DOES MOTION INCREASE THE INERTIA AND ENERGY-CONTENT OF A BODY?

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Abstract*: "The concept of relativistic mass-energy increase with motion emerged soon after the discovery of the observed change in the charge to mass ratio of high velocity electrons in early cathode-ray tubes experiments. Because of the minute changes in mass involved, no other such experiments substantiated such evidence with heavier bodies other than those of atomic sizes. In Einstein's *Special Relativity*, *SR*, it is claimed that the mass of a body, and effectively its energy content, increases physically as a function of frame relative velocity. Therefore, the energy content is not single valued for a body such as an electron and is indeterminate. It is demonstrated in this paper that the above conclusion was misconstrued and is in violation of the very principle of conservation of mass and energy. It will be shown that the moving-mass of the electron, appears heavier due to the change in the size of the unit of length with the increased velocity of the electron relative to the rest frame. That gain of kinetic energy reduces, not increases, the portion of the potential *relative rest mass energy, RRME,* of a body. It seems *Nature* employs a *common duration clock system -CCS-*(similar to *GPS*) for its timing duration unit which leads to the velocity of electromagnetic-waves, though still a natural constant, becoming numerically smaller in magnitude at the frame of the speeding electrons as the size of the length measure unit (wavelength) increases. Conversely, if *Nature* keeps to *SR* time (Lorentz's proper, local clock system at the moving frame), the resulting rest-energy-mass of the electron would have been smaller when the electron is in relative motion to the frame of the laboratory. Thus the lower difference in *relative rest mass energy* of a body is made up by the increase in the kinetic energy of the body such that the total energy, both radiative and kinetic, remains always the same natural content."

Keywords*:*Fundamental physics, Cosmology, Concept of Common Time, Special Theory of Relativity.

*This note was entirely written by myself. At my advanced age, it is difficult not to repeat myself hence my apologies.

Introduction: **Motion in space is an inseparable property of matter in the Universe. It is the vehicle that conveys force and make exchange of energy possible. It is thus the antithesis of the state of rest hypothesized by a *zero momentum rest frame ZMRF.* Thus any body possesses, as a natural content, two forms of energy: the theoretical QED conversion of matter at rest into radiant energy and the kinetic-gravitational-mechanical energy of motion. Therefore any material body has these two forms of energy while the ratio of the two types of energy determines the physical state of the body. Whereas the radiant energy is propagated with the determined velocity of *EM W*aves, *C*, the other types of motion are always much less in velocity and can be of any speed less than *C*. Thus the total energy of a body, *E*, is the sum of the potential radiant energy m_oC^2 plus the inertial kinetic energy, K_o, relative to the rest state. Since according to classical principles of relativity, *the laws of physics remain universally invariant,* it follows that the total energy, mass-radiative and kinetic, of a given body of matter must be a constant for that body irrelevant of its frame's motion. At a state of *zero-momentum* -nil kinetic or gravitational motion- the total energy is mainly 'radiative' as given by $E_\infty = m_\infty C_\infty^2$ where m_∞ is the zero-momentum rest mass (*ZMRM*) of the body and C_∞ is the velocity of *EM Waves* as measured by a common duration clock at that frame. If a body receives or acquires extra momentum in the form of kinetic energy, then the body *must* change its physical property (such as normal expansion of material bodies) so that its *radiative relativistic mass energy* (*RRME)* in the moving frame, plus the acquired kinetic energy of motion, K_o , remain within the same *natural* limit of maximum *zero momentum rest energy* (*ZMRE*) thus : $E_\infty = m_\infty C_\infty^2 = m_oC_o^2 + K_o = m_vC_v^2 + K_v$ …. where m_o for example, is the mass of the body at Earth, C_o is velocity of *EMW* as measured by a common duration clock (CCS) on Earth and K_o is the total 'accumulated' kinetic energy of the body relative to the *zero momentum rest frame* (*ZMRF*). Within this theoretical frame of reasoning, there arises *no increase of the mass of the body by acquiring and converting external kinetic energy into mass* and thus the principle of conservation of energy is preserved*. Conversely, by losing kinetic energy, a body regains part of its *relativistic rest frame mass* to balance for the lost motion. This is analogous to the currently accepted mechanism of absorption and radiation of photons by electrons and atoms. When an electron captures a photon, the absorbed energy will exceed its *natural limit* and it *jumps* to a higher orbit such that the electromagnetic mass is proportionally reduced due to the larger separation of the electron from the nucleus. There is in this case no kinetic energy involved since the atom frame is considered stationary. The question of the observed change in the mass of the body is explained by the example of fast moving electrons in cathode-ray experiments. The absorbed electrostatic energy from the applied potential is the added external kinetic energy to the electron which leads to its gaining extra velocity that *physically* affects the electron by extending its radius. Hence, its electromagnetic mass as given by $m_v=e^2/r_v\ v^2$ decreases in size due to a larger separation, r_v, of the electron from the positive nucleus. Most materials expand isotropically when they gain kinetic energy whether from thermal activities or motion. The added kinetic energy is manifested as work that changes the velocity of the electron or moves a billiard ball**

