in Fig.9) to be true.

The consequence of the misconception that the term γMc^2 in the energy-momentum equation as a single whole, is that it has prevented on the one hand, the explanation why internal processes of a particle slow down when in motion, and on the other hand, it has prevented us from recognizing that in every interaction, there is a quantity energy that gets induced into the system, and how this induced energy produces as the case may be, the centrifugal force, the magnetic force in the field surrounding a current carrying conductor or the Lorentz force.

Once the idea of mass increase is rejected, we can visualize all the principal relativistic phenomena related to motion of a particle in a clear perspective from the algorithm of motion in fig.9. (Ref: SPIE 8121-62, section 6).

2.13 Energy Mechanics: Complementarity of Geometry and the Equations of Particle Physics

In particle physics the following related set of equations have been found to be valid and true. We show the equations of particle physics on the left and adjacent to each one on the right we show the geometric correlation to it, in terms of the algorithm of motion (Fig. 9).

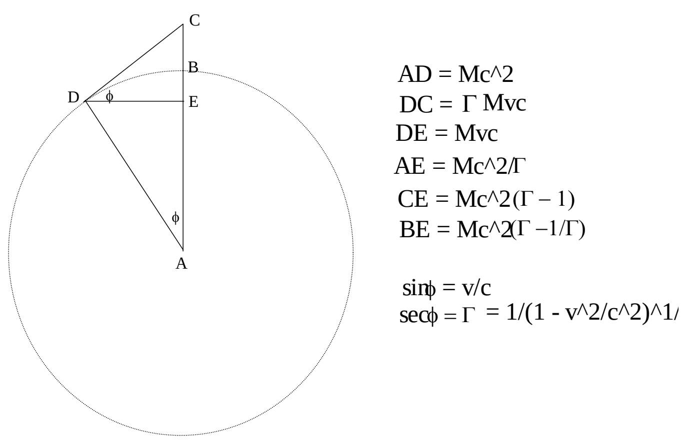

Figure 9- Algorithm made up by fusion of 3 pairs of orthogonal line segments

We find the equations below correlate to the geometry of the algorithm:

$$(Mc^2)^2 + (pc)^2 = (\gamma Mc^2)^2 \tag{1}$$

$$AD^2 + DC^2 = AC^2 \tag{1}$$

$$pc = (\gamma\, Mc^2)\,.v/c \tag{2}$$

$$DC = AC.\sin\phi \tag{2}$$

(where $\sin\phi = v/c$)

$$E_K = Mc^2(\gamma - 1) \tag{3}$$

$$(E_K = \text{kinetic energy}) \quad BC = AC - AB \tag{3}$$

Now we add to the above set Eq. (1A) and call it (4)

$$\gamma\, Mc^2 = Mc^2/\gamma + \gamma Mv^2 \tag{4}$$

$$AC = AE + EC \tag{4}$$

By these correlations we establish the validity of the algorithm and its complementarity with the equations of particle physics.

3. Energy Mechanics and Gravitation.

3.1 Energy Mechanics - Complementarity of Geometry and the Equations of Gravitation.

I have explained in http://www.wbabin.net/physics/viraj5.pdf that the gravitational energy of a body is a part of that body's total energy. That is, **the source of gravitational energy is body's own internal energy** (and that the source of this energy is **not the gravitational field** as it is commonly believed). I can now explain that it works in a manner similar to cohesion of an electron and a positron in pair production, or in the cohesion of the particle energy Mc^2 and the energy of motion pc, where fractions of their energies are withdrawn to the governing field. It is the negativity (deficiency) created by this withdrawal of fractions of energy, that causes and internal stimulus within the two entities to seek to make up for this deficiency, by **sharing energy** from one another. And in sharing each other's energy, there occurs cohesion. Gravitational "attraction" too can be looked at through the same 'lens', as a **tendency** towards cohesion by this internal stimulus. In gravitation too we have a similar pattern.

