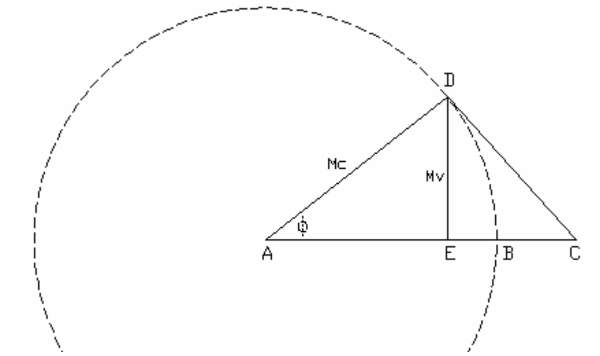
# THE UNIFIED THEORY OF RELATIVITY

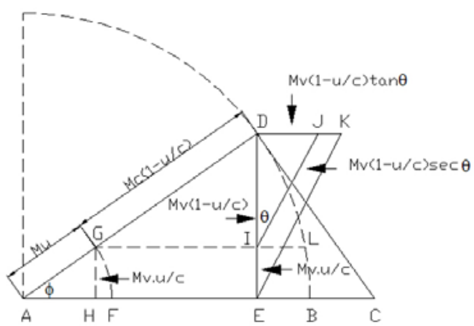
**- Viraj Fernando -**

## Theorem I - Kinetic Energy = $Mc^2(\Gamma_v - 1)$




## Theorem III –The Physical Basis of the Lorentz Transformation

**Inertia of Energy – Resistance to Motion of the Background Space - Action of Field Momentum**




## Theorem IX – The Deflection of the Direction of Energy Transmissions in Gravitational Fields

**Advancement of the Perihelion of Mercury**

$\alpha \approx 3GM/Rc^2$

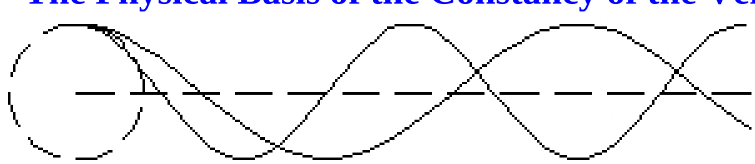
$\varepsilon = 2\pi.\alpha = 41.162''$

**Bending of a Ray of Light in a Gravitational Field**

$\alpha = \sin^2\theta\,(1-\sin^2\theta)^{-1/2}$; $\sin\theta = (3GM/Rc^2)^{1/2}$

$\alpha = 1.313''$

## Theorem XII – The Physical Basis of the Constancy of the Velocity of Light



**The Cosmological Redshift**

$\lambda = \lambda_0[1 - (Ht/c)^2]^{1/2}$

**The Aberration of Starlight**

$\delta_1/\delta_2 = \Gamma_u(c-u)/c$

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## THE ABSTRACT:

The reason why we have entitled this paper as 'the Unified Theory of Relativity' is because we explain the phenomena occurring in vector fields as well as gravitational fields under the same 'Universal Formal Principle' that energy has inertia, and when energy is in motion, the inertia of energy causes a resistance in the form of a drag against the background field, leading to the manifestation of various 'relativistic phenomena'. In this paper we derive the general formula for $E = Mc^2(\Gamma\text{-}1)$ for kinetic energy, by way of a geometrical theorem and show how it tends to $1/2Mv^2$ at low velocities. We demonstrate by derivation that the **physical basis** of Lorentz transformation is the fact that energy has inertia, and that when energy is in motion this inertia develops a resistance to the background space. In our theory, the constancy of the velocity of light is no more a postulate as in Einstein's theory. We demonstrate with facts confirmable by experiments, that there is a physical mechanism of self-adjustment between spin and linear momenta of an energy transmission in order to move at the constant translational velocity c. We also show how the gravitational redshift, the cosmological redshift and the aberration of starlight are manifestations of this mechanism of self-adjustment between spin and linear momenta. On the basis of the same 'universal formal principle': of possession of inertia by energy, and that when energy is in motion, this inertia develops a resistance to the background field, we show how an energy transmission deflects the direction of its transmission in gravitational fields. Unlike in Einstein's theory (where two equations are involved) we not only predict the advancement of the perihelion of planets and the bending of a ray of light under one and the same equation, but we also obtain a result of very high accuracy for the bending of a ray of light by a deflection of 1.313" as against 1.74" in Einstein's theory which has an error of over 20%. This will be the decisive test between the two theories.


## THE INTRODUCTION:

This paper finds explanations for all relativistic phenomena under a unified theory based on **first principles** originating from some of the concepts of Einstein, Maxwell and Newton which have not received the due attention in modern physics. This approach is in contrast to Einstein's **constructive approach** where the special theory or the general theory are required discriminately to explain these same phenomena depending on whether they occur in vector fields or gravitational fields. We have in our approach provided new dynamic explanations and predictions for some of the phenomena for which theory of relativity has been able to provide only kinematic explanations or none at all (e.g. aberration of starlight). And for some phenomena, we have also provided more accurate predictions, where the theory of relativity has been able to predict results only partially (e.g. bending of a ray of light, gravitational redshift). How we have arrived at this new approach is as follows.

Upon careful scrutiny of Einstein's 'Autobiographical Notes', the essays by other physicists, and Einstein's responses to these essays in the same book (1), it becomes clear that Einstein himself has considered his constructive theories to be tentative. Einstein goes so far as to say that there is a "right way and we are capable of finding it" implying that the way by which he has developed the theory is **not the right way**. Filmer Northrop points to this position taken up by Einstein and indicates that this is an unequivocal admittance by Einstein that his basic tenet of **spatio-temporal relatedness** in nature on which theory of relativity is constructed is a **mere mental construct** (1, p.398). In response Einstein endorses Northrop's view: "I see in this critique a masterpiece of unbiased thinking and concise discussion which nowhere permits it to be diverted from the essential" (1, p. 683). This situation necessitates us to review some of Einstein's ideas in his formative period and to consider whether his theory could be reformulated.

In reviewing Einstein's ideas in the early period, we find that as a **corollary** to the very first paper on special theory of relativity, and in the same volume of *Annalen der Physik* Vol 17, 1905, Einstein has written an accompanying paper on **Inertia of Energy** (2, p.69). In the same year (in Vol 18), he has written the rigorous derivation of the expression for inertia of energy, and then again he has written yet another paper on the same subject in 1906 (1, p. 524). All these show how much of importance Einstein has ascribed to the concept of inertia of energy originally, at the formative stages of his theory. It appears that Einstein has had a hunch that inertia of energy is the **physical basis** of relativistic phenomena, but his pre-occupation with the novel concepts of relativity of simultaneity and the spatio-temporal relatedness which he mistakenly thought to hold the key to unravelling of the mystery of Lorentz transformations, has obscured the simple path to the explanation of relativistic phenomena in terms of inertia of energy.

***Einstein therefore has proved the 'law of inertia of energy' relativistcally*** (1, p.524), ***when in fact he should have proved the converse, that relativistic phenomena arise from the existence of inertia of energy.***

It appears that it was while Einstein was still grappling to incorporate inertia of energy into the theory, that Minkowski has made the fatal formulation of the theory in terms of "world geometry" in 1908. It is worth noting that Einstein had at first rejected Minkowski's proposals. According to Arnold Sommerfeld: "When.. Minkowski built up the special theory of relativity into his 'world geometry' Einstein said on one occasion: 'Since the mathematicians have invaded the theory of relativity, I don't understand it myself anymore'. But soon after, at the time of the conception of the general theory of relativity, he readily acknowledged the indispensability of the four dimensional scheme of Minkowski" (1, p.102). We see here Einstein making a decision to abandon his preferred **path of physics**, and adopting **mathematical physics** instead, under youthful haste and expediency of developing his theory to embrace all phenomena around the year 1912. (In contrast to Einstein's approach, in the present paper we develop the theory on the premise that the **inertia of energy** is the physical basis of relativistic phenomena).

It is not only that Einstein has indicated that there is a "right way" as against the detour he has taken in terms of mathematical physics, but he has even ventured to point out the type of theory this "right way" would lead to. Although Einstein developed his relativity theory as a 'constructive theory', it becomes clear that he was convinced of the superiority of 'theories of principle', of the type of classical thermodynamics from the following statement. 'It (thermodynamics) is the only physical theory of universal content concerning which I am convinced that, it will **never be overthrown**…'(1, p.33). Therefore, contrasting the provisional nature of his theory in the present constructive form, and implying the necessity to write it as a theory of principle, he wrote, "there is, in my opinion, **a right way**, and that we are quite **capable of finding it …..**" (1, p. 398).

Einstein also wrote: …. 'The longer and the more despairingly I tried, the more I came to the conviction that only the discovery of a **universal formal principle** could lead to assured results. The example I saw before me was thermodynamics. The general principle was there given in the theorem: the laws of nature are such that it is impossible to construct a *perpetuum mobile*' (1, p.53).

In thermodynamics, the impossibility of construction of a *perpetuum mobile* was demonstrated by Sadi Carnot, by showing that even in an ideal engine, where all the radiative, frictional etc., heat losses have been eliminated, there would still be a fraction of heat that will defect without being converted to work. Due to this defection of the fraction of heat, the construction of a *perpetuum mobile* becomes impossible. The greater the ambient temperature relative to the temperature of the source, greater the defective fraction of heat and lesser the heat available for the conversion to work. It was found that if the data were extrapolated so that the ambient temperature is reduced to absolute zero, then this fraction that defects disappears altogether, and the total heat produced would be available for conversion to work completely. There is a striking similarity between this and the implications of Maxwell's equations. The momentum available to move a charge appears to defect a fraction of it, depending on the velocity of the **proper** reference frame, and consequently work is performed only partially, when that reference frame is in motion. When the data are extrapolated so that the velocity of the proper reference frame is zero, the total momentum becomes completely available for work. Therefore, this was found to be analogical to the impossibility of construction of the *perpetuum mobile* in thermodynamics. However, a study of the pattern of changes of co-ordinates in a motion of a particle revealed that it follows a more complicated form – Lorentz transformation. Einstein therefore wrote intuitively, (i.e. **without demonstrating how** this analogy works), stating that: "The universal principle of the special theory of relativity is contained in the postulate: the laws of physics are invariant with respect to the Lorentz-transformations. …. This is a restricting principle for natural laws, comparable to the restricting principle of the non-existence of the *perpetuum mobile* which underlies thermodynamics" (1, p.57). We demonstrate how this analogy works in Appendix II.

Towards the end of his career Einstein came to the conclusion that there is a "total field". "Our problem is that of finding the field equations for the **total field**"(1, p. 89). In this paper in deriving the equation $E = Mc^2(\Gamma -1)$ for the quantity of kinetic energy required to set a body in motion, we prove that the momentum necessary for the motion of matter emanates from the "total field".

Maxwell realised that there are errors and omissions in the Newtonian conceptual framework and to address this problem he set out to develop his programme. "….the determination of the quantity of energy which **enters or leaves** a material system during the **passage of the system** from its standard state to any other definite state" (3, p. 74). Maxwell has insisted that in the implementation of this programme, the changes of configuration and motion, and the energy that enters or leaves a system, must be considered in **extreme generality** (3, p. 122). We believe that our theory is a synthesis of the conceptions of Newton and Maxwell together with some of Einstein's ideas in his formative stages which he abandoned in preference to Minkowski postulates.

Considering all the above factors, we believe that Einstein himself would have arrived at the simple theory we are presenting in this paper, had he not made the fatal error under expedient circumstances of following the path of mathematical physics chartered out by Minkowski.

## THE UNIFIED THEORY OF RELATIVITY:

We start off this theoretical discourse by asking the most fundamental question in physics, which has been asked by physicists and philosophers over and over again, since time immemorial: "How does a body move from rest?".

In attempting to find the answer to the above question, for methodological reasons we have to consider the problem of the motion of a body in two phases: a) In the first phase we have to consider this motion **as if** there were no interaction between it and the motion of its space of location, (which scenario we call the 'foreground' motion), and,
b) thereafter in the second phase we consider the problems of the 'background', that is taking the *interaction the motion of the body has with the motion of the space of location into consideration.

We contend that in Newtonian mechanics, the problem of the interaction with the background has been overlooked altogether, and even the problem of motion of the foreground has been addressed only partially, and this is the reason why Newtonian mechanics cannot explain relativistic phenomena. In this paper, upon taking all these aspects into consideration, relativistic phenomena find simple, coherent and comprehensive answers.

**The Problem of the 'Foreground Motion':**
The questions that arise pertaining to the foreground motion are:
Why is it that the **internal processes** of a body **slow down**, when it is in motion?

Why is it that the kinetic energy E necessary to set a body of mass M in motion at velocity v is given by the expression $E = ½Mv^2$ at low velocities and by the expression $E = Mc^2[(1- v^2/c^2)^{-1/2} – 1]$ at high velocities?

How does the value c, which is numerically equal to the velocity of light enter into expressions of motions of bodies, even when electromagnetism has no role to play in the motions of bodies?

What function does the "total field" conjectured by Einstein have in the motions of bodies?

And most importantly, how are all the above matters connected to each other?

**The Problem of the Background Interaction**:
The question that arises pertaining to the 'background' is, how does the motion of the space of location of a body affect the motion of that body relative to that space?

(*In regard to the interaction with the background: It may be noted that at the very foundation of modern physics is the principle of relativity, whose basis is the assumption that the motion of a body is independent of the motion of the space of its location, and it is this assumption that makes it possible to consider the equivalence of all inertial reference frames. Thus this proposition of an interaction with the background would appear contradictory and inconsistent with modern physics. However, in AppendixI of this paper we find a resolution to this contradiction).

**The Foreground Motion:**

Although when a body moves, all the factors involved in the 'foreground' come into operation simultaneously, in order to grasp what happens, we need to consider them **as if** they occur sequentially. Also, in this regard we shall first consider the actions in the foreground as the 'first phase' and then subsequently consider the *interaction with the background as the 'second phase'; although these too happen simultaneously. In classical mechanics, from Newton's second law, we have formed the notion that by way of impressing a force F on a body of mass M, it **directly** transfers a quantity of momentum Mv to the body; and as a consequence, it moves with a velocity v. Therefore it is claimed that when a body of mass M moves at velocity v, its momentum is Mv and its kinetic energy $E = ½Mv^2$. On the basis of these two concepts, if we are to establish a relationship between momentum and kinetic energy of a moving body, we find that $Mv = (2EM)^{1/2}$. On the other hand, in the motion of particles at high velocities it has been found that a quantity of energy E has a momentum p that corresponds to it, and that they are related by the equation p = E/c. (Note: In this paper the nomenclature used is not in strict conformity to that of SRT. E energy in general and not does not necessarily represent total energy. p stands for momentum is general and not necessarily for that of massless particles and so on).

Since laws of physics must hold for all velocities, and if we assume the equation p = E/c to hold at lower velocities also, where the kinetic energy $E = ½Mv^2$, then we find that the momentum $p = ½Mv^2/c$. That is, p = Mv (½ v/c). The momentum p then turns out only to be 50% of the v/c$^{th}$ fraction of classically attributed momentum Mv. Considering an example of an object of mass M moving at a velocity v = 100 kilometres per hour, (which is in the range of velocities where classical mechanics is applied mostly), we get the value of p expressed in terms of Mv as $p = Mv \times 4.6 \times 10^{-8}$. We therefore have a **paradox** of having two concepts of momentum ('classical momentum' and 'relativistic momentum') which give magnitudes that are widely different from one another. We contend that the above paradox originates from the above mentioned notion that by way of impressing a force F on a body of mass M, it **directly** transfers a quantity of momentum Mv to the body externally, and thereby it moves with a velocity v. This is contrary to how things actually work. The body is not an inert, dead mass of matter. It has an '**internal subsystem**' consisting of motions at intermolecular, intra-molecular, atomic and subatomic levels, which is packed full of energy. The motions of this internal subsystem occur relative to the centre of mass of the body. When the body is set in motion at velocity v, since this motion is represented by the motion of the centre of mass, the internal subsystem which moves relative to the latter has to form a component of momentum Mv for **co-movement** with the centre of mass out of its total internal momentum Mc. It must be noted that this **concept of 'co-movement'** finds its origin in Newton's *Principia*, which states: "That if a place is moved, whatever is placed therein moves along with it; and therefore a body, which is moved from a place in motion **partakes also of the motion of the place**" (4, p.9). The centre of mass is the 'place' relative to which the internal subsystem moves, and accordingly when the centre of mass which is initially at rest is set in motion, the internal subsystem, in order to partake in this motion, must form a **co-movement component of momentum** equal to Mv.

When a quantity of kinetic energy $E_k$ (or momentum $E_k/c$) is applied to a body of mass M, to set it in motion at velocity v, as a **prelude** to the body's motion (represented by the motion of it centre of mass), the following series events occur at a **potential level**. The prospect of motion of the centre of mass, necessitates the internal energy to form a co-movement component of momentum with the centre of mass. This prompts the **inertia** M of the internal momentum to potentially resist this tendency of motion. This is because when the centre of mass is at rest, ( ref. fig 1a) the internal momentum AB = Mc of the body functions relative to its ‘place’ at rest. Therefore the inertia of internal momentum has zero effect on account of the (zero) motion of the centre of mass. However, when instead the centre of mass is on the verge of moving at velocity v, reciprocally with it, the inertia of internal momentum gets activated potentially and forms the tendency to potentially resist this motion. (This resistance is of the form of a drag, arising out of absence of momentum, where it is necessitated to overcome inertia, rather than it being a force opposing motion). We contend that when the body is in this state of being at the brink of motion which is at the same time countered by the potential resistance to motion, the “**total field**” releases a quantity of **field momentum** ED = Mv = Mc.sinϕ, orthogonal to the original direction of internal momentum in order to overcome this potential resistance (ref. fig 1b). Simultaneous with this action of field momentum, the internal momentum rescinds a portion of momentum EB = Mc(1 – cosϕ) in the original direction. (We shall explain the function EB plays in the motion of the body later below).

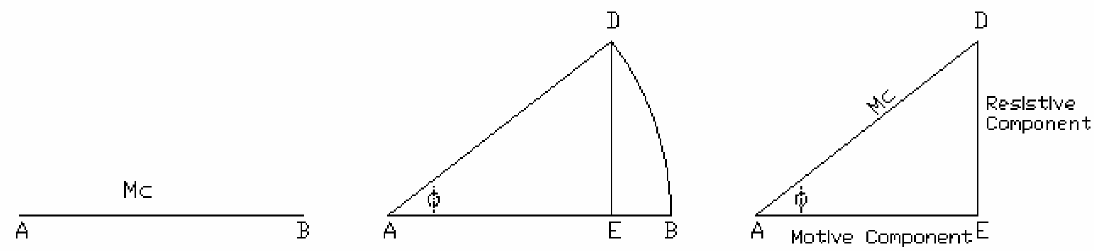



Fig 1a — Geometric structure of Internal momentum when the centre of mass is at rest.