*The principle states: "the total amount of energy in an isolated system remains constant over time"

from one end of the table to another without being *converted* to extra mass. We must not be misled by the discovery that when moving with high velocity, the mass of electrons increased in cathode-ray experiments. This anomaly will be resolved when the increase is explained in terms of the change in the unit of length in the frame of the moving electrons when we keep to *common duration clock system 'CCS'*. It also reveals *Nature's* choice for a timing clock that is consistent since its duration reference unit remains invariant as well as the metre retains its modern defined extension irrespective of motion.

***1- Mass and Energy*: Early1900's, both Einstein[1] and G.N. Lewis[2], following J.J. Thomson[3], W.Kaufmann and Bucherer discovery and experimental study of the increase of an electron's mass with velocity, had stipulated that kinetic energy could be derived from the *observed increased mass* of a body in motion multiplied by the square velocity of electromagnetic waves, C^2, less the body's initial rest mass energy:**

$$E_k = (m_v - m_o)c^2 \qquad \text{.....} \quad (1)$$

where m_o and m_v are the initial and final mass of the body and E_k is the kinetic energy increase due to motion. Since $E_k=m_ov^2/2$, then $m_v=m_o/(1-v^2/c^2)^{1/2}$ and it follows that the moving relativistic mass m_v is larger than the rest mass m_o. This supplanted the popular energy equation: $E=mc^2$ which was originally introduced by Henri Poincaré (not Einstein!) in 1900. We are, in this context, assuming a system whereby there is external addition or exchange of kinetic energy without limit to adding extra mass to a single body such as the electron. However, in an enclosed system such as, say, the universe having initially *zero momentum rest energy* (*ZMRE*) E_u and therefore net *zero momentum rest mass* (*ZMRM*), m_u, that is given by $E_u= m_uc^2$, there arise, in this case, no external source for such an additional kinetic increase causing motion (or expansion) without resorting to a hypothetical imaginary source providing this force. Logically, we can add no more mass or energy to the universe. Hence this contradiction can only be resolved by accepting that m_v, the assumed *relativistic rest frame mass* (*RRFM*) in its moving frame F_v, (such as the moving mass of the Universe -or the electron- in motion) must be smaller in size than its initial state, at its *zero momentum rest frame (ZMRF)*, because the energy for the kinetic force must ultimately be provided by the *zero momentum rest mass* (*ZMRM*) m_u. Thus at time t_v :

$$E_u = m_uc^2 = m_vc^2 + E_{kv} = m_vc^2 + (m_u - m_v)c^2 = m_uc^2 \quad \text{.....} \quad (2)$$

And after overall changes in motion and positions at time t_y:

$$E_u = m_uc^2 = m_yc^2 + E_{ky} = m_yc^2 + (m_u - m_y)c^2 = m_uc^2 \quad \text{.....} \quad (3)$$

Here $m_v= m_u\,(1-v_v^2/c^2)^{1/2}$ and $m_y = m_u\,(1-v_y^2/c^2)^{1/2}$. Hence the total *zero momentum rest*