3.2 Energy Mechanics: How Gravitation Occurs

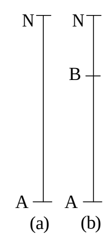

Fig. 12 (a) and (b) - Particle Energy in :

a) NA = M_n c^2 in absence of gravitanional field

b) BA = NA cos^2α in gravitational field;

NB = NA sin^2 = gravitational energy

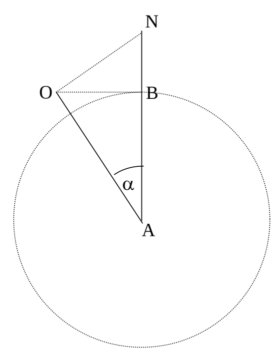

Fig. 12c- Algorithm of Gravitation

Following is the manner in which two-body gravitation operates. Let us take the case of the gravitation of a small body (a caesium atom of a GPS clock) and the earth. It manifests the tendency that if the body in question were hypothetically at an infinite distance away from the earth, it would be uninfluenced by the presence of the earth where the whole of nascent energy NA of the body will totally be dedicated to its internal processes as shown in fig. 12a below. (Note: This is the ideal case which we never find in reality). In the actual situation, the body is always under the influence of the earth, and the omnipresent governing field provides the body with the necessary information about the presence of the earth (and *vice-versa*). Let us consider the case where the body is a distance R_E from the earth's centre.

The information that is provided by the field is, that at the position R_E where the body is, the square root of the gravitational potential of the earth is proportional to OB, such that OB in relation to NA is v : c. (where the sqrt of gravitational potential is $(GM_E/R_E)^{1/2}$ = v. Hence v is the **potential orbital velocity** at R_E). Then it forms the algorithm of gravitation as in fig 12c, such that OB is perpendicular to NA and the angle AON is a right angle (angle in a semi-circle with NA as the diametre). Then it is found that at the position R_E, the gravitational energy is given by NB =

$M_nc^2 \sin^2\alpha$ and the internal energy of the body is given by AB = $M_nc^2\cos^2\alpha$.

This contention will become clear from the following:

Since ON = NA sinα and NB = ON sinα, we get NB = NA $\sin^2\alpha$,

Since NA = M_nc^2; NB = $M_nc^2 \sin^2\alpha$.

Then AB represents the internal energy of the body at R_E. AB = $M_nc^2.\cos^2\alpha$. This shows that the inertial mass M of a body varies with the position it finds itself in a gravitational field where M = $M_n\cos^2\alpha$.

And since $v = (GM_E/R_E)^{1/2}$ and OB/AB = tan α = Mvc/Mc² = v/c.

NB = Mc^2. $\tan^2\alpha$ = $Mc^2 (GM_E/R_E)/c^2 = M(GM_E/R_E)$ – Gravitational energy.

In the general situation, upon having this information about the potential orbital velocity provided by the field, and depending on whether the body in question has moved towards or away from the centre of the earth (from its earlier relative position), a fraction of the total intrinsic energy of the body (M_nc^2) is exuded to, or absorbed from, the governing field. And to the extent the energy is exuded or absorbed, energy available for internal processes is scaled down or scaled up, and to the same extent the internal vibrations are decreased or increased.

And in general when a body is in the vicinity of another, they both are **always in a state of deficiency of energy**, where a fraction of each body's energy has been withdrawn to the governing field. And it is this negativity or the deficiency of energy that creates the urge for one body to share energy of the other body (the earth). This then tends the body towards the earth seeking coherence with the earth (and *vice-versa)*. This creates the impression that an external gravitational force acts on the body tending it towards the earth, whereas it is an internal 'negative force' originating within the body by virtue of the mutual suction-like action that occurs between the two bodies due to the requirement of having to share their energy. If the body is moved from the surface of the earth to a higher altitude, energy from the governing field is drawn into the body and this intensifies the internal vibrations. As it is presently believed, kinetic energy does not transform into potential energy (internal energy). The net gain of internal energy is not equal to the kinetic energy that corresponds to the initial velocity v, with which the body is projected away. Kinetic energy returns to the field. At the new altitude, a fraction of gravitational energy transforms into internal energy. We demonstrate the validity of the above contention by accounting for the time change of an atomic clock due to change of altitude in a GPS satellite.

When the clock is at rest on the earth's surface before the launch of the satellite, its energy levels are as shown by the algorithm of gravitation as in fig. 12c (above). Let the launch velocity be v′. The algorithm of motion (as in fig. 9 gets superimposed on fig. 12c in which DE is proportional to the launch velocity v′ and then we have fig. 12d (next page).