Fig 1b — AB = AD = Mc; AE = Mc cos ϕ; DE = Mc sin ϕ; EB = Mc(1-cos ϕ)

Fig 1c — Geometric Structure of internal momentum when the centre of mass is at the verge of motion

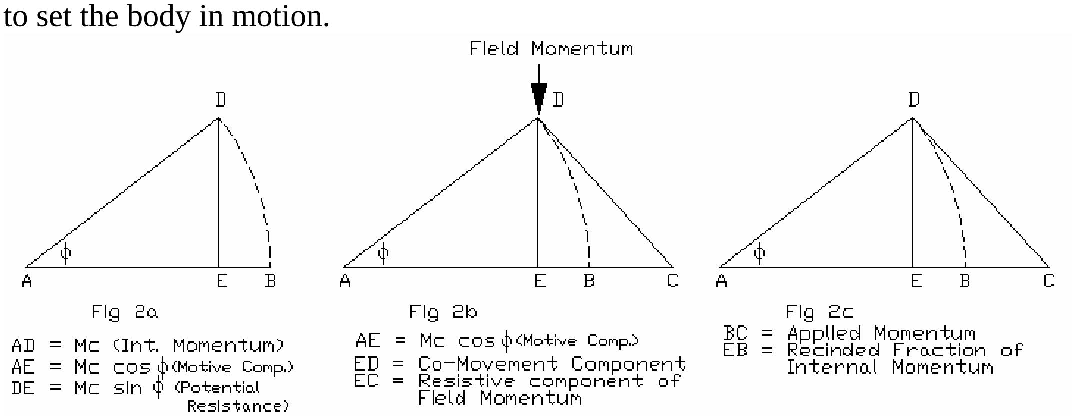
Just before the field momentum is released ED depicts the ‘resistive component’, which arises by virtue of there being no momentum for co-movement with the centre of mass, where this momentum is necessitated. Upon the release of field momentum to fulfil this necessity, ED transforms itself into the “co-movement component”. Thus in the new configuration (subsequent to the action of field momentum), the total internal momentum Mc consists of two perpendicular components, the “co-movement component” equal to Mv = Mc sinϕ and the “motive component” $M.(c^2- v^2)^{1/2}$ = Mc.cosϕ. Thus we see here that after the emergence of the “co-movement component” ED = Mc.sinϕ, (and rescinding of EB to facilitate this) the momentum left for internal action is only AE = Mc.cosϕ compared to AB = Mc when the centre of mass was at rest. This will explain why the internal processes slow down when a body is in motion.

**Important Note**: The reader is requested to bear the following in mind throughout this paper. As we shall show in theorem IV (‘the principle of partial action’), nature uses geometry to determine scalars as well. Or rather nature uses geometry to determine magnitudes of vectors without regard to their directions. If one were to consider any vector diagram in the paper involving momenta and scale up the whole diagram by the factor c, what we would get is a diagram of relationships between quantities of energy (scalars). Thus in fig 1, c is a hidden parameter and AB and AD in fact represent magnitudes of quantities of energy. Thus their orthogonal alignment is immaterial. What matters here is the relationship of magnitudes that the diagram offers and not their directions.

We now draw attention to Hermann Weyl's conception of streaming of energy and momentum from the field to matter and *vice-versa*. We also adopt the same categorical distinction made by Weyl between "*field momentum*" and "*kinetic momentum of matter*".
"The total energy and total momentum remains unchanged: they merely stream from one part of the **field** to another and become transformed from field energy and ***field momentum*** into kinetic energy and ***kinetic momentum of matter*** and ***vice-versa***"(5, p.168).
**Proposition I**: We contend it is the *field momentum* Mv = Mc.sinϕ that acts on the centre of mass of the body to propel it to move at velocity v, (and it is not the externally applied momentum $E_k/c$) that corresponds to the momentum of the body that moves the body as it held in accordance with the present conceptions of physics. (We contend that the externally applied momentum only **triggers** the process of setting the body in motion, but does not supply the momentum required for the motion of the body).

We note here (ref. fig 2a) that a) the internal momentum is a form of *kinetic momentum of matter* and b) the activation of inertia of internal momentum (by the potential motion of the centre of mass) leads to the formation of the tendency of resistance ED (which is due to the absence of *kinetic momentum of matter*), and c) ref. fig. 2b that this potential resistance ED is overcome by the release of an equal amount of *field momentum*. d) This field momentum itself in turn forms a resistive component EC in the form of a drag.

**Proposition II**: At the next level, an alternate process occurs, ref. fig 2c, where the tendency of potential resistance EC generated by inertia of the *field momentum* ED, is overcome by the *kinetic momentum* EC which is the sum of EB and BC. EB is what is rescinded from internal momentum as discussed above, and BC is the momentum applied to set the body in motion.




We prove the propositions I and II in the combined form by means of Theorem I below.

We note here from fig. 2a that upon considering the internal momentum, the ratio of ED the "resistive component" Mc.sinϕ to AE the "motive component" Mc.cosϕ is equal to tanϕ. We contend that by the law of proportions, this proportionality between the "resistive component" and "the motive component" of internal momentum of a body becomes the **determinant** of that between ED the "motive" and EC the "resistive" components of its external motion. We call this as the **law of proportionality between resistive and motive components of momentum** or for short **the law of gradient invariance**.

We also note here that the “resistive component” of internal momentum being at the same time identical with the “motive component” of external momentum. We call such stratagems of nature where the same entity plays two functions as “**dualisation**”.

**Theorem I – The Quantity of Kinetic Energy Required to be Applied to set a Body in Motion.**

Let the kinetic energy required to set the body at velocity v be $E_k$. Then momentum that corresponds to this energy is $E_k/c$. Consider the following **algorithm**. Let $E_k/c$ = BC. Ref. fig 3, when BC is applied to the body, its internal momentum Mc deflects through an angle $\phi$ to AD such that CD is the tangent drawn from C to the circle of radius AB.

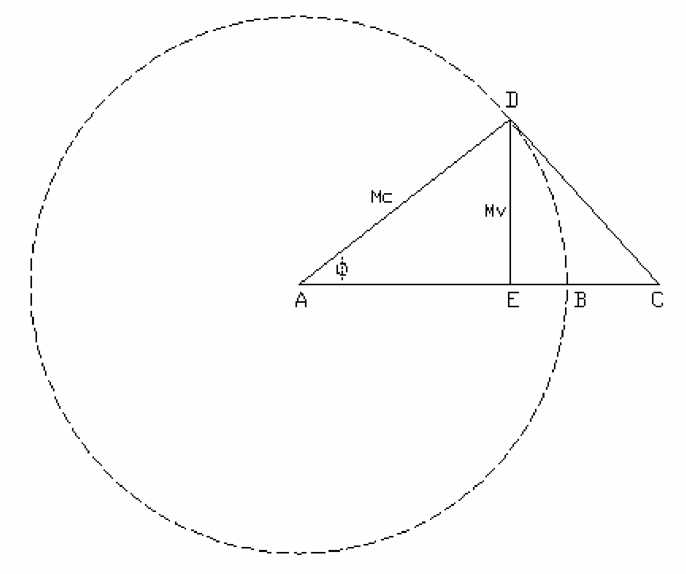



Fig 3

We contend that the momentum ED = Mv where ($\phi = \sin^{-1} v/c$) is **supplied** by the “**total field**” conjectured by Einstein (1, pp. 75, 89). This **added field momentum** ED has **inertia** Mv/c and it increases the total inertia of the system. The inertia of ED forms a resistance to the motion of the body; and the body becomes able to move only upon overcoming this resistance. In order to overcome this resistance, a quantity of momentum (Mv/c)v will be necessary, but then this momentum too has inertia $(Mv^2/c)/c$ and in turn further quantity of momentum will be necessary *ad infinitum*. That is this leads to a Zeno’s paradox.

To explain this, the inertia of internal momentum Mc is Mc/c = M. If the centre of mass were to move at velocity v, the momentum necessary to overcome the intertia M of internal momentum of AD is DE = Mv. This momentum Mv has an inertia Mv/c and if the centre of mass were to move this inertia Mv/c too has to be overcome. The momentum necessary to overcome this inertia is $Mv^2/c$. But then when this momentum is applied it too has an inertia $Mv^2/c^2$ and that too has to be overcome, by the application of momentum $Mv^3/c^2$ etc., … and the problem extends endlessly, and the centre of mass will never move. This paradox is resolved by nature in one stroke by turning this problem from its algebraic form into the geometric form.

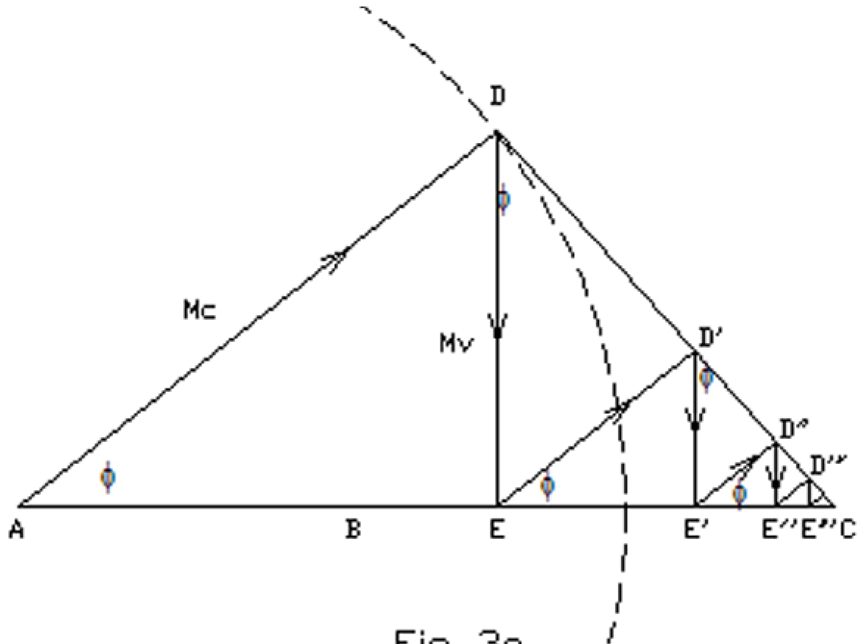



Fig 3a

If we consider any two pairs of monenta such as Mc and Mv, the ratio of the second quantity of momentum necessary to overcome the inertia of a given quantity of momenta is $Mv/Mc = (Mv^2/c)/Mv = (Mv^3/c^2)/(Mv^2/c)$ and so on = v/c.

Then momentum necessary to overcome the inertia of a given quantity of momentum is the v/cth fraction of that quantity. In the geomentric form this ratio is assigned as sinϕ = v/c. Then momentum necessary to overcome the inertia of a quantity of momentum is sinϕ of that quantity. Thus the quantity of momentum necessary to overcome the inertia of ED = Mv is ED' = Mv sinϕ. The quantity of momentum necessary to overcome the inertia of ED' is D'E' = $Mv\sin^2\phi$. The sum of ED' and D'E' is EE'. This shows that the sum total of all the quantities of momenta that become necessary to overcome the inertia of the preceding quantities of momenta in the endless series tends to EC. Now EC = ED tanϕ. This result is obtained due to the fact that the convergence of the series takes the form of addition of pairs (such as ED'+ D'E') successively to obtain Mv.tanϕ as we demonstrated in fig. 3a.

Therefore instead of making the momentum necessary to overcome the inertia of ED = Mv as ED' = Mvsinϕ and going through an endless series, nature in one stroke makes the **potential** resistive component of momentum to be equal to EC = (Mvsinϕ)secϕ = Mv.tanϕ. Upon supplying this amount, the total momentum becomes DC = Mv.secϕ. Then the inertia of total momentum becomes Mvsecϕ/c. Since v/c is sinϕ, the inertia of Mvsecϕ is Mtanϕ. The momentum necessary to overcome this inertia is Mv.tanϕ. Thus when this quantity of momentum is supplied in one instalment instead of supplying in an endless series, Zeno's paradox becomes resolved. This is the basis of the **law of gradient invariance**.

As we stated under Proposition I, the resistance due the inertia of *kinetic momentum* has to be overcome *field momentum* and *vice-versa*. Thus the resistance due to inertia of field momentum ED, has to be overcome by *kinetic momentum*. By the law of gradient invariance we enunciated above, the quantity of *kinetic momentum* required to overcome the resistance of the inertia of *field momentum* ED is equal to EDtanϕ = EC.

We contend that the *field momentum* takes form **potentially** as two perpendicular components, (ref. fig. 3) the "motive component" ED and "resistive component" EC. The "motive component" turns into its **real state** from the potential state, **only when** the "resistive component" has been negated by an equal quantity of *kinetic momentum*. This division of field momentum in the potential form, takes place in such a way that the "motive component" of momentum is equal to Mv = DE and the "resistive component" of momentum is equal to Mv.tanϕ.= EC. The *kinetic momentum* BC = $E_k$/c of the applied kinetic energy acts towards overcoming of the "resistive component" of *field momentum*. However since EC > BC, the applied *kinetic momentum* alone cannot overcome the "resistive component" of *field momentum*. Therefore the part of the internal momentum equal to EB that is rescinded out as described above, combines with the applied *kinetic momentum*, so that EB + BC negates EC the "resistive component" of *field momentum*. Upon this negation, the momentum ED transforms from the potential state to its real state. Then the body, being in possession of momentum Mv, moves with velocity v.

AC = AD secϕ = AB secϕ. [where $\sec\phi = \{1- (Mv/Mc)^2\}^{-1/2} = (1- v^2/c^2)^{-1/2}$]
BC = AB secϕ - AB ( Since AB = Mc)
BC = Mc (secϕ - 1) Let secϕ = $\Gamma_v$, then
BC = $Mc(\Gamma_v - 1)$

Therefore, the **kinetic energy** required to set a body in motion $\mathbf{E_k = Mc^2(\Gamma_v - 1)}$

**Q.E.D.**

What we can observe here is that upon applying a quantity of kinetic momentum Mc (secϕ -1) to the body, it is set in motion at velocity v, and that the internal processes are **slowed down** in the proportion of AD:AE, i.e. c: c cos ϕ where $\cos\phi = [(c^2-v^2)^{1/2}]/c$. This is because the internal processes lose a quantity of momentum equal to EB out of a total of AB in the process of overcoming "resistive component" of *field momentum*.

**Corollary I: How Kinetic Energy Acquires the Expression ½$\mathbf{Mv^2}$ at Lower Velocities.**

Ref. fig. 3, EC = Mv.tanϕ. At lower velocities tanϕ ≈ sinϕ where sinϕ = v/c. Therefore EC ≈ Mv sinϕ.= $Mv^2$/c. Also, at lower velocities, it is found that BC ≈ ½ EC (since BC ≈ EB). Therefore momentum BC = ½ $Mv^2$/c. This is why at lower velocities kinetic energy that sets a body in motion at velocity v happens to have a value equal to ½$Mv^2$.

(Note: There are two different Γ-terms involved in the motion of a body, one related to the velocity v of motion of the body and the other related to the velocity u of the space of location of the body. In order that there be no confusion, we use the symbols $\Gamma_v$ and $\Gamma_u$ respectively to differentiate between the two terms).

**Corollary II: How Kinetic Energy Acquires the Expression $\mathbf{Mc^2(\Gamma_v -1)}$ at Higher Velocities.**

Ref. fig. 3, at higher velocities where BC >> EB, kinetic energy can no more be expressed as ½ $Mv^2$, it can only be expressed in its true form as it appears in the above theorem, where BC = Mc.(secϕ - 1). Let $\sec\phi = \Gamma_v = (1- v^2/c^2)^{-1/2}$. Then the general expression for kinetic energy necessary to set the body in motion at velocity v turns out to be $Mc^2(\Gamma_v -1)$.

**The Appearance of the constant c in the Expressions of Motion of Bodies:**
The reason why the value c appears in expressions of motions of bodies is not because that the motion of light is somehow mysteriously involved in the geometry of motion of bodies but due to the following group of interconnected reasons.

**Rest Energy:** We contend that one of the reasons why the value c appears in expressions of motions of bodies, is due to the fact that the "total field" **replenishes** internal energy to bodies in such a way that a body of mass M at rest with respect to its proper reference frame always has a quantity internal energy $E_0$ equal to $Mc^2$. That is **rest energy** of a body of mass M is always equal to $Mc^2$, and consequently its internal momentum in this state is equal to Mc.

$E_0 = Mc^2$

The quantity of energy E that would move this body of mass M at velocity v is Mvc, so that the momentum is Mvc/c = Mv.

When we consider the case where this same amount of energy is in self-motion (i.e in transmission as in the case of light) where it moves at velocity c, it moves against its own inertia j.

Then we have that

$Mvc = jc^2$.

From which we have,

$j = Mv/c$

**The Relationship between Inertia of a Body in Motion and the Inertia of Energy moving it.**
We find that the inertia j of a quantity of energy moving a body of mass M at velocity v is the v/c^th^ fraction of the inertia of the body. $j = M(v/c)$

Let $Mv = p$ then,

$j = p/c$

Therefore we find that, c is the ratio of a given quantity of momentum p and its inertia j; $c = p/j$

or c is the square root of the ratio of energy and its inertia; $c = \sqrt{(E/j)}$

**The relationship between Total Momentum and the Resistive Component of Momentum:**
As we found in theorem I, the total momentum $\Gamma_v$Mv is required to move a body, (where $\Gamma_v = \sec\phi$) in the form of two components – the "resistive component" given by Mv.tan$\phi$ and the "motive component" Mv.

Mv.tan$\phi$ = Mvsec$\phi$.sin$\phi$. where sin$\phi$ = v/c

This indicates that the "resistive component" is the v/c$^{th}$ fraction of the total momentum.

**The Function c plays in the form of the Constant of Velocity Resistance:**
From the above we can deduce that the factor 1/c is the **constant of velocity resistance**.

Since the "resistive component" is the v/c$^{th}$ fraction of the **total** momentum as discussed above, the "resistive component" of momentum = $\Gamma_v$.Mv$^2$/c.

The **"resistive component"** of momentum is given by the **product** of the total momentum $\Gamma_v$Mv, the velocity v and the constant of velocity resistance 1/c.

i.e. the "resistive component" of momentum = $\Gamma_v$Mv .v .1/c = $\Gamma_v$Mv$^2$/c

**The Reason Why the Applied Kinetic Energy has to Increase Exponentially with the Increase of Velocity of Motion of a Body.**
When the total momentum $\Gamma_v$Mv increases exponentially with the increase of v (since $\Gamma_v$ increases exponentially with v), so does the v/c$^{th}$ fraction of it, which is the "resistive component". It is because the "resistive component" of momentum increases exponentially with velocity v and this has to be partially overcome by the momentum of the applied kinetic energy in moving a body, that the applied kinetic energy also increases exponentially with v.

Note: The mathematical relationship that yields the terminal velocity to be c is formed by the foreground motion in conjunction with the background motion as it will be demonstrated theorem III.

Note: c is the maximum potential velocity or the **terminal velocity** that a quantity of energy can attain against internal resistance (reasons will be explained under theorem II). We shall continue with the topic of "The Appearance of the constant c in the Expressions of Motion of Bodies" under theorem II.