***energy (ZMRE), E_u*, is thus preserved in both Eqn (2) and (3). Therefore, part of the initial mass, m_u, must had been the source providing the kinetic (or gravitational) energy for motion. It follows that in general:**

$$m_v c^2 = m_u c^2 - (m_u - m_v)c^2 \quad \text{.....} \quad (4)$$

Since $m_v = m_u (1-v^2/c^2)^{1/2}$ and kinetic energy --for v<< c-- $(m_u - m_v)c^2 = m_u v^2/2$. Therefore, re-arranging we arrive at:

$$m_v c^2 = m_u \left(1 - \frac{v^2}{c^2}\right)^{1/2} c^2 \quad \text{.....} \quad (5)$$

Obviously, following this line of reasoning and keeping to the velocity of *EM* Waves constant as in *SR* by using a local or proper clock (as originally proposed by Lorentz) on the moving frame, the *relativistic rest frame mass* (*RRFM*) of the Universe in motion, m_v, is now lighter, not heavier, by the factor $1/\gamma = (1-v^2/c^2)^{1/2}$ at the moving frame F_v while the kinetic energy (in the universe) becomes proportionally increased to make up for the difference in total energy of the universe. Therefore it is questionable, as postulated by current theory, to convert kinetic energy into the, *ZMRM* or *RRFM,* of the body since it already possesses maximum allowable mass for that state of the frame at rest or in motion. It is commonsensical to ask in this particular case of the universe, where would this *extra* kinetic energy comes from in the first place to make the increase in velocity possible as well as adding more mass to the cosmos!

It follows that at rest on the Earth frame, F_o, the total energy of a body of mass m_o is given by :

$$E_o = m_o c_o^2 + \frac{m_o V_o^2}{2} \quad \text{.....} \quad (6)$$

Here $m_o V_o^2/2$ is the total added up kinetic energy of the body from its state of *zero momentum rest mass* (*ZMRM*). However, we normally consider the Earth frame as the reference-zero-rest frame and let V_o = zero. Therefore the *relativistic rest mass-energy* (*RRME*) for a body referenced to Earth is just $m_o c_o^2$. However, when a particle picks up kinetic energy (eventually from the rest frame), it will be moving in frame F_v with velocity V_v relative to F_o (the rest frame) and the total energy E_v is therefore:

$$E_v = m_v c_v^2 + \frac{m_o v_v^2}{2} \quad \text{..... (7)}$$

***Obviously, while the total energy remains invariant, the relativistic rest frame mass (RRFM) varies and hence the controversy presented by SR system*. Therefore the extra kinetic energy must originate from the F_o frame which preserve the principle of conservation of energy. That is: $E_v = E_o$ (or $E_o = m_\infty c_\infty^2 = E_\infty$ when the body is assumed at *zero momentum rest frame*), and therefore we can finally write:**

$$m_v c_v^2 = m_o c_o^2 - \frac{m_o v_v^2}{2} = m_o\left(1 - \frac{v_v^2}{c^2}\right)^{1/2} c_o^2 \quad \text{..... (8)}$$

Therefore if $C_v = C_o$ then m_v is lighter than m_o by Lorentz's factor $1/\gamma = (1-v^2/c^2)^{1/2}$ relative to the F_o frame. Clearly, *keeping to the same metrics on the moving particle's* frame is questionable when our reliable experimental laboratories' data report a heavier mass for the electron when set in motion. I shall later explain why I used C_v instead of C_o on the left side of the above expression. To be sure, it is the same constant velocity -no violation of the second principle of relativity - but is now expressed in different units.