From the algorithm of motion (see fig. 9), if the internal energy is AD = AB = Mc^2 when the body is at the surface of the earth at distance R_E from the centre (where M = $M_n\cos^2\alpha$), and it is projected up with velocity v′, then the energy of motion is DE = Mv′c and its corresponding kinetic energy = BC. As explained before, at the starting point of the launch, on account of motion, the fraction of internal energy BE = $Mc^2(1\text{-}\cos\phi)$ is lost to the governing field, and in return energy EC = $Mv'^2\tan\phi$ is induced from the governing field. The net gain in energy to the system is EC – EB = BC. Which is the same as AC-AB = $Mc^2(\gamma -1)$ (where $\gamma = \sec\phi$) and it is this net gain that has come to be called 'kinetic energy'. We may note that on account of the loss of internal energy equal to EB, the internal energy available to internal processes becomes equal to AE. Hence the clock will slow down by the factor (AB –AE)/AB = (1-cosϕ) at the beginning of the launch.

Then, as the body ascends, the speed of ascent drops. And as a result, a) the fraction of internal energy that was initially lost to the field gradually gets restored back and b) as the speed of ascent drops, the kinetic energy too becomes less and less. On the other hand, as there is a decline in the gravitational potential, and to this extent there is an influx of energy from the field to the body. When the body comes to a momentary rest at distance R_o (orbital altitude) from earth's centre, the whole of internal energy EB which was lost to the field initially has got restored back, and also what was previously the kinetic energy BC has now returned to the field (compare figures 12d and 12e).

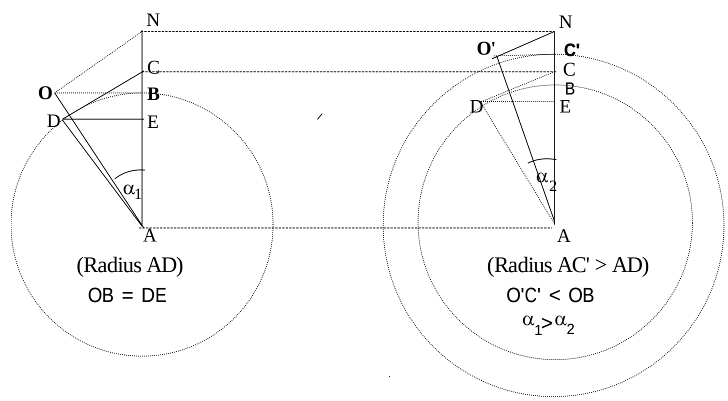

Fig. 12d- Clock on Earth   Fig. 12e- Clock at orbital altitude

In the above we considered the changes of internal energy that occur due to motion, during the ascent of a GPS satellite. Now let us consider the gravitational side. At R_o, since the sqrt of gravitational potential has changed from being proportional to OB to O′C′ (as shown in fig. 12e), the gravitational energy becomes NC′ and the body's internal energy becomes equal to AC′. As a result the internal processes intensify (and the clock would run faster). The increase of internal energy is given by:

$$BC' = NB - NC' = M_nc^2(\sin^2\alpha_1 - \sin^2\alpha_2)$$

This change of internal energy correlates to 45.67 microseconds per day, which is cofirmed by observational data [4]. In SPIE 8121-62, section 6 [2], I have demonstrated the exact amounts of clock slow down due to motion, and the clock rate increase due to change of altitude. And the accuracy of these numbers, derived by means of the algorithms, would validate both the algorithm of motion and the algorithm of gravitation.

3.4 Energy Mechanics: Inverse similarity between gravitational algorithm and light in moving medium

Now before we move to examine the phenomena of light, we need to make the following observation in regard to gravitation.