**The Role Played by Mechanically Applied Kinetic Energy in the Motion of a Body:**
Ref. fig. 3, total momentum AC is equal to the sum of internal momentum AB + applied kinetic momentum BC. The fraction of AC that has to be set apart to overcome the "resistive component" of total momentum DC, is EC = j'c$^2$.

EC = EB + BC.

This means that the applied kinetic momentum BC itself is insufficient to overcome the "resistive component". Therefore a part EB of internal momentum AB too has to be set apart to make up EC = j'c. Upon forming EC by the combination of EB and BC to **overcome** "resistive component", (the momentum ED required for motion which is) "motive component" ED of the total external momentum DC is what remains available for the motion of the body. It must be noted that the applied kinetic momentum BC merely activates or **triggers** motion, while the actual momentum ED required for motion is supplied by the "total field".

It will now become clear, what role a quantity of kinetic energy plays, upon its application to a body to set it in motion. This kinetic energy ref. fig 3, a) it activates the internal subsystem to divide up its momentum to form two components – the active component AD = Mc.cosϕ and resistive component ED = Mv, b) activates the "total field" to supply field momentum ED = Mv, and c) thereafter employs its momentum BC together with part of internal momentum EB to overcome the "resistive component" of field momentum equal to EC. Thereby it facilitates field momentum Mv to move the body at velocity v.

**Why the Internal Processes of a Body Slow Down when it is in Motion**

The reason why internal processes of a body slow down when it is in motion is because (ref. fig. 3) in order to activate the "total field" to supply the momentum ED, internal momentum has to sacrifice the fraction of momentum EB. The momentum remaining for internal motions is ADcosθ, where AB = AD and $\theta = \sin^{-1} v/c$. We can verify this contribution of EB from internal momentum for the purpose of activation of motion of a body in terms of the example of the delay in the disintegration of a muon when in motion compared to its time of disintegration in a laboratory on Earth.

When a muon is at rest in a laboratory on Earth let the time of its disintegration be t. We contend that the threshold q for the disintegration of the muon is determined by the product of the "motive component" of internal momentum and the interval of time t. Thus (with reference to fig. 3) in the laboratory when the muon is at rest relative to its proper reference frame, the "motive component" is equal to the total internal momentum of the muon, which is AD and the time is t. The threshold q = AD.t. When the muon is in motion relative to its proper reference frame at velocity v, the muon loses the fraction of internal momentum EB and what remains as the "motive component" is AD.cosθ. In order to reach the same threshold q, the internal momentum ADcosθ must remain active for a time t' = t.secθ.

In a laboratory on Earth, the disintegration time $t = 2.2 \times 10^{-6}$ sec. By the estimated distances travelled by muons in cosmic rays moving at velocities near 0.9c the time t.secθ taken for these muons to disintegrate can be calculated knowing v = 0.9c, $t = 2.2 \times 10^{-6}$ and sinθ = v/c. This time calculated independently as above, is in agreement with our proposition t' = t.secθ

$$t' = t \sec\theta = t\,(1- v^2/c^2)^{-1/2}$$

$$= 5.047 \times 10^{-6} \text{ sec}$$

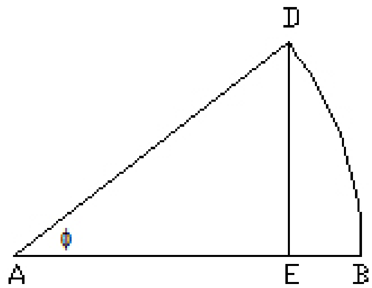



Fig 4a

AD = c
DE = t

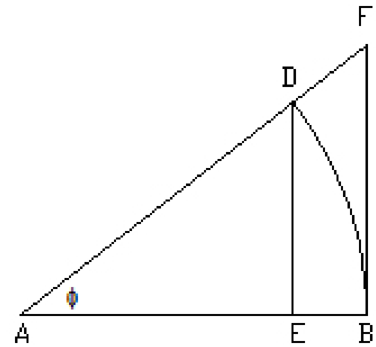



Fig 4b

For the present without any further comment (see note), we contend that nature **dualises** (ref. this concept under Theorem II) the time t of disintegration of the muon (when at rest) to be represented by the "resistive component" of the internal momentum ED, i.e. ED = t. The threshold is then given by q = AB.ED. When the muon is in motion, the "motive component" of internal momentum becomes equal to AE = AB.cosϕ. Then the time of disintegration comes to be represented by BF = EDsecϕ. Hence the threshold q = AB.cosϕ . EDsecϕ = AB.ED.

Note: In Einstein's theory, although time is not absolute, it is not relational either; it is **arbitrary.** For instance consider Einstein's statement: "Clearly to recognise this axiom (of time) and its **arbitrary character** really implies already the solution to the problem (in terms of relativity of simultaneity)" (1, p. 53). Because, of this **arbitrariness of the character of time** in Einstein's theories, John Earman writes: "the relativistic conception is much more inhospitable to relationism than the classical conception" and "relativity theory, in either its special or general form, is more inimical to a relational conception than is classical physics" (6, p 221). We on the other hand consider time to be relational. However, this subject is beyond the scope of this paper, and will be dealt with separately.

**Theorem II - The Energy-Momentum-Inertia Theorem.**

From the foregoing, it would be clear that when a quantity of energy is in action moving a body, it experiences an **internal resistance** due the **inertia** of energy such that a) this resistance is proportional to velocity w of motion of the quantity of energy in action and hence we recognise this internal resistance as form of a velocity resistance; and b) we also identify that the constant of proportionality of this velocity resistance is 1/c.

It is observed that there is an abstract geometric relationship between a quantity of energy E, the momentum p that corresponds to E, and the inertia j of p. This relationship is E/p = p/j = c as we discussed under theorem I. This relationship is familiarly written in the following two forms as E = pc or p = jc. Eliminating c we have $Ej = p^2$. It is on this latter equation that the Energy-Momentum-Inertia theorem is based. In geometric terms, it is none other than the familiar Euclidean theorem of the relationship between the tangent and the secant. Let us invert the original relationship and re-write it as p/E = j/p = 1/c. This brings us back to the discussion of how c appears in the expressions of motion of bodies….

We contend that since nature knows no anthropomorphic dimensions, in a **dimensionless** and a **relational world**, it has to resort to forming expressions by means of geometric structures whose component elements are relational to each other. And then algebraically, nature finds the solution by way of having the **unit of measure** as the reciprocal of the 'whole quantity'. In order to establish such a relationship, the 'whole quantity' must have a constant value - a definite number k. Then a part (the unit of measure) is determined to be 1/k, such that there are k aliquot parts in the whole.

1 whole = k parts or 1 part = 1/k x the whole

We contend that in the present case, nature has chosen 1/c as the 'unit of velocity'. The 'unit of velocity' poses as the minimum possible value (least quantum) at which a body can move; and at the other extreme – the maximum - is the **terminal velocity** c. Thereby in relational terms, the terminal velocity has c parts of the 'unit velocity', and conversely the 'unit velocity' is 1/cth part of the terminal velocity.

But then the question arises, what **physical mechanism** does nature use to fix c as a constant by way of making it the **terminal velocity** for motion of bodies? The answer is: it is done by the stratagem of 'dualisation'. **Dualisation** is the assignment of the **same value** to two different physical characters, such as the components of metrical tensor and gravitational potentials being described by identical quantities in the general theory of relativity (7, p.220) or in special relativity the 'force vector of motion' being equal to the motive force vector' as identified by Planck and Minkowski (2, p. 87) or as we found earlier in this paper where the "resistive component" of internal momentum was equal to the "motive component" of external momentum or as in the case of the disintegration of the muon above, the resistive component of internal momentum represents time of disintegration when the muon is at rest. In the present case by dualisation, the coefficient of velocity resistance to the background motion is made to be equal to the unit of velocity 1/c.

Nature creates the condition that for any object in motion, there is a velocity resistance to the motion of its background (of velocity u). The "*background motion" is the motion of the space of location relative which the object is moving. And nature chooses 1/c as the co-efficient of velocity resistance. Then we have the **ideal equation** for the velocity of a hypothetical body of zero mass being moved by a quantity of energy given by.

c' = c(1- u/c)

(Note: A quantity of energy moving a hypothetical body of zero mass is equivalent to that quantity of energy being in self motion overcoming its own inertia).

With reference to the above equation, we see that nature by dualising the unit of velocity to be at one and the same time the coefficient of velocity resistance, makes the hypothetical 'zero mass body' to lose, $1/c^{th}$ part of the background velocity u, out of its potential velocity c. By this device, c' -> c, when u -> 0.

This is how nature has contrived to have a terminal velocity of c for the motion of bodies. This form of dualisation is a common stratagem of nature as we pointed out for the case of metrical tensor and the gravitational potential, etc.

. (*And the background motion is represented in the abstract as the motion of the proper reference frame).

We propose that the relationship between the unit velocity and the terminal velocity be geometrically represented by the **algorithm** of a circle of radius AB = c.cosω such that 1/c = sinω. Then the unit velocity is represented by the tangent BC to the circle, when the secant AC represents the terminal velocity c.

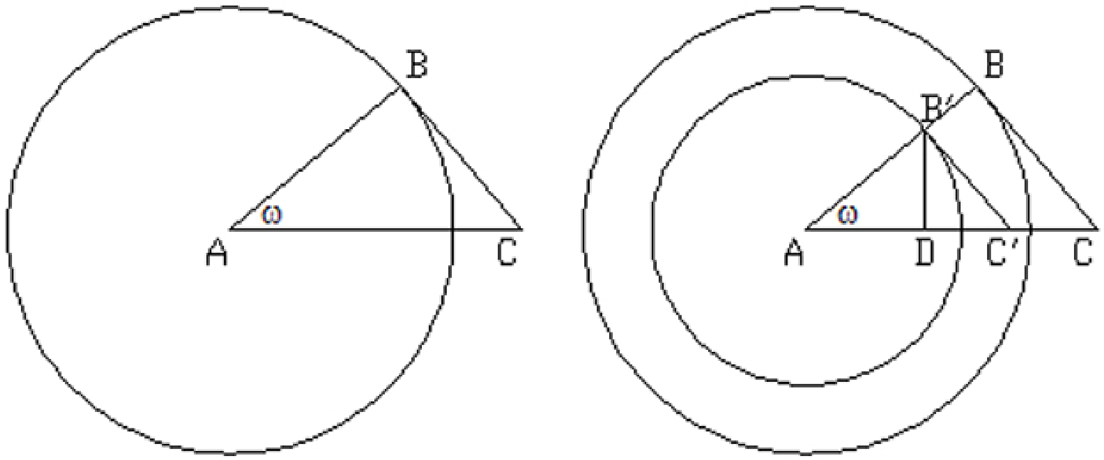



Fig 5a Fig 5b

We contend that the relationship between a quantity of energy $E_0$, its momentum $p_0$ and its inertia $j_0$ are structured on the basis of the above algorithm where sinω = 1/c. Draw a circle of radius AB' = $E_0$.cosω. Draw AC' = $E_0$ and draw the tangent C'B' from C' to the circle. Let C'B' = $p_0$.

Then we have B'C'/AC' = DC'/B'C'

$B'C'^2 = AC'.DC'$

$p_0^2 = E_0.j_0$

It is on the above equation that the **Energy-Momentum-Inertia** theorem is based. As we already pointed out, in geometric terms, it is none other than the familiar Euclidean theorem of the relationship between the tangent and the secant.

From triangles ABC and AB'C' we have

AC'/AC = B'C'/ BC

$E_0/c = p_0 /1$ or $p_0 = E_0/c$

And considering triangles ABC and B'DC'

B'C'/AC = DC/BC

$p_0 /c = j_0/1$ or $j_0.c = p_0$.

The relationship between Energy $E_0$, momentum $p_0$ and inertia $j_0$ is given by

$j_0$ c = $p_0$ = $E_0$/c ----------------( 1)

or

$j_0c^2 = p_0c = E_0$ ----------------(2)

This equation represents the **Energy-Momentum-Inertia Theorem.**

Re-writing the equation (2) by multiplying it by unit velocity,

$j_0$ c x 1 = $p_0$ x 1 = $E_0$ x 1/c

$j_0$c x 1 is the (1/c)th fraction of $E_0$,

Reference theorem I $\Gamma_v$jc x1 = j'c x 1 is the fraction of the energy $\Gamma_vE_0$ = E, that forms the resistive component of the field energy, per unit of velocity. That is 1/c is the **coefficient of velocity resistance**, such that when the velocity of the body is v, the fraction of energy E that forms the resistive component is j'cv = Ev/c. So we have the following **law of physics**:

*A quantity of field energy acting on a body so as to move it, forms a resistive component as a fraction of itself equal to the product of a) the quantity of energy $E_0$, b) $\Gamma_v$ c) the velocity v of the body and d) the co-efficient of velocity resistance 1/c.*

*This resistive component of momentum is determined by as well as overcome partially by the applied kinetic energy*.

From equation (1) we get the idea how the universal constant c comes into existence:

c = $\sqrt{}$(Energy/inertia) = Energy/momentum = momentum/inertia

This is yet another reason why the value c appears in the expressions of motions of bodies. And it is not because that motion of light has some mysterious connection to the geometry of motions of bodies. Coincidentally, the velocity of light in vacuo is equal to c because $c = 1/\sqrt{(\varepsilon_0\mu_0)}$ where $\varepsilon_0$ is the constant of permittivity and $\mu_0$ is the constant of permeability of free space.

**Conclusions to the Problem of Foreground Motion:**
We have thus answered all the questions posed above at the beginning of the paper in regard to the foreground motion satisfactorily. However, it is found that the actual velocity of the body differs from the above value v obtained in theorem I, depending on the velocity u of motion of the proper reference frame of the body. This manifests as the discrepancy between the expected displacement vt = x, if the body were moving at the theoretical velocity v given by theorem I, and the actual displacement measured which is found to be $x' = (x-ut)/(1- u^2/c^2)^{1/2}$. This suggests that the velocity of a body changes from v to v', with the magnitude of v' being **dependent** on the velocity u of the **proper reference frame**. What is the reason for this?

**THE INTERACTION OF THE FOREGROUND MOTION WITH THE BACKGROUND:**

As Newton has stated, "That if a place is moved, whatever is placed therein moves along with it; and therefore a body, which is moved from a place in motion **partakes also of the motion of the place**" (4, p.9). Both Galileo (8, p.185-188) and Newton have recognised that a body in motion relative to its space of location also moves with that space. That is, a body in motion has a minimum of two motions. They have assumed this hidden motion of a body with its space of location to be **the basis** of the principle of relativity. This is because even a body at rest relative to its space of location is in fact in motion along with the latter, they have assumed that a given force F will set a body in motion at velocity v, irrespective of the velocity of the space of location. They have assumed that the momentum generated by the force will be fully employed for the motion of the body relative to the space of location. It had not occurred to them that the generated momentum itself has inertia j. This inertia adds to the motion of the body and that in order to co-move with the space of location at velocity u, the resistance due to this inertia too has to be overcome by forming a **co-movement component of momentum**.

As we discussed in the section above a quantity of energy E, when moving a body of mass M at velocity v has the form E = Mvc. And when E is in self-motion moving at velocity c, it has the form $E = jc^2$. Hence E/c = Mv = jc. E/c is the abstract form of momentum, whereas Mv and jc are its two empirical forms when moving a body of mass M at velocity v and when in self-motion at velocity c respectively.

We contend that depending on the empirical velocity of motion of energy (i.e. v when moving a body and c when in self-motion), the co-movement component of momentum is given by the product of the momentum E/c, the velocity u of the space of location and the constant of velocity resistance 1/c. Depending on the empirical form of E/c, the co-movement component E/c.u.1/c assumes the form Mv.u/c or jc.u/c

We contend that nature has configured the empirical physical relationship between an energy transmission occurring in a given space, and the velocity of that space, on the basis of the **ideal** mathematical law, that when the velocity u of the space (to which the proper reference frame is attached) is zero, the velocity of the energy transmission attains the value c, and conversely when the velocity of the proper reference frame is c, the velocity of the energy transmission becomes zero. This is because when a quantity of energy is in action, it experiences a **resistance** from the 'background **field**'. This 'background **field**' is the **velocity field** of the space of *location of the energy in action

(*or it is the potential velocity field of the type $v = \sqrt{(GM/R)}$, if the space of location is a gravitational field. See under theorem IV pp. 24-25 for further explanation of this case in a gravitational field). This resistance is proportional to velocity u of the proper reference frame and the constant of proportionality is 1/c. (It may be noted that by the term "velocity of the proper reference frame" we mean the "velocity of space of location" of the energy in action. We shall be using these two terms interchangeably).

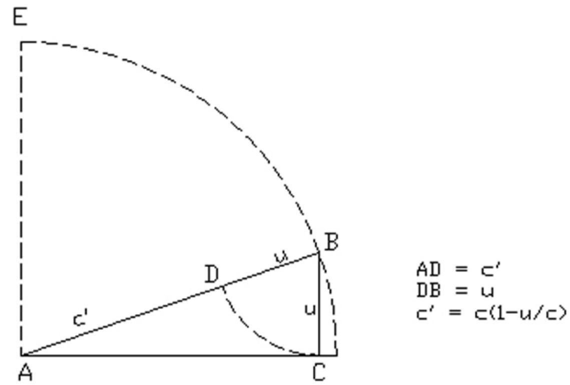



Fig 6

Fig. 6 provides the algorithm for the above mathematical relationship. AB = c, BC = BD = u (the velocity of the proper reference frame). Then AD = (c – u) the phase-velocity of the energy transmission. (Note: In theorem XII we show how the velocity of an energy transmission finally becomes equal to c). When BC = 0, AD = AB = c, and when BC = AE, (i.e. u = c), AD = 0. This is why c has turned out to be the **terminal velocity** for the motion of energy under most prevalent conditions. (*We do not exclude the possibility of this terminal velocity being exceeded under special circumstances).

The above law is enforced by having a **constant of proportionality** of 1/c for the **velocity resistance** such that the velocity c' of the energy transmission that corresponds to a given velocity u of the proper reference frame is given by:

c' = c (1 – u/c) ---------------------(3)

At this point we need to comment on three matters:

1) the above equation is only a preliminary expression of the tendency leading to a law in which the actual equation where the phase-velocity is given by:

$c' = \Gamma_u(c - u/c)$

where $\Gamma_u = (1-u^2/c^2)^{1/2}$ as we shall see in theorem III.

2) We have stated that the above reciprocal relationship between the velocity of an energy transmission and the velocity u of the proper reference frame as an **ideal relationship.** Since motion is relative and since always u > 0, this would mean that the velocity of an energy transmission can never be c. However as we show in theorem XII, there is another physical process which **negates** the above relationship by superimposing another tendency which causes an energy transmission to move at velocity c.