We conclude that increased motion relative to the rest frame, leads to increase of kinetic energy of the body as well as a reduction of its 'potential' *relativistic rest frame energy* (*RRFE*) such that the sum total energy of the body remains a constant. Otherwise, if the energy exceeds this constant limit, an electron is no longer the same single particle. Obviously there was confusion about the identity of the masses on the right hand of expression (4) and consequently there is no overall increase of the 'potential' relativistic mass but an *exchange* of mass and kinetic energy in the equation. It is probable Einstein and other theoreticians based their calculations on the then important and newly discovered increase of cathode ray electrons mass after they were accelerated with very high velocity towards a highly positively charged anode. It was experimentally found that the ratio of charge to mass of the electrons was changed and since the charge of the electron assumed invariable, it was *simply concluded the mass of the electron must have increased due to converting extra gained kinetic energy of motion to mass*. To Einstein[4], the energy withdrawn from the electrostatic field, is equated to the energy of motion of the electron. However, since the total energy of the electron *ZMRE* is constant and is a natural property of the particle, the potential *relative rest frame mass* of the electron (*RRFM*) itself must change such that the total energy dose not exceed that natural constant. Because motion (as well as temperature) affect the dimension of objects, the electron radius is similarly enlarged and the electromagnetic mass of the electron given by $mv^2 = e^2/r_o\,(1-v^2/c^2)^{-1/2}$ ends up smaller. Clearly only kinetic energy increases with motion while the 'radiative potential' or relativistic rest-frame mass (*RRFM*) decreases as evidenced by the lower

frequency output from a radiator when set in relative motion (see ref. 5). Since at F_o, $hv_o = m_o c_o^2$ but at F_v (when in motion) $hv_v = m_v c_o^2$ and as v_v is lower in frequency than v_o, therefore, m_v must be smaller in size or lighter than m_o. Consequently, we must place the horse in front of the cart instead of following Einstein's hypothesis, that addition of external kinetic energy leads to increasing the *rest-mass* of the body that is in relative motion and its energy *'W' would become proportionally infinite when the frame's translation approaches the velocity of light !*

Nevertheless, experimental discoveries *definitely confirm an increase in the mass* of the electron when set in motion as evidenced by the changed ratio of *e/m* in high-voltage cathode rays experiments. This is obviously contrary to what I have arrived at by the preceding analysis. I shall next demonstrate in the following sections that this contradiction can be readily resolved if we consistently keep to a clock system (similar to *GPS*) that, by a proper synchronization, keeps a common duration standard unit of time irrespective of the motion of frame systems.

2-The Concept of Common Clock System (CCS). **When we first measure time and decide upon a duration unit as a standard, this can be the start reference for an *LCS* clock (*Local Clock System* as in *SR*) with its characteristics of a different local duration tick (so called: time-dilation) when transported to another frame relatively slower or faster in motion. Alternatively, it can be the start of a *Common Clock System, CCS,* reference standard unit, (similar to *GPS*) that can be synchronized with as a master clock, to act as a unit for a shared common-duration system that can be used by observers at all frames of different relative motions. *However, at this stage, we do not know as yet which of the two clock systems our physical laws are naturally expressed and that would more likely improve the expression of our contrived system of physical relations and natural constants of physics.* Thus, it can be equally argued that *Nature* does not employ a clock system that slows down or runs faster! Neither has it measuring rods excepting waves for measuring extensions of space. In effect, we humans are the ones who interpret, decide and express the complex physical world in the language of mathematical symbols and relational algebraic equations of our own invention and logical construction. Indeed, it is possible the parameters we use in our formulas may not necessarily be the same used by *Nature's* own metrics. These are relative and important questions which must be considered by investigators of natural phenomena. Energy is classically measured in power-time duration and this is also the case when calculating the Planck constant of action, *h*, which has the dimension of joules-second. Therefore to be truly consistent, we must keep to a *common-clock-system*, *CCS,* that gives true and comparable measure of output energy as well as the same distance a body travels when formulating physical equations in various frame systems in relative motion. Mere corrections by applying Lorentz and Fitzgerald transformations may solve problems and predict results but they do not completely remove the underlying physical contradictions and ambiguities. From further analysis that follows, perhaps we will be in a better position to finally decide which clock system (or perhaps whether to use either one according to the type of problems to be dealt with) is better suited to be our correct choice. It is more likely that we may express our physical laws more consistently if we discover the most probable 'logical-type' of measure units *Nature* employs in its own scheme without need for us to add**

our own *expedient hypothesis* and theories based on mathematically complex constructions to justify our own contrived version of interpreting the character and parameters of physical laws.