(This is of particular importance to the understanding of Fresnel's result). Ref. figures 13a, 13b and 13c. In fig 13a the nascent energy of the particle is represented by AN = M_nc^2. And at any given position R from the earth and where the corresponding gravitational potential v^2 =GM/R, AN gets divided into two parts. This division is regulated by the algorithm of gravitation, where OD acquires the value M_nvc, and the angle OAD = α. Then the division of AN into two parts takes the form of ND = $M_nc^2.\sin^2\alpha$ and AD = $M_nc^2.\cos^2\alpha$. NB is the gravitational energy which acts on the particle to tend it towards the earth and AD = internal energy Mc^2 at the position R (M = $M_n\cos^2\alpha$). Fig. 13 c – note that the triangle with A′D as the hypotenuse is similar to the gravitational triangle AON of fig. 13a inverted. When light moves in a moving medium, there is of ingress of energy from the field proportional to OD (of fig 13c), which augments the velocity c′ (which it would have if the medium were still) by the amount OD = $v\sin^2\alpha$, (This ingress of energy into the photon is similar to ingress of gravitational energy into the atom during the altitude increase due to launch of the satellite into orbit).

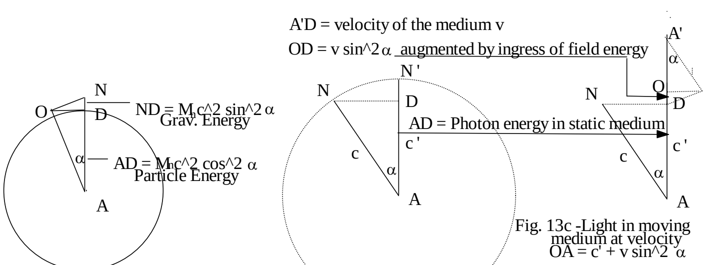

Fig. 13a - Particle under Gravitation

Fig. 13b - Light in static medium at vel. c'

Fig. 13c -Light in moving medium at velocity OA = c' + v sin^2 α

It may be noted that $c'/c = \cos\alpha = 1/n$. Hence $\sin^2\alpha = 1 - \cos^2\alpha = (1 - 1/n^2)$.

Hence velocity of light in moving medium = $c' + v.\sin^2\alpha = c' + v(1-1/n^2)$.

4. Energy Mechanics -Motion of Light

4.1 Energy Mechanics: Coordinates of Photon Energy

In the paper SPIE 7421-36 –(2009), I have explained the following:

1. that energy of a photon is organized as a 'co-ordinate volume' where E =inertia x translational velocity x oscillatory velocity (co-ordinates), wherein the oscillatory velocity co-ordinate is further internally composed as the product of frequency and wavelength. Accordingly, in the nascent condition photon energy E = $(mc\lambda)f$ = hf.. such that translational velocity = c and the oscillatory velocity = $f\lambda$ = c.

2. That in response to constraints, it is **either** the translational velocity **or** the oscillatory velocity that undergoes change, and **not both**.

3. Against change of medium of propagation with a different refractive index, it is the translational velocity that changes.

4. Against the motion of the source or the receptor it is the oscillatory velocity that changes. The photon acts in E = hf mode and it is a frequency change that takes place, in this instance.

4.2 Energy Mechanics: Algorithms of Photon Energy

Just as we saw in the case of motion of particles, where we found that various phenomena are regulated by the algorithm of motion and algorithm of gravitation, there are similar algorithms that regulate the phenomena of photons. And an important aspect of this regulation is the ingress and egress of energy, from and to the field. For instance against the constraint of a medium of higher refractive index, a fraction of photon energy gets egressed, which results in the reduction of velocity. And when the photon emerges back into the original medium, the egressed fraction of energy gets ingressed back and the original velocity is restored (ref. sec. 4.3). If the medium is in motion, a quantity of energy in a certain proportion to the velocity of the medium ingresses. And this is the physical basis of Fresnel's formula (ref. sec. 4.8). So we see that in the motion of light in a moving medium, two components of energy are involved in the ingress and egress process with the field.

Similarly when an extra-terrestrial photon is incident on earth, there are two components involved. In proportion to the earth's velocity, a certain fraction egresses, this manifests in the transverse Dopper effect (ref. sec. 4.5). Then there is the other component dependent on the direction of motion of the earth with respect to the direction of motion of light. When this component is positive there is an ingress of energy from the field, and a resultant is a blue shift, and if the component is negative the resultant is a redshift (ref. sec. 4.6).