3) Nature always works through tendencies given by simple and ideal mathematical relationships. Each ideal relationship is negated and superimposed by the other. It is in recognition of this **contradictoriness** in the processes of nature that Einstein made the following seemingly contradictory statements: The "axiomatic basis of theoretical physics **cannot be** abstracted from experience but must be **freely invented**, …. Experience may suggest the appropriate mathematical concepts, but they most certainly cannot be deduced form it" (p. 393). …. 'If, then, it is true that this axiomatic basis of theoretical physics cannot be extracted from experience but must be freely invented, can

we ever hope to find the **right way**? Nay more, has the right way any existence outside our illusions? . .. without hesitation that **there is**, in my opinion, **a right way**, and that we are quite **capable of finding it**. Our experience hitherto justifies us in believing that **nature is a realisation of the simplest conceivable mathematical ideas**. I am convinced that **we can discover** by means of purely mathematical constructions, the concepts and the laws**,** connecting them with each other, which furnish the key to the understanding of natural phenomena. Experience may suggest certain mathematical concepts, but they most certainly cannot be deduced from it. Experience remains, of course, the sole criterion of the physical utility of a mathematical construction. But the creative principle resides in mathematics. In a certain sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed" (1, p.398). In this paper it is these simple but contradictory tendencies that are superimposed on one another that we trace theorem after theorem, in the unravelling of the relativistic phenomena.

When a quantity of energy E is in transmission relative to its proper reference frame moving at velocity u, the energy in transmission experiences a resistance due to the motion of the reference frame. E.1/c is the fraction of the energy E, that has to be set apart to overcome the resistance to the velocity of the proper reference frame, per unit of velocity. That is 1/c is the **coefficient of velocity resistance**, such that when the velocity of the proper reference frame is u, the fraction of energy E that has to be set apart to overcome the velocity resistance of the proper reference frame is Eu/c. So we have the following **law of physics**:

*A quantity of energy in transmission has to set apart a fraction of itself equal to the product of the quantity of energy in transmission E, the velocity of the proper reference frame u and the co-efficient of velocity resistance 1/c, in order to overcome the resistance to the velocity of the proper reference frame*.

**Theorem III – The Physical basis of the Lorentz Transformation - The Effect of the Motion of the Proper Frame of Reference on the Motion of a Body**

In the theorem I above, we proved that the application of kinetic energy mechanically to a body only **activates** the release of field momentum required for the motion of the body, from the "total field". However, the **quantity** of momentum released by the "total field" in the theorem I was considered on the **basis of an ideal condition**. In empirical situations the result of the theorem I is altered in similar manner to that of the ideal gas equation under empirical circumstances. The ideal condition on which the theorem I is based is the premise that the motion of the **space of location** in which the motion of the body occurs has no bearing on the velocity of the body. That is, the theorem I assumes that the velocity of the ***proper reference frame** (which is by definition the frame **attached** to the moving space of location of the body) is effectively zero and therefore the motion of the body is assumed to occur, in effect, relative to absolute space; and consequently, the motion of the body comes to be considered as absolute.

(* Note: In this paper all bodies whose motions are compared are located in the **same space** relative which they move and no arbitrary reference frames are involved. The motions of bodies are in relation to a reference frame attached to this space, and as such it is the **proper reference frame** of motion of all these bodies. The same holds for Newton's concept of '**place'** in the statement quoted above "That if a place is moved, whatever is placed therein moves along with it; and therefore a body, which is moved from a place in motion **partakes also of the motion of the place**" (4, p.9). The proper reference frame is that attached to the moving 'place'. Therefore in this paper, true to Newton's conception, we do not deal with arbitrary reference frames, but with the proper reference frames attached to the spaces of location of bodies).

However, in the **real situation**, what we have empirically is **relative motion**. There is always the motion of the proper reference frame (of velocity u) relative to which a body moves, and therefore this motion of the proper reference frame has a bearing on the motion of the body moving relative to it. The body of mass M even when at rest **co-moves** with its proper reference frame at velocity u, (or as we already quoted from Newton, 'partakes in the motion of the place') and by virtue of this, it has a component of momentum Mu, (which we call the "co-movement component of momentum").

As a result, even when the body is at rest relative to the proper reference frame, the internal momentum AB = Mc is cleaved into two components, AF = Mu, and the remainder Mc(1 – u/c).

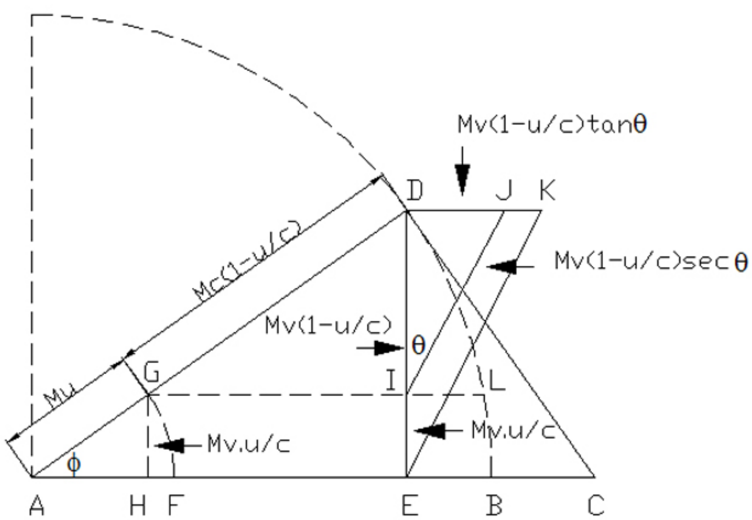



Fig 7

When the body which was initially at rest, moves at velocity v, in theorem I we assumed that it is supplied with momentum Mv, from the "total field", and as such this momentum comes **totally from outside the system**. This momentum has **inertia** Mv/c, and this **inertia is entirely in addition** to the original inertia M the body possessed when it was initially at rest. As a corollary to Newton's conception of a body partaking in the motion of its place, the additional inertia of the momentum Mv too has to simulate 'motion with the place', or in other words form a supplementary co-movement component of momentum in order to overcome the resistance due to this inertia to the motion of the proper reference frame. Ref. fig. 7, in the initial state, in so far as internal momentum is concerned, the co-movement component with the reference frame was AF = Mc.sinθ = Mc.u/c (since sinθ = u/c), out of a total internal momentum of AB = Mc. This same pattern of internal momentum now gets extended on to the external momentum. By the law of proportions, the co-movement component out of a total external momentum ED = Mv is given by EI = Mv sinθ = Mv.u/c.

We now find that the external momentum ED = Mv cleaved into two components EI = Mv. u/c (which is equal to GH = Mv. u/c) and ID = Mv(1 – u/c).

We contend that as opposed to the assumption in theorem I, the empirical situation is slightly different. In the empirical situation, when momentum BC is applied externally, the "total field" field contributes not only momentum ED, **but also** the complement DK. DK = ED tanθ, where $\theta = \sin^{-1}u/c$ (u = velocity of the proper reference frame). Since ED is always complemented by DK of value equal to ED.**tanθ**, we call this component the "**tangential complement**" of momentum. When we developed the theorem I, we assumed that u = 0. By virtue of this assumption, we have quite unknowingly disregarded the 'tangential complement' DK altogether. However, in the empirical situation where always and inevitably u > 0, then DK > 0. Since DK = ED tanθ, the resultant of ED and DK is EK = ED.secθ. (Let $\sec\theta = \Gamma_u = (1- u^2/c^2)^{-1/2}$). EK = $\Gamma_u$.Mv

By the law of proportions, when the co-movement component is EI = Mv. u/c for a total momentum of ED = Mv, it (the co-movement component) is EL = $\Gamma_u$. (Mv. u/c) when the total momentum is EK = $\Gamma_u$.Mv

Out of a total momentum of EK when EL is set off for co-movement with the proper reference frame, the momentum available for motion relative to the latter is

LK = EK – EL, which is:

LK = $\Gamma_u$ Mv(1-u/c).

Whereas the displacement is x in time t, for a momentum of ED = Mv in the ideal condition (where the motion of the proper reference frame is deemed to have no effect on the motion of the object moving relative to the latter), given by

x = vt,

in the empirical situation the displacement is given by x' when the effect of motion of the proper reference frame on the motion of the object moving relative to it is taken into account.

x' = $\Gamma_u$ v(1-u/c)t

x' = $\Gamma_u$ (x – vt.u/c) -----------------------(4)

When v -> c   vt.u/c -> ut

x' = $\Gamma_u$ (x – ut) ---------------------------(5)

Equation (5) as we know is what has come to be called the "Lorentz transformation".

This equation holds only for motions of particles at near light velocities. Therefore **general equation of motion** for the motion of a **material object** is given by equation (4) as it will be applicable for motions of bodies at all velocities. Accordingly, the verification of this equation with empirical facts will validate or disprove our theory.

This verification can be undertaken immediately. There are records of thousands of experiments carried out for particles moving at moderate to very high velocities in the past century. Processing of data from such experiments covering a full range of velocities will show that all results conform to equation (4) whereas even at velocities as high as

0.8c there are substantial discrepancies between the predictions according to equation (5) and the actual results. This will validate our theory.

Einstein has built his special theory of relativity, on the basis of three postulates. Postulate I is the principle of relativity, and postulate II is the principle of the constancy of the velocity of light. He claimed the contradiction between postulates I and II are resolved by postulate III which is that the "co-ordinates and times of events" conform to Lorentz transformations (1, p. 57).

When in the above theorem we have proved that the physical basis of the Lorentz Transformation – the effect the motion of the proper frame of reference has on the motion of a body, it instead of reconciling the contradiction between Einstein's postulates I and II, firstly calls to question the validity of the principle of relativity itself. While the principle of relativity asserts that the velocity of an object is **independent** of the velocity of the proper reference frame relative to which it moves, theorem III clearly contradicts this position and establishes that the velocity of an object is **dependent** on the velocity of the reference frame. This contradiction between our theorem III and Einstein's postulate I is resolved under Appendix I.

Secondly, in the theorem III when we consider a photon as the 'body' in motion, from equation (5) the velocity c' of the photon is given by $c' = \Gamma_u(c-u)$, which means that the velocity is c is possible only when the velocity u of the reference frame is zero. It indicates that for values of $u > 0$, $c' < c$. This would appear to contradict Einstein's Postualte II, which is the principle of constancy of the velocity of light. This contradiction is resolved under theorem XII, where we establish the physical basis of the constancy of the velocity of light.

Einstein, wrote: 'By and by I **despaired** of the possibility of discovering the **true laws** by means of constructive efforts based on known facts. The longer and the **more despairingly** I tried, the more I came to the conviction that only the **discovery of a universal formal principle** could lead to **assured results**. The example I saw before me was thermodynamics. The general principle was there given in the theorem: **laws of nature** are such that it is impossible to construct a ***perpetuum mobile***' (1, p.53). He also wrote: "The **universal principle** of special theory of relativity is contained in the postulate: The laws of physics are invariant with respect to the Lorentz transformations. …This is a restricting principle for natural laws, comparable to the restricting principle of the non-existence of the *perpetuum mobile* which underlies thermodynamics" (1, p. 57).

Although Einstein by intuition indicated this analogy, he never demonstrated the underlying physical basis in the two processes which make them analogical. In Appendix II, we demonstrate this physical basis.

Lastly, although by way of theorem III we derived the Lorentz transformation, when one considers the geometry behind this derivation, we find that it provides the correct magnitude for IJ in fig 7. However the direction of IJ is found to be incorrect. We have here a problem similar to that of position and momentum in quantum mechanics. This problem is addressed in theorem IV.

**Theorem IV - The Principle of Partial Action:**
We indicated above in the theorem III that when kinetic momentum BC is applied to a body, the "total field" not only imparts momentum ED, but this is complemented by momentum DK (tangential complement). However, the action of DK does not follow the principle of addition of velocities in terms of magnitude and direction. Under different conditions it either changes the magnitude of ED or the direction of ED, but never both. In the above case of inertial motion of a body in a **vector field**, the action of DK was to **change the magnitude** to EK' without a change of direction.

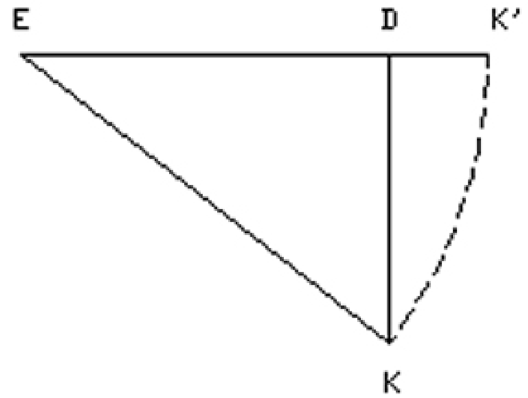


Fig 8a

Action of Field Momentum
In a Vector Field

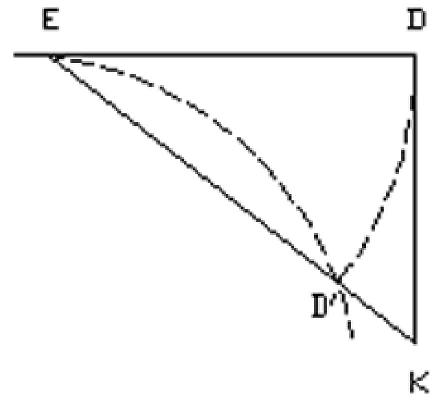


Fig 8b

Action of Field Momentum
In a Gravitational Field

In the orbit of a body in a **gravitational field**, the action of DK is to **change the direction** of ED to ED'without a change of magnitude. If a satellite were to be launched at the certain altitude R from the centre of the Earth, then in order to transport it to that altitude, the appropriate amount of energy has to be expended and then to set it in orbit, a quantity of kinetic energy $\frac{1}{2} mv^2 = \frac{1}{2} GMm/R$ has to be imparted to the satellite such that the satellite will move with a velocity $v = (GM/R)^{1/2}$. That is, the velocity of orbit v is given by the square root of twice the kinetic energy per unit mass.

In this case too (ref. fig. 9) by applying momentum of $BC = \frac{1}{2}GMm/Rc$ ($= \frac{1}{2} mv^2/c$), as per theorems I, the field imparts momentum ED and its tangential complement DK. However, DK changes the direction of ED without changing its magnitude. Thus the satellite moves in orbit with the velocity $v = (GM/R)^{1/2}$ (how this orbit becomes elliptic will be considered later in theorem VIII). In Newtonian mechanics, DK is attributed as due to the "attractive force" which incessantly changes the direction of motion of the body.

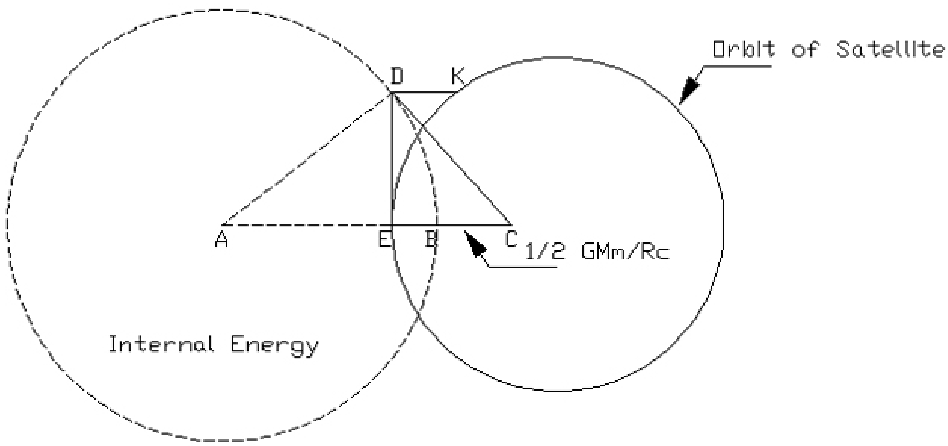



Fig 9

Note: It may be noted for later reference in theorem VIII that the gravitational potential energy at this position is GMm/R and the kinetic energy is ½GMm/R so that the total energy is 1.5GMm/R. If the velocity were to be determined by the total energy of 1.5GMm/R instead of (½GMm/R) it would have the value twice the square root of 1.5GMm/R per unit mass which is $(3GM/R)^{1/2}$. It may also be noted that Einstein has obtained the number 3GM/R by trial and error and has used it in his field equations. He has not been able to account whence it comes. In regard to this situation Feynman in his book *Six Not so Easy Pieces* wrote that 'Einstein pulled it out of a hat. In our case we have explained how this quantity comes into being.

The above examples will show that the 'tangential complement' imparted by the "total field" acts in such manner as **either** to change the magnitude of the principal component of momentum without changing its direction or it acts to change the direction of the principal component without changing its magnitude. This aspect of the action of the 'total field' on the motion of bodies we call the "**Principle of Partial Action**".

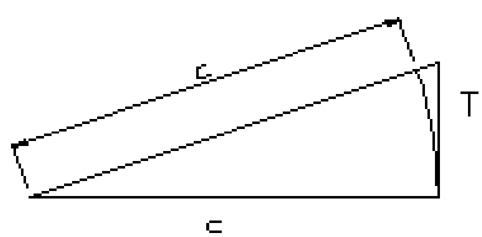



Fig 10

It is in accordance with this principle that light rays bend in gravitational fields (theorem IX) as well as in velocity fields (theorem XII). It is the phenomenon of bending of light in a velocity field that we have come to call "aberration of light". Both these theorems can be combined into a general theorem. When a light ray moves in either of these types of fields, a tangential complement T acts on it. This tends to increase the velocity to $c' = (c^2 + T^2)^{1/2}$. This increase is averted by the principle of partial action by opting to deflect the ray through an angle $\beta = \tan^{-1}T/c$, instead of increasing the magnitude. In a gravitational field ref. theorem IX, T = 3GM/Rc and in a velocity field ref. theorem XII, $T = (c.\cos\alpha - u.\cos\chi)\tan\theta$ (as in the case of aberration of starlight entering the earth orbiting at velocity u).

**GRAVITATION: Theorems V to IX**

As we have pointed out, Einstein was quite aware of the fictitious nature of constructive theories. As an example of the fictitiousness of the constructive theories, Einstein states, "The tremendous success of his (Newton's) doctrines may have prevented him and the physicists of the eighteenth and nineteenth centuries from recognising the fictitious character of the foundation of his system. …… General relativity showed that … one could take account of a wider range of empirical facts, and that too in a more satisfactory and complete manner, on a foundation quite different from the Newtonian. But quite apart from the question of the superiority of one or the other, the **fictitious character of fundamental principles** is perfectly evident from the fact we can point to two essentially different principles, both of which correspond with experience to a large extent; this proves at the same time that every attempt at a logical deduction of basic concepts and postulates of mechanics from elementary experiences is doomed to failure" (1, p. 393).

Newton's own writings show that he was certainly aware of the fictitious nature of his theory, (contrary to Einstein's opinion above, in regard to Newton being deceived due to the overwhelming success of his theory). In the first place Newton found it appropriate to entitle his work as "Mathematical Principles …." instead of "Physical Principles …..."; (and the significance of the difference of the two terms 'mathematical' and 'physical' will become clear from Koyre's comments below). And as for the fictitious basis of his theory of gravitation, Newton's position was quite clear: "That gravity should be innate inherent and essential to matter so that one body may act upon another at a distance through a vacuum without the mediation of anything else by and through which their action or force may be conveyed from one to another is to me so great an absurdity that I believe no man who has in philosophical matters any competent faculty of thinking can ever fall into it" (9, p. 337).