4.3 Energy Mechanics: Change of Velocity due change of refractive index

Reference fig. 14a the direction of incidence is NA. The ray refracts through angle α such that AD = NA cosα. Consider the original photon energy as represented by NA, the refraction is caused by the fraction of energy NA(1-cosα) getting egressed to the field, and the energy left available for motion through the medium being AD. Hence there is a proportionate decrease of velocity from c to c′. Therefore when NA is proportional to c, AD = NA.cosα is proportional to c′. Deviation of a ray is not unique to refraction, it is a general property of motion of light associated with a change of state of photon energy. That is any change of frequency or velocity is associated with a change of direction that is proportional to the frequency or the velocity change as the case may be.

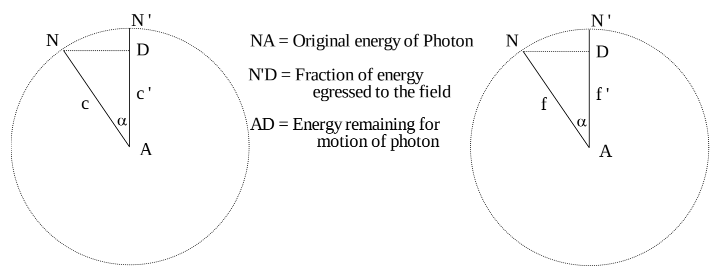

Fig. 14 a - Algorithm of Refraction (change of velocity from c to c')

Fig. 14 b - Algorithm of Doppler Shift (change of frequency from f to f')

Fig. 14b represents the transverse Doppler shift of a ray of light due to the motion of the source or the receptor. In the case of starlight falling on earth, ND represents the velocity of motion of the receptor (the earth) and in Ives and Stillwell experiment ND represents the motion of the source (moving hydrogen atom). Due the motion of the source or the receptor, the photon energy NA = N′A loses the fraction N′D to the field. The photon energy that remains is DA. And accordingly there is a frequency shift proportional to DA = NAcosα. Accordingly we find f′ = f.cos α.

In both figs. 14a and 14b we find the change of energy of the photon is accompanied by a change of direction of the light ray.

4.4. Energy Mechanics: Doppler Change of Frequency and Aberration

As stated above, in the motion of photons, any change either of velocity or of frequency must have associated with it a proportionate change of direction. This we saw in the case of refraction – a change of direction associated with the change of velocity. Analogously the phenomenon of aberration is identified as the change of direction that occurs concomitant with the Doppler change in frequency of a ray of light in response to the motion of the earth.

Ives and Stilwell experiment revealed that, the Doppler change of frequency has two components. One component is direction independent. And this component has come to be called the 'Transverse Doppler Effect" or TDE. For a given velocity of the source (or observer), this component remains invariable. And the other component is dependent on the direction. The value of the direction dependent component is maximum when the direction of the source and the direction of light are coincident and it disappears altogether when the two are perpendicular to each other. It is by recognizing that the direction dependent Doppler component of the fast moving Hydrogen ions measured from opposite directions (front and rear) cancel out each other, that Ives and Stilwell were able to measure transverse Doppler effect.

4.5 Energy Mechanics: The algorithm of TDE

As we saw, the algorithm of TDE is similar to the algorithm of refraction. In this the photon loses a fraction of energy equal to hf_0 (1-cosα) (where sinα = v/c and v the velocity of the source/observer)., in exact similar manner as in the case of refraction (where c′/c = cosα) and in similar manner to a particle in motion loses the fraction Mc^2(1-cosα) of its internal energy.

In the case of TDE, the frequency f is scaled down as shown fig. 14b, in a manner analogous to the algorithm of motion of a particle as shown in fig. 9. In fig. 14a (algorithm of refraction) line segments represented velocities, whereas they are replaced by frequencies in fig. 14b (algorithm of TDE).

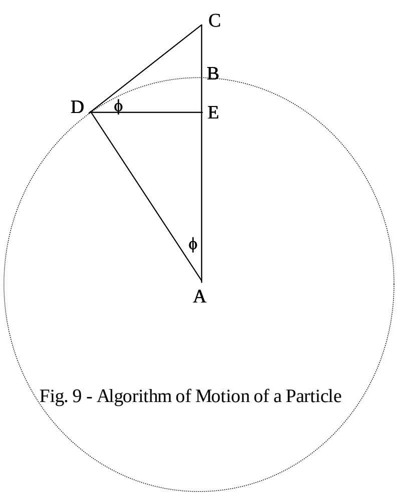

Fig. 9 - Algorithm of Motion of a Particle

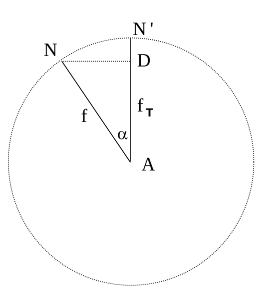

Fig. 14 b - Algorithm of Doppler Shift (change of frequency from f to f')

To draw a comparison between motion of a particle and motion of a photon, we examine the parallelism between fig. 9 an fig.14b.

Analogy between Algorithm of motion of a particle and Algorithm of TDE.

Particle (Fig. 9)	Photon (Fig. 14b)
AD = c	AN = f_0
DE = c.sinϕ = v	ND = f_0.sinα = f_0. v/c
sinϕ = v/c	sinα = v/c

We note that in the TDE algorithm (fig 14b) in place of the velocity v (in the algorithm of motion of particle) is replaced by f_v = f_0.sinα.

Let the frequency of the incident ray independent of the effects of observations be f_0. Then the TDE frequency f_T (when incident ray observed perpendicular to the direction of observer's motion) is given by.

$f_T = f_0(1- \sin^2 \alpha)^{1/2} = f_0 \cos \alpha = f_0(1 - v^2/c^2)^{1/2}$.

From this we can draw the conclusion that, just the same way the internal energy of a particle is scaled down by the factor $(1 - v^2/c^2)^{1/2}$, when in motion at velocity v (resulting in 'clock slow down'), a photon's energy too is scaled down to adjust itself to the motion of the receptor or the source by a similar scaling factor $(1 - v^2/c^2)^{1/2}$, where in this case v = the velocity of the receptor or the source. However, it is to be noted that in this case the change of state of energy manifests itself as a change of frequency. In the case of TDE, independent of the direction of the the ray of light, there is always an egress of energy from the photon into the field proportional to N′D. And therefore TDE is always a redshift.

4.6 Energy Mechanics: Direction Dependent Doppler Effect (DDDE)

DDDE is superimposed on the TDE algorithm (see fig.14b) . We consider here the case of the stationary source and the moving observer. The inclination of the earth's motion to the ray of light is θ. The magnitude of earth's velocity v is represented ND = f_0 sinα.= KD. KD represents earth's velocity at any given time in both the magnitude and direction.. The inclination of earth's velocity and the light ray is θ. KDcosθ gives the DDDE at a given position. Since KD = ND = f_0 sinα, DDDE at any position is given by LD = f_0 sinαcosθ. When cosθ is positive there is a proportionate ingress of energy from the field into the photon, and in this case DDDE is a blue shift. And when cosθ is negative, there is a proportionate egress of energy from the photon into the field, and in this case DDDE is a red shift.

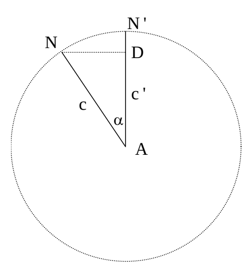

Fig. 14 a - Algorithm of Refraction (change of velocity from c to c')

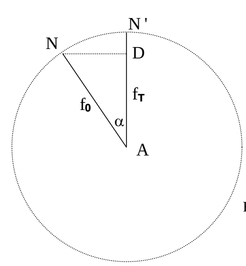

Fig. 14 b - Algorithm of TDE (change of frequency from f_0 to f_T)

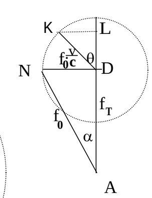

Fig. 15 - Algorithm for Total Doppler Shift - TDE + DDDE

Total Doppler shift at a given position is TDE + DDDE = LD + DA = LA

Since KD = ND = f_T.tanα,

LD = f_T tanα. cosθ

Therefore the Total Doppler Shift $f' = f_T + f_T \tan\alpha . \cos\theta$

Since $\tan\alpha = f_0.(v/c)/f_0\ (1-v^2/c^2)^{1/2}]$

$f' = f_T\ [1 + \cos\theta.(v/c)/(1-v^2/c^2)^{1/2}]$

(Note: $\cos\theta$ is negative in the range where $\theta > \pi/2$ and $\theta < 2\pi/3$)

$f' = f_T\ [1 + \cos\theta.(v/c)/(1-v^2/c^2)^{1/2}]$

This equation conforms to the result of Ives and Stilwell experiment. When $\theta = 0$ $\cos\theta = 1$ and when $\theta = \pi$, $\cos\theta = -1$. Hence when measured from these positions the second term of the equation have equal values of opposite sign. And for this reason the DDDE can be eliminated and from this f_T (i.e. TDE) can be calculated.