Koyre remarks how this clear position of Newton, about the fictitious basis of his theory, was wilfully ignored and presented otherwise as an indisputable truth by his immediate followers: "Newton himself, as we well know, never admitted attraction as a 'physical' force. Time and again he said, and repeated, that it was only a 'mathematical force', that it was perfectly impossible – not only for matter but even for God – to act at a distance, that is to exert action where the agent is not present; that attractive force therefore ….. was not to be considered as one of the essential and fundamental properties of bodies …. and he did not want to give a fanciful explanation when lacking a good theory … and (preferred to) leave the question open. Yet, strange, or natural, as it may seem, nobody – with the single exception of Colin Mclaurin – followed him in that point. The very first generation of his pupils … accepted the force of attraction as a real physical, and even primary property of matter and it was their doctrine that swept over Europe…" (10, p.16).

Einstein considered his theories of relativity to be provisional. Not only that Einstein has had to write his theory in the form of a constructive theory in the absence of his ability to write it in the preferred form of a theory of principle, but he even found the theory he developed not to be to his satisfaction. In regard to the basic equation of general relativity, Einstein candidly expressed his misgiving as follows: "Not for a moment, of course did I doubt that this formulation was merely a **makeshift** in order to give the general principle of relativity a preliminary closed expression. For it was essentially nothing *more* than a theory of the gravitational field, which was **artificially isolated** from a **total field** of as yet an unknown structure…" (1, p. 75). He wrote: "Our problem is that of finding the equations for the total field. …Therefore it would be most beautiful, if one were to succeed in expanding the group once more analogous to the step which led from special relativity to general relativity. ….. All such endeavours were unsuccessful”.(1, p. 89-91). Yet as if the history of how Newton considered his own theory to be fictitious and how his followers presented it as the indisputable truth were to repeat itself, the present day’s scientific community considers Einstein’s theories as the indisputable truth in spite of his own misgivings about them.

As it would be indicative from the foregoing, both Newton and Einstein have admitted that their theories of gravitation are based on fictitious concepts. This situation warrants us to reconsider the presently accepted theories and also re-visit other theories like those of Kepler, Borelli and Hooke in particular in regard to the question of ellipcity of orbits.

**Theorem V - The Motion of a Body in a Gravitational Field**

We must recognise the fact that there is no place in the universe free of the effects of gravitational fields. Therefore, an object projected into space in a certain direction moves according to the theorems I -IV but in addition is subject to the effects of the gravitational fields. For simplicity, we consider the effect on such a projectile due to the dominant gravitational field in which it is moving. For instance a projectile moving in Earth’s space at a distance R from the centre will tend to move in accordance with theorems I-IV, but will be subject to the following effect.

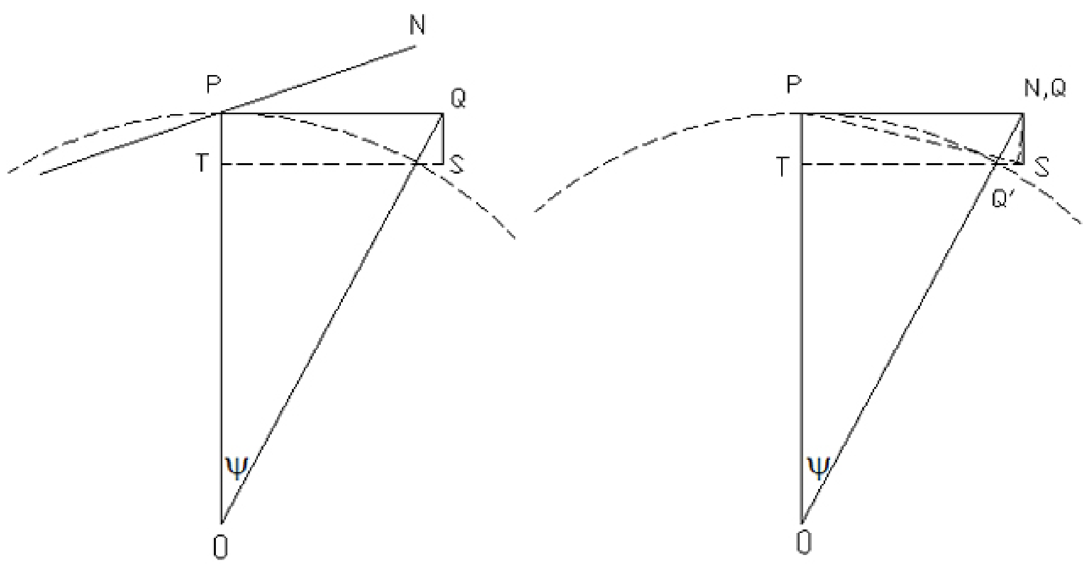



Fig 11a Fig 11b

We contend that for a body placed at P in a gravitational field distant R from the centre O, a quantity of momentum PT is imparted by the “total field” directed towards the centre of the field in accordance with the following algorithm. OP = R the distance from the centre, PQ = w which is the square root of the gravitational potential ($w = \sqrt{(GM/R)}$). The angle POQ = $\psi$. Irrespective of the velocity PN of the object, the total field imparts a momentum PT = PQtan$\psi$ = QS. As Galileo demonstrated, the object moves under the combined effect of PN and PT in a parabolic path. When PN = 0 the object falls directly towards the centre. It must be noted here that upon the action of PT the principle of partial action prompts a change of magnitude of the motion of the body in the vertical (without changing the direction of vertical component of PN).

**Theorem VI – Orbit of a Body in a Gravitational field.**
We contend that under the **special condition** of PN = PQ in magnitude and direction, (ref. fig. 11b) the principle of partial action prompts a **change of direction** of PN without a change of magnitude of motion of the body. In this case the action of PT is to change the direction of PN (= PQ) to PQ' and by this action it tends the body to move in a circular orbit.

However, there are no objects to be found in circular orbits of zero eccentricity. In the orbits of bodies there is always some eccentricity involved. Why is this so?

**Theorem VII. – Pauli Principle Applicable to All Objects in Motion**
We contend that the Pauli Principle is followed not only by microscopic particles, but also by macroscopic objects. We contend the reason for this being that an object (microscopic or macroscopic), in addition to their principal motion is constantly in a mode of transferring a quantity of kinetic energy to and from the "total field" in the manner described by Weyl.

"The total energy and total momentum remains unchanged: they merely stream from one part of the **field** to another and become transformed from **field energy** and **field momentum** into kinetic energy and kinetic momentum of matter and ***vice-versa***"(5, p.168).

This reciprocal transfer to and from the field, causes the object to oscillate in various directions in accordance with the degrees of freedom available while it is engaged in its principal motion. This is why no two particles in the universe can maintain the same velocity and distance relative each other.

Just like a biological cell that must undergo metabolism for its existence, which is a two way process of anabolism and catabolism, a body in motion or even a quantity of energy in transmission must undergo an exchange of energy between itself and the "total field" on a continuous basis. This "metabolic process" of continuous exchange of energy between a body in motion and the "total field" is therefore true for a body in orbit as well, and it manifests by way of eccentricity of the orbits of the body. (This same intercourse with the "total field" is the cause of the so-called "cosmological redshift" in the motion of light – see theorem X)

**Theorem VIII – Elliptic Orbits of Planets.**
When an object moves under the special circumstances as in theorem VI, its degrees of freedom for oscillation in various directions are more or less restricted, and it is confined more or less to oscillate in one particular direction in the plane of its orbit. (Oscillations in other directions become comparatively insignificant). This oscillation in the plane of orbit defines the line of apsides and causes the orbit to become elliptic as Kepler (11, pp.274-279) and Borelli (11, pp.503-513) demonstrated. This oscillation is caused by the transmission of energy to and from the body and the "total field" as we discussed in theorem VII. We refer to such a transmission in relation to a body in orbit as the "apsidal energy transmission".

It is of interest to quote Borelli on the question of elliptic orbits of planets. "We see that animals are endowed with perpetual pulsation in the heart, that is to say, a certain systole and diastole which are also observed in the arteries: similarly, all parts of an animal endowed with a certain peristaltic motion by which they dilate and contract. We might assume that planets have a similar perturbation by means of which they approach and move away from their proper vital source about which they move in orbit, and so perform a pulsation somewhat similar to that of the heart. ….. In truth, other natural operations in which we see similar effects produced by blind necessity present themselves to those to whom these views are not acceptable on account of their *animistic* character. Such for example is the behaviour of pendulums through which they spend long hours performing their proper oscillations which would continue indefinitely if the retarding influences were completely removed; but it is preferable to consider the natural operation, more like the operation of the planet". Then he goes on to demonstrate the periodic variation of the distances between planets and the Sun in terms of a wooden cylinder made to oscillate up and down while floating in a vessel. (11, p. 503-4).

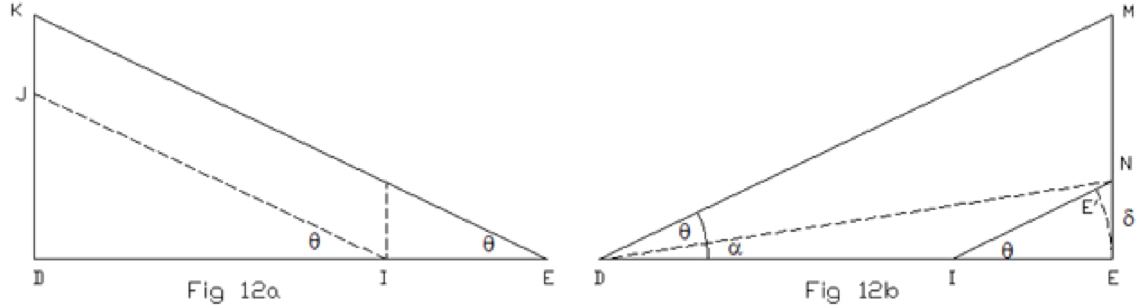
The elliptic orbit as a superposition of a linear oscillation on a circular motion was demonstrated analogically by Robert Hooke in 1666 (10, p. 181), where he first made a pendulum bob to oscillate in a vertical plane by applying a force F. Then applying a force F' on the bob perpendicular to the plane of oscillation, he made it to oscillate as a conical pendulum. When F' = F, the trajectory was circular, but when F'> F the trajectory became elliptical with the major axis in the direction of the force F' and with the minor and the major axes being proportional to F and F'. The same effect was obtained by applying a force F'-F, to a pendulum in circular motion, thus showing that the superimposition of force F'-F is what makes the pendulum to assume the elliptic shape what would otherwise have been circular.

**Theorem IX – Deflection of the Direction of Energy Transmissions Occurring in Gravitational Fields.**

As we made note in theorem IV, the **total gravitational energy** of the satellite at the altitude R is gravitational potential energy GMm/R plus the gravitational kinetic energy ½GMm/R equal to 1.5GMm/R. If this total energy were to activate momentum from the "total field" to act on the satellite, then this momentum would be mv' = $m(2 \times 1.5GM/R)^{1/2}$.= $m.(3GM/R)^{1/2}$. This is because, by the law of proportions, when for a quantity of energy ½GMm/R the momentum is $m(2 \times ½GM/R)^{1/2}$, then for energy 1.5GMm/R the momentum has to be $m(2 \times 1.5GM/R)^{1/2}$.

From theorem VIII, we contend that the reason why the orbit of the satellite becomes elliptic is because there is an energy transmission occurring to and fro between the body in orbit and the "total field" causing it to oscillate along the line of apsides. We contend that the total momentum p of energy of this oscillation is cleaved into two components. One component is $p.(3GM/Rc^2)^{1/2}$ and the balance is $p[1 - (3GM/Rc^2)^{1/2}]$.

If we refer back to the theorem III, fig. 7 the total momentum DE is cleaved into DI = Mv(1-u/c) and IE = Mv.u/c. DK is the tangential complement of ED. And DK is also cleaved into DJ and JK proportionate to DI and IE. EI and IL (= JK) combined form the co-movement component equal to EL, and the momentum that remains for independent motion of the body is LK = IJ




DE = Mv
DI = Mv(1-u/c)
IE = Mv.u/c

DE = p
DI = $p[(1\text{-}3GM/Rc^2)^{1/2}]$
IE = $p(3GM/Rc^2)^{1/2}$

In summary what we have as the net result is that total momentum DE is cleaved into two components DI and IE. The component of momentum for independent motion IJ (i.e. motion relative to the proper reference frame) is formed by ID and the **proportionate** tangential complement DJ. And this by the principle of partial action manifests a change of magnitude of DI without a change of direction. It must be noted that IE = Mv.u/c is the "background dependent component" that reflects the interaction with the motion of the proper reference frame (which is the background) and DI = Mv(1 –u/c) is the "background independent component". In this case in the net situation, the "tangential complement" acts on the "background independent component" and the principle of partial action causes a change of magnitude without a change of direction. It must also be noted that the angle θ that determines the "tangential complement" is given by the inverse sine of the ratio of the "background dependent component" Mv.u/c and the total momentum Mv, (where $\theta = \sin^{-1}u/c$).

In contrast, in a gravitational field, the opposite happens. The net effect is that the "tangential complement" EN acts on the "background dependent component" IE. And the principle of partial action causes the direction of DE to change by the angle α without a change of its magnitude, where α = EN/DE (since for small angles $\alpha \approx \tan\alpha$).

In this case also angle θ is given by the inverse sine ratio of the "background dependent component" IE = $p.(3GM/Rc^2)^{1/2}$ and the total momentum p, i.e. $\sin\theta = (3GM/Rc^2)^{1/2}$.

IE = p. sinθ, and EN = p. sinθ tanθ.

Note, EN is the deflection δ or the perpendicular height through which the energy transmission deflects.

$\delta = p.\ \sin\theta.\tan\theta$

And the angle of deflection α is given by tanα = EN/DE.

$\tan\alpha = EN/DE = (p.\ \sin\theta.\tan\theta)/p$

$\tan\alpha = \sin\theta\ \tan\theta$ ---------------------(6)

For small angles of θ, $\tan\theta \approx \sin\theta$, therefore

$\tan\alpha \approx \sin^2 \theta$ ---------------(6a)

Therefore since $\sin\theta = \sqrt{(3GM/R)}$, when a planet orbits in a gravitational field, its line of apsides deflects through an angle given by $\alpha = \tan^{-1}.3GM/Rc^2$ due to the change of direction of the apsidal energy transmission to the field and back. Since for small angles $\alpha \approx \tan\alpha$,

$\alpha \approx 3GM/Rc^2$ ------------------(6b)

One cycle of the "apsidal energy transmission" from the planet to the "total field" and back to the planet, is synchronised with the orbit of the planet from perihelion back to the perihelion. When this occurrence is observed relative the sidereal frame of reference, it appears that the planet completes its revolution relative to the line of apsides in advance of completion of its revolution relative to this reference frame. Let this advance per revolution of the planet be ε.

Then we have in one revolution of 2π radians, the advancement of the perihelion by ε, synchronised with one cycle of the apsidal energy transmission changing direction by a deflection α.

Therefore we have $\varepsilon/2\pi = \alpha/1$

Hence, $\varepsilon = 2\pi.\alpha$ --------------------(7)

or $\varepsilon = \alpha \times 1.296 \times 10^6$ seconds -------------(7a)

**Perihelion Motion of Mercury:**
Let us apply the above result, $\varepsilon = \alpha \times 1.296 \times 10^6$ seconds, (where $\alpha \approx 3GM/Rc^2$) to the perihelion motion of Mercury.

(Heliocentric gravitational constant - GM =$1.32712440018 \times 10^{26} cm^3 s^{-2}$, R=$5.7909151 \times 10^{12}$ cm, c = $2.99792458 \times 10^{10}$ cm/sec, 100 Earth years = 415.1968828 revolutions of Mercury).

The advancement of perihelion in 100 years = $1.296 \times 10^6 \times 415.1968828 \times (3GM/Rc^2)$

= 41.1626542 seconds of an arc.

The question arises that Einstein obtained the result of 43" which **exactly** accounts for the anomaly found by Leverrier, whereas our result has an error of 4.27%. This would mean that either we are in error or Einstein's result demands scrutiny (we shall discuss this in a separate paper). However, if we can explain another phenomenon by the application of same theorem IX, where Einstein's prediction is in wide error, then it will tend to validate our position. Fortunately, we are able to explain the bending of a ray of light in a gravitational field by the application of this theorem.

**Bending of a Ray of light in a Gravitational Field:**
Einstein in his paper '*On the influence of gravitation on the propagation of light*' written in 1911, predicted a deflection of $2GM/Rc^2$ of a ray of light in a gravitational field (2, p. 108). This was 0.83" which was far smaller than the actual. He then changed it to $4GM/Rc^2$ in his paper '*The Foundation of the General Theory of Relativity*" written in 1916 (2, p.163). This latter prediction is found to have an error of 20% above the actual(12, p. 405). That is his prediction is 1.75" when the observed result is near upon 1.40". The method in which Einstein arrives at $4GM/Rc^2$ is discussed by Weyl (5, p.252-259). It may be noted that this constructive derivation is found to be quite laborious and is based on abstract principles at the beginning and the required result is finally obtained through a devious series of approximations.

Now let us compare Einstein's result with our formulation of the deflection. Our position is (ref. fig 12b) that the net effect is that the tangential complement EN acts on the "background dependent component" IE. And the principle of partial action causes the direction of DE to change through the angle $\alpha$ without a change of its magnitude, where $\tan\alpha = EN/DE$. From equation (6) where

$$\tan\alpha = \sin\theta \tan\theta = \sin^2\theta \sec\theta$$

$$\tan\alpha = \sin^2\theta (1- \sin^2\theta)^{-1/2} \text{ -------------------------(8)}$$

.
Since $\sin\theta = (3GM/Rc^2)^{1/2}$, the deflection $\alpha = \tan^{-1} (3GM/Rc^2)/(1-3GM/Rc^2)^{1/2} \times 60 \times 60$ secs. (In this case $R = 7.0 \times 10^{10}$ cm the radius of the photosphere and since $\alpha$ is substantially larger than in the previous case, in this case $\alpha \neq \tan \alpha$), Therefore we find that,

$$\alpha = \tan^{-1} [\sin^2\theta (1- \sin^2\theta)^{-1/2}]$$

$\alpha$ = 1.313" which is within an experimental error of 6.5% compared to Einstein's margin of error of 20%.

When we compare the predictions made by means of our theory and Einstein's theory for the perihelion motion of Mercury and the bending of a ray of light in a gravitational field, our predictions are consistent with the observations, whereas in the case of Einstein's predictions, one is suspiciously exact with the observation and the other has a 20% margin of error. In our case we obtain the result from one and the same equation (6), whereas in the case of Einstein he has two equations for the two results.

The error in Einstein's prediction of the bending of the ray of light is so glaring that it begs for an additional explanation to account for the margin of error. In the absence of an explanation which can quantitatively account for the deviation between the prediction and the observed result, only qualitative explanations have been offered. For instance Erwin Schrodinger wrote: "The new phenomena it (general theory of relativity) predicted correctly, ….. though strictly speaking, **true only** for the precession of the perihelion of Mercury. The deflection of light rays that pass near the sun is not a purely gravitational phenomenon, it is due to the fact that an electromagnetic field possesses energy and momentum, hence also mass" (13, p ). By this, what is implied is that if it were only a gravitational phenomenon the deflection would be 1.75", but the electromagnetic factor scales this deflection down to the observed 1.40" level. However, it must be noted that this explanation in terms of scaling down of the deflection is only a qualitative proposition without quantitative substantiation, and therefore is of little value.

Einstein attributed gravitational redshift as a phenomenon that validates his theory. He claimed that the gravitational redshift occurs because physical processes slow down near heavy masses. Beyond this there was no clear explanation. Since the general theory of relativity does not give a clear explanation of this phenomenon as it claims, Schrodinger (while pointing out that strictly speaking general relativity has a definitinve prediction only for precession of perihelion of Mercury), wrote: "And also the displacement of spectral lines on the sun and on very dense stars (white dwarfs) is obviously an interplay between electromagnetic phenomena and gravitation" (13, p. ). Which in effect is a statement **refuting** that gravitational redshift has been explained by the general theory of relativity satisfactorily, although it is so claimed. Our explanation of the gravitational redshift follows under the theorem XII. It may be noted that $\lambda_0 = \lambda(1- 2GM/Rc^2)^{1/2}$ is an equation of the same form as $l = l_0( 1- u^2/c^2)^{1/2}$, hence it is due to a 'SRT type' of interaction and due to not due to one of 'GRT type'.

**Theorem X - The General Equation of Motion for Matter Particles and Energy Transmissions.**

From this theorem we derive equation (9) below. And from it we get Lorentz transformation for the motions of material particles, and the equations for a) Motion of a quantity of energy within the frame of its emission and b) **Bending of the Direction of Energy Transmissions in Vector Fields (aberration of light).**

In theorem III we considered the effect of the motion of the proper reference frame moving at velocity u on a body of mass M in motion at velocity v relative to the former. In this, no matter whatever the obliquity $\chi$ of the direction of motion of the body was to the direction of motion of the reference frame, the body had to set apart a quantity of momentum equal to Mv.u/c for co-movement with the reference frame and the balance fraction is Mv(1 – u/c).

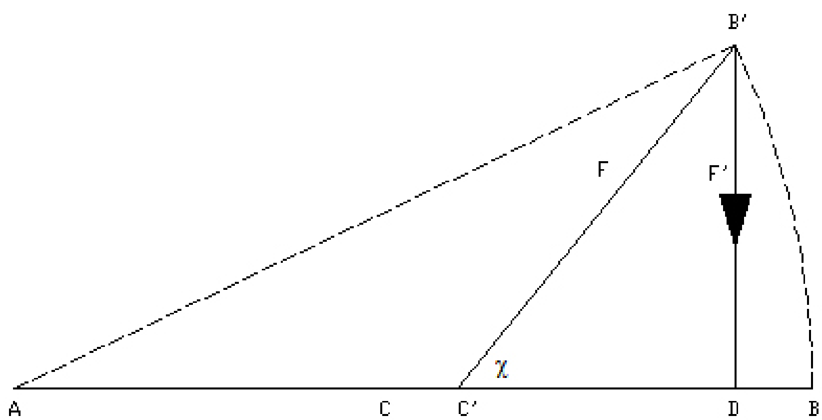



Fig 13a

Consider a current carrying conductor placed in an external magnetic field. When the direction of the current is oblique at an angle $\chi$ to the field, the force F' that acts on the conductor is equal to F.sin$\chi$, so that F' = 0 when the current is co-linear with the field, and F' = F when it is perpendicular to the field. Consider, (ref. fig. 13a) the current carrying conductor and the field to be collinear originally, (then the force vector F = CB originally lies along AB). Consider then that the conductor is turned through an angle $\chi$ to the field. Then, in accordance with the obliquity of the direction of the field to the direction of the current, CB aligns itself as C'B'. The force F' acting on the conductor is given by C'B'sin$\chi$. (We may in general refer to CB as the 'background vector' and F' as the 'active component of the background vector').

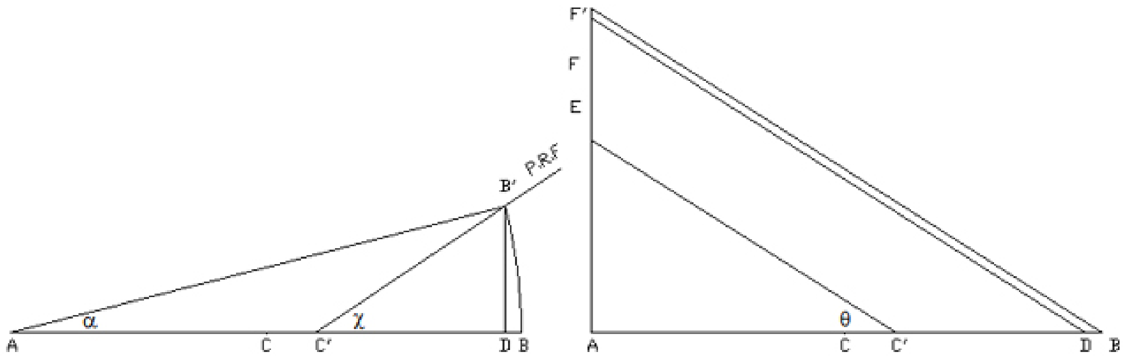



Fig 13b

Fig 13c

We contend that in the motion of a *'particle' something similar to the above action (of a current carrying conductor in an external magnetic field), but 'inverse' happens. By 'inverse' we mean that the 'active component of the background vector' in question (the co-movement component) becomes equivalent to C'B'cos$\chi$ = C'D in this case, in place of C'B'sin$\chi$ in the above example. That is, when the motion of a particle is inclined at an angle $\chi$ to the direction of motion of its proper reference frame, the following happens (ref fig. 13b). As in theorem III, the momentum AB = Mv first cleaves into two components CB = Mv.u/c and AC = Mv(1-u/c). ABB' forms an arc of a circle of radius AB. According as the obliquity $\chi$ of the direction of motion of the particle to the direction of motion of the reference frame, the point C shifts to C', while at the same time vector CB rotates through $\chi$ such that C'B' = CB is aligned in the direction of motion of the reference frame. Then the co-movement component becomes equal to C'D and the independent component becomes AC' (DB gets transferred to the field).

Now let us investigate what happens with AC' (ref. fig. 13c)

From fig. 13b, we have AC' = AB' cos$\alpha$ - C'B'cos$\chi$

Now (ref. fig 13c) out of the total tangential complement AF' added to AB by the "total field", the proportionate amount that acts on AC' is AE such that AE = AC'.tan$\theta$ where $\theta = \sin^{-1}$u/c, and where u is the velocity of the proper reference frame. Therefore C'E = AC' sec$\theta$.

Hence the momentum of the 'particle', available for its independent motion relative to the proper reference frame is

C'E = AC'sec$\theta$ = (AB' cos$\alpha$ - C'B'cos$\chi$) sec$\theta$ -----------------------(9a)

Let C'E = p, AB' = Mv and C'B'= Mv.u/c, then equation (9a) becomes

p = Mv/c(c.cos$\alpha$ - u.cos$\chi$)sec$\theta$ -----------------(9)

This is the **universal equation of motion** of any form of 'particle' (photon, electron, field signal) relative to the motion of its proper reference frame. According as the 'particle' is a) a material mass in motion, b) a quantity of energy transmitting signals within a field (such as between two charges) or c) a quantity of energy in free transmission (such as in the propagation of light, equation (9) gives different results as follows.

**a) Equation (9) Leads to Lorentz Transformation for the Motions of Material Particles:**

We contend that for a **material mass**, irrespective of the actual inclination of its direction of motion to that of the proper reference frame, $\alpha$ and $\chi$ assume the value zero. This will be confirmed by a particle accelerator experiment carried out firstly with the direction of motion of the particle aligned to the direction of motion of the Earth, and six hours later, when the two directions are perpendicular to each other. The results obtained will be found to be identical indicating that irrespective of the obliquity $\chi$ of the direction of motion of an object to that of the proper reference frame, in the equation (9) $\alpha$ and $\chi$ assume the value zero.

When $\alpha$ and $\chi$ assume the value zero, equation (9) reduces itself to,

$p = (Mv/c)(c - u.)\sec\theta$

The displacement x' that corresponds to momentum C'E is given by:

$x' = \Gamma_u v(1-u/c)t$

$x' = \Gamma_u (x - vt.u/c)$ -----------------------(4)

When v -> c   vt.u/c -> ut

$x' = \Gamma_u (x - ut)$ ---------------------------(5)

As discussed earlier, equation (4) is the general equation of motion of material objects, and an analysis of past experiments will confirm this. The equation (5) is well established by experiments for particles moving at near light velocities.

**b) Equation (9) as applicable to Energy Transmissions within a field (between two charges):**

For **energy transmissions** within a field (between two charges) the 'particle' in equation (9a) is a quantum of energy carrying signals. For such a particle v = c, therefore AB' = Mc and C'B'= Mu. C'E = p, the momentum available for the independent motion of the photon. Then the equation (5) becomes,

$p = \Gamma_u M(c. \cos\alpha - u\cos\chi)$ -----------------(10)

And the corresponding displacement in a unit of time x' then should be

$x' = \Gamma_u (x.\cos\alpha - ut.\cos\chi)$

When $\chi = 0$, $\alpha = 0$

Then $x' = \Gamma_u (x. - ut)$

And when $\alpha = \theta$, $\chi = 90°$

$x' = \Gamma_u\, x.\cos\theta - ut.\cos\chi)$

$x' = x$ (since $\Gamma_u = \sec\theta$)

The validity of this position for transmission of signals within a field will be confirmed by repeat of the experiment conducted by Lorentz. In this experiment it was found that a system of charges which keep in equilibrium only through the action of their electrostatic forces contracts of itself as soon as it is set in motion and that this contraction occurs only in the direction of motion, while in the perpendicular direction it is found that there is no contraction (14, p. 221).

**b) Equation (9) as applicable to Free Energy Transmissions (such as propagation of light):**

For **energy transmissions** the 'particle' in equation (9) is an energy particle such as a photon. For such a particle v = c, therefore AB' = Mc and C'B'= Mu. C'E = p, the momentum available for the independent motion of the photon. Then the equation (5) becomes,

$p = \Gamma_u M(c. \cos\alpha - u\cos\chi)$ -----------------(10)

And the corresponding **general velocity transformation** is:

$c' = \Gamma_u(c.\cos\alpha - u.\cos\chi)$ --------------------(10a)

However, it turns out that the empirical velocity remains the same in all directions irrespective of the values of u, $\alpha$ and $\chi$. This means that the velocity of light remains constant, irrespective of the magnitude and the direction of the velocity of the proper reference frame relative to which it is moving. For this to happen, the field has to replenish a quantity of momentum q equal to (Mc – p), back to the photon in motion. How does this happen? As a prelude to explaining this, we need to consider how the internal and external subsystems are constituted in an energy transmission. This result will be confirmed by the experiment involving the geopositional satellite as described under theorem XII.

**Theorem XI – The Trochoidal Form of Wave Propagation.**

Our position is that all energy transmissions propagate in a wave form which is constituted by a complex of two motions. We contend that such a wave motion is formed by a transverse oscillation about a centre being superimposed on a longitudinal translation of that centre. What oscillates about the centre is considered as the internal subsystem, and the movement of the centre is considered the external subsystem. (It may be noted that, our theory differs from the concept of undulatory propagation of waves by means of alternate expansion and rarefaction of the wave front).

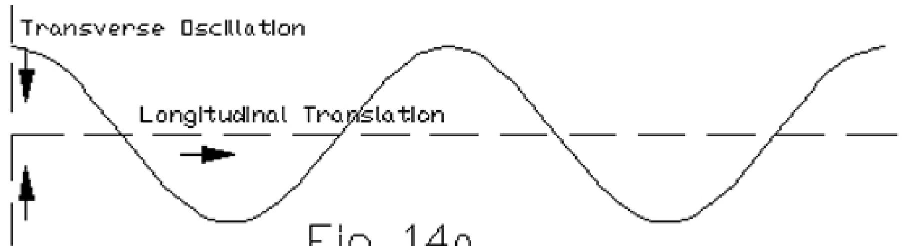


Fig 14a

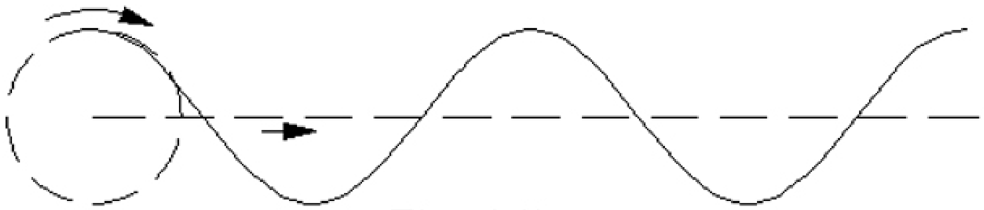


Fig 14b

The longitudinal translation, consisting of linear motion at velocity c defines the magnitude and direction of the displacement of the energy-in-transmission, and the transverse oscillation superimposed on the former defines the wave character of the transmission. It is the combined motion of the two aspects that gives the wave-form to the energy transmission. If for some reason the oscillatory aspect slows down or moves faster, while the longitudinal aspect moves at constant velocity, the wavelength increases or decreases as the case may be, resulting in a redshift or a blue shift respectively.

Special theory of relativity is based on the postulate that the velocity of light in vacuo is constant in all inertial reference frames. That is, Einstein attributes a metaphysical property to the motion of light without giving any physical reasons why this happens. He cannot explain why this occurs, because **spin motion** which is a fundamental character in quantum mechanics has no place in his theory. In contrast, we offer in this paper, quite a natural solution as to why the velocity of light is constant in all inertial reference frames in terms of an interaction between linear motion and spin motion. This is an explanation that can be **verified experimentally**. Even Einstein could have offered this natural solution originating from a certain deduction he had toyed with from the age of sixteen: "If I pursue a beam of light with velocity c, …. I should observe such a beam of light as a spatially oscillatory electromagnetic field at rest". Here Einstein has identified that a wave-motion consists of a complex of two aspects of motion, where the oscillatory (spin) aspect of motion is superimposed on the translational aspect of motion. Instead of 'pursuing' the beam of light at velocity c, if he 'pursued' it at varying subluminal velocities u he would have observed that there is a decrease of the velocity of the oscillation associated with any increase of the velocity of the reference frame and *vice-versa*, while the translational velocity of light always remained constant. In other words, he would have observed that as the velocity of the proper reference frame of the motion of light increased, there occurred a proportionate increase in the redshift of the wavelength of light, always **compensating** for the anticipated decrease of the translational velocity of light according to **general velocity transformation** (i.e. equation 10a). Extrapolating these results in the two directions (i.e. decreasing and increasing values of u) he would have found out that the redshift disappeared totally when the proper reference frame was at rest, and the oscillation disappeared when the velocity of the proper reference frame became equal to c. The conclusion he would have drawn is that there occurs a transfer of momentum from the oscillatory aspect of motion of the wave to the translational aspect of its motion, so that the reduction of the translational velocity that ought to occur in accordance with **general velocity transformation** (equation 10a) gets compensated by this transfer of momentum from one aspect of motion to the other.

This idea conforms to the algorithm for the motion of waves of ocean energy, with the modification that the velocity of propagation is less than c, and transverse oscillation is replaced by a circular motion equivalent to it (ref. fig 14b). Motion of ocean waves is considered to conform to the "Trochoidal Wave Theory" in Naval Architecture and Oceanography (15, p. 193), where energy swirls round in a circular motion while the centre of the circle moves forward in rectilinear motion. When we consider the motions of tornadoes and hurricanes, we find the same pattern of a swirling pool of energy being carried forward by the translation of the centre. We can therefore consider that the general form of motion of energy consists of a transverse oscillatory motion superimposed on a rectilinear translational motion. In the case of energy transmissions we encounter pertaining to relativistic phenomena, the velocity of this translational motion is c. While the energy moves in translational motion at velocity c, the transverse oscillatory motion causes the path of motion of energy to describe a wave form. If for some reason, the transverse motion loses a part of its momentum, then the oscillation takes a longer period to complete a cycle, and therefore the wavelength increases.

Thus the unique property of an energy transmission is that its external subsystem moves with velocity c, while the internal subsystem oscillates about the centre of the external subsystem. This can be depicted by an algorithm of a trochoidal motion, where there is a centre in translation motion at velocity c and a particle rotating about this centre at a radius r at a certain velocity v and having a momentum p. The motion of the particle in conjuction with the motion of the centre constitutes a wave motion in which r determines the amplitude and v determines the wave-length. If v slows down then the wavelength becomes longer and *vice-versa*.

**Theorem XII – The Tendency Towards Maintaining of the Velocity of the Energy Transmission Constant (Constancy of the Velocity of Light).**

Another unique property of an energy transmission is that under most conditions, if due to some constraint mq, the translational motion of the centre loses a fraction of its momentum, this is immediately replenished by the "total field", so that the velocity of translation remains the same at c, however this replenishment is activated by the internal subsystem losing a fraction of momentum equal to $p.[1 - (1 - q^2/c^2)^{1/2}]$ so that the momentum of the internal subsystem scales down from p to $p.(1 - q^2/c^2)^{1/2}$. This leads to a slowing down of the internal subsystem, resulting in a redshift or the lengthening of the wavelength from $\lambda_0$ to $\lambda$. (This process of scaling down of momentum is explained below).

Since the wavelength is inversely proportional to the momentum of the internal subsystem:

$\lambda_0 \propto 1/p$

$\lambda \propto 1/p( 1 - q^2/c^2)^{1/2}$

$\lambda = \lambda_0( 1 - q^2/c^2)^{1/2}$ --------------------------(11)

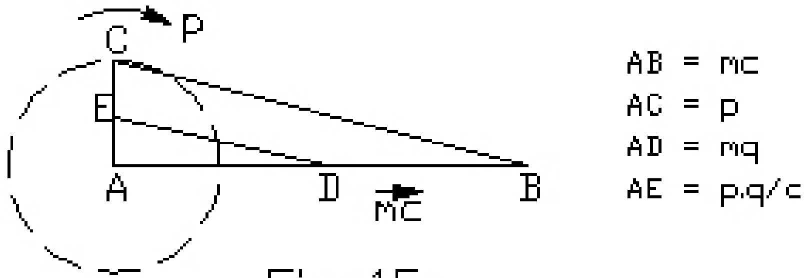



Fig 15a

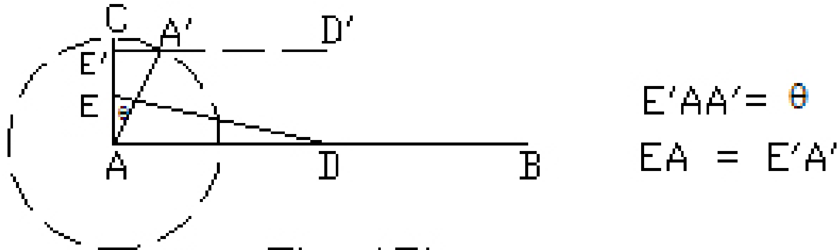



Fig 15b

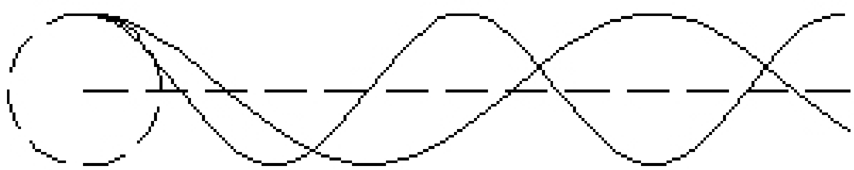


Fig 15c

Ref. fig.15a when the constraint mq = DA acts on the energy transmission, the momentum of the external subsystem tends to get reduced from AB = mc to DB = m(c-q). The proportionate effect of this constraint acts on the internal subsystem (whose momentum is AC = p) proportionately equal to p.q/c = AE.