4.7 Energy Mechanics: Aberration

Let $v: c = f_v : f_0$. Hence $f_v = f_0.\ v/c = f_0.\sin\alpha$.

Aberration angle α' at any position is given by the arc tan of the ratio of f_v/f'. (noting that $f_T = f_0\cos\alpha$)

$\tan\alpha' = f_0\sin\alpha/f_0\cos\alpha[1 + \cos\theta.(v/c)/(1-v^2/c^2)^{1/2}]$

$= \tan\alpha/1 + \cos\theta.(v/c)/(1-v^2/c^2)^{1/2}]$

This equation predicts that

1. when $\theta = \pi/2$ $\tan\alpha' = \tan\alpha$

i.e. $\tan\alpha' = (v/c)/(1-v^2/c^2)^{1/2}$

2. When $0 < \theta < \pi$ $\tan\alpha' < \tan\alpha$

3. When $\pi/2 < \theta < \pi$ $\tan\alpha' > \tan\alpha$

These results will confirm the validity of the theory.

4.8 Energy Mechanics: Fresnel's Formula: Motion of Light in a Moving Medium

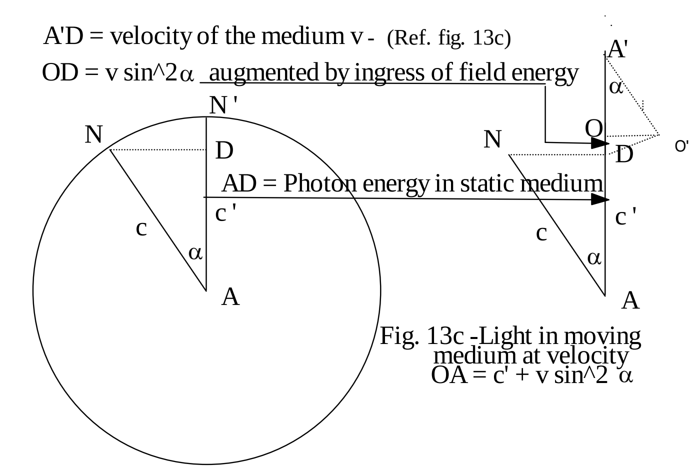

Fig. 13c -Light in moving medium at velocity OA = c' + v sin^2 α

Fig. 13b - Light in static medium at vel. c'

When light propagates in a moving medium, in addition to refraction, as evident from fig. 13b, there is an ingress of energy from the field in a certain proportion to the velocity v of the medium which adds on to the energy of the photon and makes a change in its overall velocity. So for the effect of the medium alone, independent of its motion, we have the same algorithm as for refraction as shown in fig. 13b. We find that the same algorithm gets modified, for the motion of the medium as follows in fig. 13c. DA′ represents the total amount of energy that would be required if the velocity v of the medium were to add in full to the velocity c′ of the refracted photon. However just as in the algorithm of gravitation where the fraction $M_nc^2.\sin^2\alpha$ of the total energy of the body acts on the body as gravitational energy (see sec. 3.2), in the case of a photon's motion in a moving medium, out of the would be energy of motion mvc due to medium's motion, only the fraction $mvc.\sin^2\alpha$ acts on the photon, where α is the angle of refraction. Hence the velocity c′ of the photon gets augmented only by $v.\sin^2\alpha$. So that the final velocity is:

$$c'' = c' + v\sin^2\alpha$$

Since $\cos\alpha = c'/c = 1/n$,

$$c'' = c' + v\ (1 - 1/n^2)$$

Q.E.D.

5. Conclusion

The accurate results derived from the concepts of new field of study - Energy Mechanics – and the concomitant geometric theorems prove its validity and its universal applicability.

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