Ref. fig. 15b, this constraint is met by the internal subsystem by forming two components of momentum AE' and E'A' by deflecting through $\theta = \sin^{-1}q/c$ by means of having AE =E'A'= p.q/c and thereby releasing E'C to the field. As a result the momentum of the internal subsystem scales down to AE' = p.cosθ. In exchange for scaling down of internal momentum D'E' is supplied by the field equal to DA = mq, the original constraint. By the supply of momentum from the field, the external subsystem overcomes the constraint and continues to move at velocity c, while the internal subsystem moves at a velocity proportional to p.cosθ, instead of a velocity proportional to p.

Ref. fig. 15c, the effect of this change of momentum of the internal subsystem is that, since the velocity proportional the p.cosθ is less that proportional to p, the wave length becomes redshifted. We can verify this contention by means of the following experiment.

**Verification of the Constancy of the Velocity of Light by Signals sent to a Geopositional Satellite.**

An experiment can be performed by sending out an electromagnetic signal of a given frequency to a geopositional satellite when it is in the direction of Earth's orbital velocity. Six hours later a signal of the same frequency sent to the satellite will be in the direction perpendicular to the direction of orbit of the Earth. From the returning signals, velocity of the signals in the two directions can be determined after correction for the Sagnac effect owing to Earth's rotation. It will be found that the velocity of the electromagnetic signal in the two directions is constant subject to this correction.

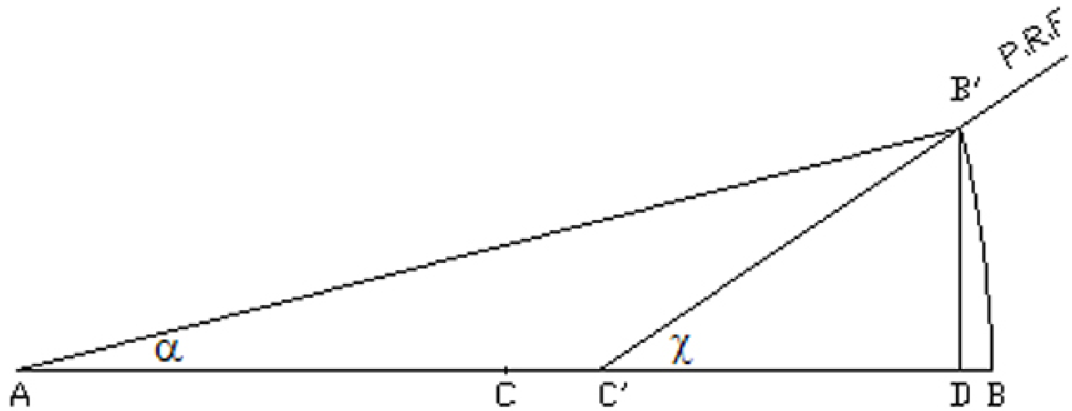



Fig 16

This is presently accepted as a confirmation of Einstein's contention of the constancy of the velocity of light. It is assumed that the reason for this constancy is the **adjustment of the time unit** in the direction of motion of the Earth from t to t[Γ(c-u)/c]. However, if one measures the wavelengths of the two returning signals, it will be found that the one in the direction of Earth's orbit is redshifted relative to the other.

Let us consider fig. 16 (which is the same as fig. 13b) in relation to equation (10)

$p = \Gamma_u M(c.\cos\alpha - u\cos\chi)$ -----------------(10)

When the direction of the signal is aligned to the direction of Earth's orbit $\alpha = 0$ and $\chi = 0$, therefore

$p_1 = \Gamma_u M(c-u)$ ------------------(10b)

When the direction of the signal is perpendicular to the direction of Earth's orbit $\alpha = \theta$ and $\chi = 90°$ and therefore

$p_2 = \Gamma_u Mc.\cos\theta$ --------------(10c)

Let the wavelength of the returning signal in the direction of orbit be $\lambda_1$ and that in the perpendicular direction be $\lambda_2$. Then since $\lambda_1 \propto 1/p_1$ and $\lambda_2 \propto 1/p_2$ it will be found that

$\lambda_1/\lambda_2 = p_2/p_1 = c.\cos\theta/(c-u) = c(1-u^2/c^2)^{1/2}/(c-u)$ ----------------(10d)

This equation will prove that the constancy of velocity of light is maintained by the activation of transfer of lost momentum, from the "total field" back to the photon, by means of the internal subsystem sacrificing a fraction of its momentum. This result will clearly show that constancy of the velocity of light is not maintained by the adjustment of the time unit (relativity of simultaneity) as claimed in the theory of relativity.

**Gravitational Redshift:**

When a photon is emitted from a body of mass M, there is a constraint against its escape from the gravitational field of the body. This constraint amounts to a quantity of momentum equal to mass m of the photon times the escape velocity $\sqrt{(2GM/R)}$ of the field at the point of location of the photon distant R from the centre of the field For this reason the photon must expend a quantity of momentum consonant with the escape velocity given by $q = m.\sqrt{(2GM/R)}$ and the balance momentum available for the motion of the external subsystem becomes equal to $mc[1-\sqrt{(2GM/R)}]$. The same constraint acts on the internal subsystem (of momentum p), by the law of proportions given by $q. p/mc = p.\sqrt{(2GM/Rc^2)}$. The process occurs according to theorem XII. And as described therein, the velocity of the external subsystem is restored back to c, leaving behind the tell-tale sign of the momentum of the internal subsystem scaling down from AB to AE = AB $\cos\theta$, where $\theta = \sin^{-1}q/c = .\sqrt{(2GM/Rc^2)}$

Adapting equation (7) for $q/c = \sqrt{(2GM/Rc^2)}$ we have,

$\lambda = \lambda_0(1 - 2GM/Rc)^{1/2}$ --------------------------(12a)

**Cosmological Redshift:**

We contend that the cosmological redshift also occurs under theorem X, XI, and XII. This is because energy transmissions always occur in some form of a field. Even in a vacuum there are fields present. For instance there is the 3°K field homogeneously spread over the universe, thus any energy transmission will experience the constraint of this field. Therefore any energy transmission occurring anywhere in the universe has to overcome the combined constraint of such universal fields incessantly, over the whole period of its transmission. This constraint is so small for energy transmissions occurring over short periods the effect is never noticed. However, in those transmissions that occur over very long periods (measured in terms of a time scales of million of light years), this constraint per million light years turns out to be equal to H the Hubble constant. So we have q = Ht.

Adapting equation (12) for this situation we have,

$\lambda = \lambda_0[1 - (Ht/c)^2]^{1/2}$ --------------------------(12b)

**Aberration of Starlight:**
We contend that when a ray of star light from **outside** the velocity field of Earth's orbit enters it, the 'total field' exerts the appropriate 'tangent complements' on the momentum of the incident ray and tends to increase its velocity.

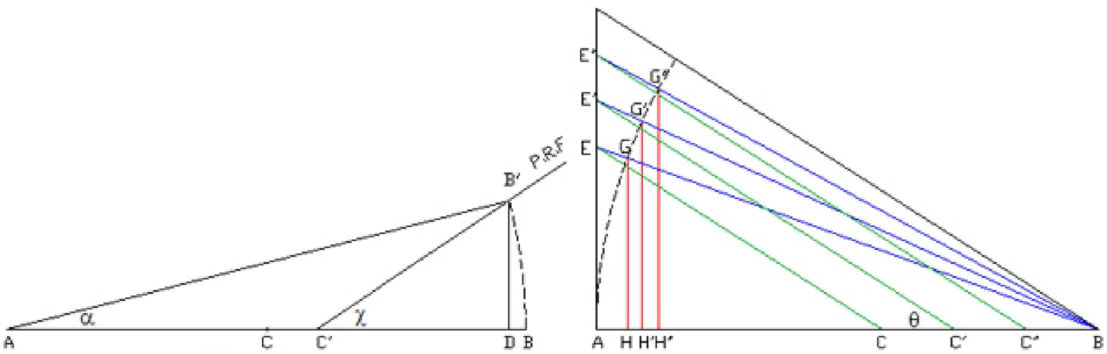



Fig 16a Fig 16b

In order to maintain its velocity constant at c, it deflects its direction by the principle of partial action, instead of permitting the velocity to increase. It is through this process of deflection of the ray of light in order to avert the increase of velocity that the aberration of starlight occurs.

However, in accordance with the direction of incidence $\chi$, the "motive component" AC' fluctuates between AC' = AC when the ray of light falls in the direction of the Earth's orbit (where $\chi = 0$) and AC' = AC" when the ray of light falls perpendicular to the direction of Earth's orbit where $\chi = 90°$. Depending on the magnitude assumed by AC' the 'tangent complement' exerted by the 'total field' differs, causing the deflection to vary during the course of Earth's orbit.

In order to ascertain this let us consider the equation (10),

$p = \Gamma_u M(c.\cos\alpha - u\cos\chi)$ -----------------(10)

From this equation we can determine the 'tangent complement' of the 'total field' that acts on the incident ray.

In general the 'tangent complement' AE' = p' is given by

$p' = M(c.\cos\alpha - u\cos\chi)\tan\theta$ ---------------(10e)

Let the 'tangent complement' be AE = $p'_1$ when the beam of starlight falls in the direction of Earth's orbit and let it be AE" = $p'_2$ when it fall perpendicular to it. For $p'_1$ $\alpha = 0$ and $\chi = 0$, therefore

$p'_1 = M(c-u)\tan\theta$

And for $p'_2$ $\alpha = \theta$ and $\chi = 90°$ therefore

$p'_2 = Mc.\cos\theta\tan\theta = Mc.\sin\theta$

Ref. fig 16b, in the general case, depending on the magnitude of ‘tangent component’ AE’ that corresponds to AC’, the ray of light deflects from position BA in the direction BE’. Thus by the principle of partial action it changes direction and acquires the value BG’ = Mc maintaining the same magnitude. By this means corresponding to the ‘tangent complement’ p’ the ray of light undergoes a deflection (aberration) of G’H’ = $\delta$

Let the aberration due to AE = $p'_1$ be $\delta_1$ and that due to AE” = $p'_2$ be $\delta_2$. During the course of the orbit we find that the aberration of the starlight describing an ellipse having $\delta_2$ as the major axis and $\delta_1$ as the minor axis.

We predict that, since these aberrations $\delta_1$ and $\delta_2$ are directly proportional to the respective momenta, the ratio of the minor axis and the major axis of an aberration ellipse of any given star will be constant given by:

$\delta_1/\delta_2 = [(c-u)/c]\sec\theta = \Gamma_u(c-u)/c$ [where $\Gamma_u = (1-u^2/c^2)^{-1/2}$, and u the velocity of orbit of the Earth].

## Appendix I – The Relational Interpretation of the Principle of Relativity.

In theorem III we have shown that the Lorentz transformation is the manifestation that the velocity of a body is dependent on the velocity of the proper reference frame. This is in contradiction with the principle of relativity. And this leads to the question why is it that relativistic phenomena cannot be explained in terms of the Newtonian theory?

Our answer is that there are many factors that have been disregarded for convenience and simplicity, (since their effects are negligible at low velocities) in the construction of the Newtonian theory in general, and in the formulation of principle of relativity in particular. However, at high velocities, these factors acquire prominence and manifest their effects as 'relativistic phenomena'. Since these factors have been pre-emptively excluded from the conceptual framework of Newtonian theory in its original design, it finds itself incapable to account for the phenomena that are connected to these factors when they appear at high velocity conditions.

Most importantly, in his *Two World Systems* (8, p.186 - 188) Galileo not only implied a) the principle of relativity, but he also implied b) the **basic premise** underlying this principle. Newton, enunciated these two interconnected principles as follows. He wrote: a) the principle of relativity in the *Corollary V* of *Principia* as follows: "The motions of bodies included in a ***given space** are the same among themselves, whether that space is at rest or moves uniformly forwards in a right line without any circular motion" (4, p. 20) and b) as an antecedent to the above corollary, the following principle was stated in the Scholium I of *Principia*: "That if a place is moved, whatever is placed therein moves along with it; and therefore a body, which is moved from a place in motion **partakes also of the motion of the place**" (4, p.9). It must be noted that this latter principle is the primitive notion that begets the principle of relativity as a derivative notion of it, as it will be explained in the next paragraph. We identify this primitive notion as the "Principle of co-movement of a body with its proper frame of reference" or for short "the **principle of co-movement**".

The principle of co-movement implies that whether a body is at rest relative to its proper reference frame or whether it is in motion relative to it, it possesses a component of momentum, which enables it to co-move with the proper reference frame. It is by virtue of this possession by a body, of a **component of momentum of co-movement** with its proper reference frame, a body even at **rest** comes to be in **a state of motion** in the conceptions of Newton and Galileo. It is also this same background condition which enables the law of inertia to hold. A body at rest, will continue to be in that state of motion, by co-moving with its proper reference frame, or if it is **already** in uniform rectilinear motion relative to the latter, it will continue to do so, while it also continues to co-move with the proper reference frame. The rationale of the principle of relativity is that since the body already possesses the component of co-movement with the proper reference frame even when at rest, its motion relative to the proper reference frame becomes (or more correctly it is assumed to be) independent of the motion of the latter.

(* Note: In this case all bodies whose motions are compared are located in the **same space.** Their motions are in relation to a reference frame attached to this space, and as such it is the **proper reference frame** of motion of all these bodies. The same holds for Newton's concept of '**place'** in the next statement. Therefore in this paper, true to Newton's conception, we do not deal with arbitrary reference frames, but with the proper reference frames attached to the spaces of location of bodies).

It is at the next stage, when a quantity of momentum is imparted to a body, which is either at rest and co-moving with the proper reference frame, or when it is imparted to a body already in motion relative to the latter, while also co-moving along with it, that Newton's second law comes into operation.

At this stage, both Galileo and Newton have **overlooked** something of **critical importance**. They have assumed that the **inertia** of the body would **remain the same**, even after the new quantity of momentum has been *imparted to it. Therefore they have assumed that whatever momentum that is imparted will be fully employed to change the momentum of the body relative to the proper reference frame. However, when the momentum imparted comes to reside in the body whilst moving it, the **inertia of the momentum** imparted gets added to that of the body. They have failed to recognise the **augmentation of inertia** that occurs when momentum is imparted to a body.

Consequently, upon a quantity of momentum being imparted to a body, in order that the principle of co-movement with the proper reference frame be satisfied, the component of momentum of co-movement in the previous stage needs to be augmented to account for the increased inertia of the body in the new stage. Thus contrary to what both Galileo and Newton assumed, not all the momentum imparted externally will be directed to change the momentum of the body relative to the proper reference frame, but a fraction of it goes for the augmentation of the co-movement component of momentum. Herein lies one of the basic causes of relativistic phenomena.

How Newton considered the situation **without** taking the augmentation of the co-movement component into account is exemplified by his discussion of the ship and the sailor (p. 7). The gist of it can be considered as follows: At first, the frame K (attached to the ship) is at rest relative to the frame $K_0$ (attached to the Earth). A body A that is resting in K is set in motion by a certain force F at velocity v'. In the next scenario, K is in motion at velocity u. The body A resting in K is exerted the same force F and it acquires the same velocity v'. In the first case the velocity of A relative to $K_0$ is v', and in the second case the velocity of the A relative to $K_0$ is v = v' + u. From this we have the so-called Galilean velocity transformation:

$v' = v - u$.

It is on the basis of this assumption that Newton has deduced his statement of the principle of relativity. "The motions of bodies included in a given space are the same **among themselves**, whether that space is at rest or moves uniformly forwards in a right line without any circular motion" (4, p. 20).

*We have already made it clear by way of theorem I that when a body moves at velocity v, its momentum Mv is generated in an indirect manner by the field. What is imparted directly to the body is actually $\frac{1}{2}Mv^2/c$ which 'triggers' the release of momentum Mv by the field. This momentum which descends on the body from the field has inertia and it adds to the inertia of the body. However, while bearing in mind this actual process, for **convenience** we shall use the classical concept of imparting Mv directly to the body by impressing a force on to the body, for the present.

Suppose that there are bodies A, B and C moving with velocities $V_{A,}$ $V_B$ and $V_C$ when the space K is at rest relative to $K_0$. (Note that Newton's phrase "motions of bodies **among themselves**" means relative velocities such as the velocity of B relative to A and C relative to A etc.). Then let the space K move at velocity u relative to $K_0$. Let the velocities of the bodies relative to K in this case be designated $V_A$', $V_B$' and $V_C$'. Since $V_A = V_A'$, $V_B = V_B'$ and $V_C = V_C'$ we find quite trivially, that the 'motions of bodies are the same among themselves' viz., $V_A' – V_B' = V_A - V_B$, and $V_A' - V_C' = V_A - V_C$, 'whether the space K is at rest or moves uniformly'.

It is on this premise, (that the velocity of a body is unaffected by the motion of its proper reference frame), that Newton's second law has been formulated. However, upon the analysis of relativistic phenomena what has been revealed is that above situation of relative velocities remaining unchanged does not conform to reality. When the Galilean velocity transformation is v' = v – u, the corresponding transformation for displacement is x' = x – ut. What is revealed in the analysis of relativistic phenomena is that the actual transformation is x'= Γ(x – ut) which corresponds to a velocity transformation of v' = Γv(c –u)/c (see equation 4 pp.22 and 35). When this is applied to the motions of the bodies A, B and C, we find that $V_A' – V_B' = (V_A - V_B)\, \Gamma(c – u)/c$ and $V_A' - V_C' = (V_A - V_C)\, \Gamma(c – u)/c$. From these we get the result,

$(V_A' – V_B')/(V_A - V_B) = (V_A' - V_C')/(V_A - V_C) = \Gamma(c – u)/c$

The above result demands that Newton's statement of the principle of relativity which is substantival in character must be amended to a Leibnitzian relational one:

**The Statement of the Principle of Relativity in Relational Terms:**
"The **ratios of relative motions** of bodies included in a given space are the same among themselves, whether that space is at rest or moves uniformly forwards in a right line without any circular motion".

It must be clearly noted that there is something extremely misleading about the seeming similarity between the Galilean transformation x' = x - ut and the Lorentz transformations $x' = \Gamma_u(x – ut)$. The corresponding Galilean velocity transformation is v' = v –u. If we consider the Lorentz transformation in the way this has been understood hitherto, the velocity transformation that corresponds to it is $c' = \Gamma_u(c – u)$, since x is considered to be uniquely defined by ct.

Therefore although in appearance x' = x -ut and $x' = \Gamma_u(x\text{-}ut)$ seem related, there is no way this relationship can be established. This is at the root of the gulf that exists between classical mechanics and relativity. We shall show that this gulf exists because these transformations are considered from a kinematic point of view disregarding their dynamic basis. The dynamic basis is that in both these so-called 'transformations' the term ut arises not due to a co-ordinate transformation as such but due to the co-movement component of momentum which is necessary for the body in motion relative to the proper reference frame to at the same time to **partake** in the motion of the proper reference frame. This gulf appears to get bridged once it is recognised that the correct velocity transformation is, $v' = \Gamma_u v(c\text{-}u)/c$ that is associated with the equation (4) (see pp. 22 and 35). Then the general transformation for motion of material particles or bodies is: x' =

$[\Gamma_u v(c\text{-}u)/c]t$. In this x is defined by the velocity of the body x = vt and it is not defined by the unique velocity c, the velocity of light. Hence equation(4), $x' = \Gamma_u(x\text{-}vt.u/c)$

As we have shown when v -> c, $x' \to \Gamma_u(x\text{-}ut)$

Since $\Gamma_u = (1 - u^2/c^2)^{-1/2}$ when $u^2/c^2 \to 0$, $\Gamma_u \to 1$, hence we may write when $u^2/c^2 \to 0$ x' -> x -ut

But this only gives a false impression since the term vt.u/c in equation(4) can reduce to ut only when v -> c, but the Galilean transformation is held to be true only for v << c. Therefore let us analyse the problem. In the Galilean velocity transformation v' is measured relative to K and v is measured relative to $K_0$. The velocity of the body relative to K remains the same at v' irrespective of whether K moves relative to $K_0$ or not. In the Lorentz velocity transformation both v and v' are measured relative to K unlike in the other. It is v when K is at rest relative to $K_0$ and v' when K is moving relative to $K_0$. Unlike in the other, there is a velocity difference of the body relative to K depending on whether K is at rest or in motion. This structural difference is overlooked and a relationship is established illegitimately by claiming that $\Gamma_u(x - ut) \to (x - ut)$ as $\Gamma_u \to 1$ when $u^2/c^2 \to 0$. It has to be noted that Lorentz transformation expresses something entirely different from the Galilean transformation. Galilean transformation remains in the same form for all velocities of v from zero to infinity. In contrast, the **general form** of the Lorentz transformation is $v't = [\Gamma v(c - u)/c]t$ which is,

$x' = \Gamma (x - ux/c)$

At low velocities of v and u when v/c and u/c -> 0, v' = v and therefore x' = x.

It is only when v -> c that it acquires the specific form

$x' = \Gamma(x - ut)$ which is commonly known as the 'Lorentz transformation'.

The factor $\Gamma(c - u)/c$, by which the velocity of a body changes on account of its proper reference frame being in motion at velocity u, is less than one i.e., $\Gamma(c - u)/c < 1$. This means that there is a ***defection** of the fraction $[1 - \Gamma(c - u)/c]$ of the momentum of the body, on account of the proper reference frame being in motion.

Einstein realised that the fraction of momentum that defects in momentum transfer in a moving frame is analogous to the fraction of heat that defects in the process of heat transfer in an ideal engine in an ambience having a temperature above 0°K. Einstein wrote: 'The longer and the more despairingly I tried, the more I came to the conviction that only the discovery of a **universal formal principle** could lead to assured results. The example I saw before me was thermodynamics. The general principle was there given in the theorem: the laws of nature are such that it is impossible to construct a *perpetuum mobile*' (1, p.53).

In appendix II, we establish physical factors of this analogy between the theorem of non-existence of the *perpetuum mobile* and the Lorentz transformation.

*The word "defect" is used here to denote loss of a fraction of energy/momentum in the same context as "mass defect" in radio active interactions denotes the loss of a fraction of mass.

## Appendix II - The Analogy Between Lorentz Transformation and the Theorem of Non-Existence of the Perpetuum Mobile.

The first manifestation of the problem of the incompatibility between observed phenomena and the principle of relativity arose with Maxwell's equations. On the one hand observed phenomena of Maxwell's experiments conformed to his equations, and on the other hand these equations contradicted the principle of relativity. Maxwell realised that there are errors and omissions in the Newtonian conceptual framework and to address this problem he set out to develop his programme. An outline of it is to be found chapters V and VI of his book *Matter and Motion*. It is summarised in the section entitled: "Scientific Work to be Done" (3, pp. 55-122). The central theses of his programme are:

(1) "...**all phenomena are changes of configuration and motion**. The configuration and motion of a system are facts capable of being described in an accurate manner, and therefore, in order that the **explanation of a phenomenon by the configuration and motion** of a material system may be admitted as an **addition to our scientific knowledge**, the **configurations**, motions and forces must be specified, and shown to be consistent with known facts, as well as capable of accounting for the phenomenon"(3, p. 71).
(2) "….the determination of the quantity of energy which **enters or leaves** a material system during the **passage of the system** from its standard state to any other definite state" (3, p. 74).

Maxwell has insisted that in the implementation of this programme, the changes of configuration and motion, and the energy that enters or leaves a system, must be considered in **extreme generality** as we shall realise from the following.

**Maxwell's Epistemology:**
James Clerk Maxwell [1831-1879], who is the progenitor of the theory of relativity, died at a young age before he could fully unravel the mysteries of relativistic phenomena. However, he has left behind epistemological clues as to how this unravelling must be done. He had insights in regard to the direction to be taken in the development of a **new theory** to account for the **differences** the electromagnetic phenomena that he discerned had with classical mechanics; and some of these ideas and insights are to be found in his book "Matter and Motion". Despite the fact that his findings **specifically** pertained to electromagnetic phenomena, his **main epistemological insight** is that in order to arrive at an '**indisputable theory**' which would account for the observed deviation from classical mechanics, all the specific forms of energy (viz., electromagnetic, thermal, gravitational, mechanical, chemical, etc.,) should be considered in two **general categories** as generic kinetic energy and generic potential energy according as whether these are in **motion** or in **configurations** of material systems.

Maxwell provides the rationale for the necessity of adaptation of this approach of considering specific types of energy under the general categories of potential energy and kinetic energy according as whether they constitute a part of the configuration of a material system or of its motion. He says: "The success of this approach depends on the **generality of the hypothesis** we begin with. If our hypothesis is the **extremely general one** that the phenomena to be investigated depend on the **configuration and motion** of a material system, then if we are able to deduce any available results from such an hypothesis, we may safely apply them to the phenomena before us. …. If, on the other hand, we frame the hypothesis that the configuration, motion, or action of the material system is of a **certain definite kind**, and if the results of this hypothesis agree with the phenomena, then, unless we can prove that no other hypothesis would account for the phenomena, we must still admit the possibility of our hypothesis being the wrong one. ….. It is therefore of greatest importance that we should be thoroughly acquainted with the **most general properties** of material systems, and it is for this reason that in this book I have rather dwelt on these general properties than entered on the more varied and interesting field of the special properties of particular forms of matter"(3, p.122).

Thus in our quest to establish the similarity of physical factors that enable the analogy between the theorem of impossibility of the *perpetuum mobile* and the Lorentz transformation, we have to consider the factors involved in the *perpetuum mobile* in generality, (i.e. entropy which is specific to energy in the heat form to be considered as the extensive component of energy in general, and temperature which is specific to energy in heat form as the intensive component of energy in general) and then establish the connection in general terms for the case of motion of matter. We then consider

a) how the intensive component of the energy of the background (heat) field interacts with a heat transmission occurring in that field, and

b)draw the parallel of how the intensive component of energy of the background space (viz. the velocity of the proper reference frame) interact with the motion of matter occurring in that space.

It is in following Maxwell's directive "….the determination of the quantity of energy which **enters or leaves** a material system during the **passage of the system** from its standard state to any other definite state" that we discerned the theorem I. But what is the standard state?

The standard state is where a body at rest relative its proper reference frame. One thing that we contend as special about this standard state is that when a body of mass M is at rest relative to its proper reference frame, the "total field" replenishes the internal momentum to have the magnitude Mc. Thus rest energy of a body is always $Mc^2$. Once this axiom of the standard state is recognised, the concept of absolute motion relative to ether in Maxwell's theory becomes redundant.

A body passes from its standard state on to a definite state of motion of a definite velocity depending on the quantity of kinetic energy applied. In theorem I we showed that this applied kinetic energy activates the "total field" to release a quantity of energy Mvc, to impart a momentum Mv to the body to set it in motion at velocity v. However, we found that this field momentum has inertia of Mv/c and that has to be overcome, by some other quantity of momentum (Mv/c).v = Mv.sinϕ. This quantity of momentum too will have inertia $Mv^2/c^2$ and it will require a further quantity $(Mv^2/c^2)v$ and so on, leading to a Zeno's type of a paradox. Nature resolves this paradox by raising the potential of the requirement of momentum to overcome the inertia of the field momentum Mv from $Mv^2/c = Mv.\sin\phi$ to $\Gamma Mv^2/c = Mv.\tan\phi$ by the formation of a resistive component of momentum as a potential. This potential is realised by a supply of momentum partly from the externally applied momentum and partly from internal momentum as we showed in theorem I.

Then in theorem III we found that a) the supply of field momentum Mv is always complemented by the tangential complement Mv.tanθ, (where $\theta = \sin^{-1}u/c$ and u the velocity of the proper reference frame) so that the total field momentum supplied is Mv.secθ . b) There is a resistance to the velocity of the proper reference frame, and the coefficient of resistance is 1/c. c) As a result of this resistance a fraction of the total field momentum equal to Mv.secθ. (1/c).u becomes unavailable for the motion of the body. And consequently the momentum available for the motion of the body is Mv.secθ(1-u/c) = Γu.Mv(1 –u/c), since secθ = $\Gamma_u$. d) nature dualises this resistance to be identical with the co-movement component of momentum. Thus in overcoming this resistance the body moves relative to the proper reference frame, while at the same time co-moves with it.

In thermodynamics, (as we already stated) the impossibility of construction of a *perpetuum mobile* was demonstrated by Sadi Carnot, by showing that even in an ideal engine where all the radiative, frictional etc., heat losses have been eliminated, there would still be a fraction of heat that will defect without being converted to work. Due to this defection of the fraction of heat, the construction of a *perpetuum mobile* becomes impossible. The greater the ambient temperature relative to the temperature of the source, greater the defective fraction of heat and lesser the heat available for the conversion to work. It was found that if the data were extrapolated so that the ambient temperature is reduced to absolute zero, then this fraction that defects disappears altogether, and the total heat produced would be available for work completely. There is a striking similarity between this and the implications of Maxwell's equations. The momentum applied to move a charge appears to defect a fraction of it, depending on the velocity of the **proper** reference frame, and consequently work is performed only partially, when that reference frame is in motion. When the data are extrapolated so that the velocity of the proper reference frame is zero, the total momentum becomes completely available for work. Therefore, this was found to be analogical to the impossibility of construction of the *perpetuum mobile* in thermodynamics. However, a study of the pattern of changes of co-ordinates in a motion of a particle revealed that it follows a more complicated form – Lorentz transformation. Einstein therefore wrote intuitively **without demonstrating how** this analogy works that: "The universal principle of the special theory of relativity is contained in the postulate: the laws of physics are invariant with respect to the Lorentz-transformations. …. This is a restricting principle for natural laws, comparable to the restricting principle of the non-existence of the *perpetuum mobile* which underlies thermodynamics" (1, p.57). We demonstrate how this analogy works in section xx.

Although Einstein developed his relativity theory as constructive theory, he was convinced of the superiority of theories of principle, of the type of classical thermodynamics. 'It (thermodynamics) is the only physical theory of universal content concerning which I am convinced that, it will **never be overthrown**…'(1, p. 33). Therefore, contrasting the provisional nature of his theory in the present constructive form, and implying the necessity to write it as a theory of principle, he also wrote, "there is, in my opinion, **a right way**, and that we are quite **capable of finding it ….** I am convinced that **we can discover** by means of purely mathematical constructions, the concepts and the laws**,** connecting them with each other, which furnish **the key** to the understanding of natural phenomena…." (1, p. 398).

Our position is that the key to the understanding of relativistic phenomena begins with the **rediscovery** of the **principle of co-movement**. This principle being the antecedent or the mother concept of the principle of relativity, it has primacy over the latter. Therefore the principle of co-movement is the guiding thread that weaves the fabric of the contents of this paper. The other key element is the principle of dualisation in nature. In the present case nature dualises, the resistance to the velocity of the background energy to be identical to the co-movement component.

**The analogy between the impossibility of the Perpetuum Mobile and Lorentz transformation.**

As we discussed earlier Einstein contended Lorentz transformation and the theorem of impossibility of the *perpetuum mobile,* are analogous. However, he did not venture to demonstrate the physical reasons for why they become analogous.

In an ideal heat engine, when the temperature of **background energy** is $T_1$ and the heat Q produced by it has a temperature $T_2$ such that the entropy of Q is $S_2 = Q/T_2$,

Total heat produced $Q = S_2T_2$

Heat available for work = $S_2T_2( 1 – T_1/T_2)$

A fraction of heat equal to the **product** of entropy $S_2$ of heat Q, and the background temperature $T_1$ 'defects' or becomes unavailable for work.

We contend that in this the reciprocal of the temperature $T_2$ of the source heat taking the function of the **coefficient of temperature resistance** (= $1/T_2$) to background heat. For every degree of temperature of background heat there is a fraction of heat loss. That is the fraction of heat loss is equal to Q. ($1/T_2$) per degree of background temperature

Now let us consider this phenomenon in most general terms as proposed by Maxwell. Entropy is the 'extensive component' of heat and temperature is its 'intensive component'. Then there is resistance to the intensive component of background energy. Therefore if we are to formulate a law concerning the fraction of heat that gets lost, considered in **general terms.** (i.e. considering energy in general from Maxwell's standpoint), we can state,

**The Law of Loss of a Fraction of Energy in Transmission due to the Resistance of Background Energy**: When a quantity of energy Q is in transmission, a fraction of it equal to the product of Q, the coefficient of resistance (r) and the intensive component of the background energy ($I_b$) becomes unavailable for work.

The fraction of energy lost in transmission due to resistance to background energy = $Q.r.I_b$

There is an important difference that must be taken note of between motion of a body relative to the background energy field and transfer of heat relative to the background heat field. In the motion of bodies there is a terminal velocity given by c. The coefficient of resistance to background velocity in the motion of bodies is r = 1/c. That is the coefficient of resistance is the reciprocal of the theoretical maximum. In the transfer of heat the coefficient of resistance is formed by the reciprocal of the empirical maximum of the specific case ( $r = 1/T_2$).

For the convenience of presentation we chose to work in terms of momentum instead of kinetic energy, which will not alter our result. There should be no qualms about this approach because

E = pc.

E = Mvc and p = Mv.

Both energy and momentum have the same extensive component M, and their intensive components differ by a factor of c. Therefore, momentum and energy refer to the same thing. **Momentum is energy.** Momentum is energy scaled down by factor c to make energy to fit-in to a mathematical relationship with space and time. This is attained by nature by making a dualistaion where the intensive component of momentum is made identical to the velocity of motion of a body. By scaling down the intensive component of kinetic energy by the factor c, a connection is made between kinetic energy of a body, and its displacement in a given interval of time

Displacement = (Intensive component of KE/c) x time

And it is upon considering kinetic energy in the momentum form that we can find the analogy between the theorem of impossibility of the *perpetuum mobile* and Lorentz transformation. The actual amount of kinetic energy that is lost due to the resistance to background energy field is $\Gamma_u$.Mvc. (1/c).u = $\Gamma_u$.Mv.u. In the momentum form it becomes [$\Gamma_u$.Mvc. (1/c).u]/c = .$\Gamma_u$.Mvu/c.

From theorem III, ref. fig 7, when a body moves at velocity v, its total momentum is EK = M$\Gamma_{u.}$v. The coefficient of resistance to the velocity of background energy is 1/c. The velocity of background energy is u. Therefore the fraction of momentum that will be lost in transmission due to the resistance to background energy is: M$\Gamma_{u.}$v.(1/c).u = M$\Gamma_{u.}$v.u/c

Now let us work backwards from the Lorentz transformation.

x' = $\Gamma_u$(x – ut) ----------------- (5)

In theorem III we showed that (5) is obtained from (4) where vt.u/c -> ut, when v ->c

x' = $\Gamma_u$. x(1- u/c) ----------------------(4)

Let x' correspond to a velocity v' such that x' = v't. And we have x = vt. Therefore we can re-write (4) as

v't = $\Gamma_u$.vt (1-u/c) --------------(4a)

We can write (4a) in momentum form as (4b) by eliminating t and multiplying by M

Mv' = $\Gamma_u$.Mv(1-u/c) ---------------(4b)

We can write (4b) in the energy form by multiplying it by c.

$Mv'c = \Gamma Mvc(1-u/c)$ -----------(4c)

Therefore the fraction of energy lost due to resistance of the background energy = $\Gamma_u.Mvu$.

Therefore it will become clear that Lorentz transformation is only the space-time manifestation of the general law: 'The law of loss of a fraction of energy in transmission due to the resistance of the background energy'. This law in thermodynamics is known as the '*theorem of impossibility of the perpetuum mobile*'.

**REFERENCES:**

1. *ALBERT EISNSTEIN Philosopher-Scientist*: Eigth Ed., Open Court Publishing Co, Illinois
2. *The Principle of Relativity*: A.Einstein, H.A. Lorentz, H. Weyl. H. Minkowski, Dover Publications Inc. New York.
3. *Matter and Motion*: James Clerk Maxwell, Dover Publications Inc. New York.
4. *Mathematical Principles of Natural Philosophy*: Isaac Newton, University of Calfornia Press, Berkeley.
5. *Space-Time-Matter*: Hermann Weyl, Dover Publications Inc. New York.
6. *Concepts of Space*: Max Jammer, Third Ed., Dover Publications Inc. New York.
7. *Einstein and the Philosophical Problems of 20th Century Physics*, V.A. Fok et al., Progress Publishers, Moscow.
8. *Dialogue Concerning Two Chief World Systems*: Galileo Galilei, University of Calfornia Press, Berkeley.
9. *Newton*: Bernard Cohen and Richard Westfall, W.W. Norton and Co., New York.
10. *Newtonian Studies*: Alexandre Koyre, Phoenix Books, University of Chicago Press, Chicago.
11. *The Astronomical Revolution*: Alexandre Koyre, Dover Publications Inc. New York.
12. *Mechanics, Vol I, Second Ed.*, Charles Kittel, McGraw-Hill, New York.
13. *Space-Time Structure*: Erwin Schrodinger, Cambridge University Press.
14. *Fundamental Laws of Electrodynamics*: Max Born.
15. *Theoretical Naval Architecture*: E. Atwood and H. Pengelley, Longmans, London.