3-The Velocity of Elcctromagnetic Waves Measured by Common Duration Clocks.

The metre was defined by international agreement (*CGPM)* to be the length light travels in vacuum in $1/n^{(*)}$ fraction of a second. This definition can be universal using *common-clock-system* (*CCS*) where the metre would be exactly of the same extension irrespective of the frame translation. However, this is not so using *SR* local clock system (*LCS*) as the second becomes longer in duration with motion so that to keep the metre to the same length, corrections must be made. On the practical side, the *CGPM* also recommended a given number of wavelengths from a helium-neon laser source for the purpose of delineating the length of a metre. Thus, on the Earth frame surface, if n_o is number of wavelengths or rods we count for the travel of light in common duration t_o then $C_o=n_o\lambda_o/t_o$, but relative to an *airplane* frame in motion where the frequency of the same radiator is lower (i.e the wavelength or the rod is longer): then $C_p=n_p\lambda_p/t_o$, both measured with a *common-clock-system* (*CCS*). Here λ_o and λ_p are the wavelengths, respectively, in both frames. Since the velocity of light is assumed constant, the same *extension of space* must be traveled in a common duration, t_o, on both frames. Therefore, *physically,* $n_o\lambda_o = n_p\lambda_p$ (the same extension of length measured with different sized rods or waves, assuming constant velocity of *EMW,* during a common duration) but since the wavelength (the measuring rod) is longer on the airplane frame when in motion, we end up measuring n_p numerically smaller than n_o and consequently C_p is a smaller sized number, on the flying plane, than C_o on the runway. Thus there is expansion, not contraction, of the measuring rod. We must keep in mind that both λ_o and λ_p are taken as one unit length measure on both: the Earth and the airplane frame respectively. Since λ_p at the plane, is a longer wavelength than λ_o by the Lorentz transformation $(1-v^2/c^2)^{1/2}$, it follows we count less waves (or rods) in duration t_o on the plane while flying and we arrive at : $n_p = n_o(1-v^2/c^2)^{1/2}$ leading to: $C_p=C_o(1-v^2/c^2)^{1/2}$. Thus the principle of the constancy of velocity of light is upheld, though the units of length-measures are changed. With *CCS,* at a higher relative velocity of a frame, the unit of mass as defined by $m_v r_v/Ft_o^2$, also becomes smaller s*o the very same mass would be expressed in a bigger magnitude number by now a reduced unit in size.* Likewise, the *unit of length (wavelength) become physically longer and the same extension of space would become expressed in a smaller magnitude number.* Apparently, Nature employs *CCS* common clock hence, the mass appears numerically bigger when in relative motion which was *mistakenly theorized in SR to be a real physical change in the mass-energy property of the body as a consequence of absorbing kinetic energy.*

4-The Justification For Adopting Common Clock System 'CCS'. **Returning to eqn (8) and replacing C_v^2 on the left side by $C_o^2(1-v^2/c^2)$ such that we are employing *CCS* unit on the moving frame and re-arranging, we finally arrive at:**

(*) **Since 1983 the international CGPM defined the metre by the following: The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.**

$$m_v c_o^2 (1 - v^2/c_o^2) = m_o (1 - V^2/c_o^2)^{1/2} c_o^2 \quad \ldots\ldots\ldots (9)$$

which ends up with:

$$m_v = \frac{m_o}{(1 - v^2/c_v^2)^{1/2}} \quad \ldots\ldots\ldots (10)$$

Thus the electron mass when in motion, m_v, is now bigger when we keep to the size of velocity of *EMW* on the moving frame in these alternative *CCS natural* units. Therefore, in case of the *rest frame* of the now the moving electron, the discovered change in mass, confirms that *Nature* keeps to the corresponding unit of *common duration* (with $c_v = c_o(1-v^2/c^2)^{1/2}$) which reveals the size of the airplane or electron mass while in motion, in the more preferable, *CCS,* Natural time unit. Hence we obtained a different charge to mass ratio for the speeding electrons in those pioneering experiments. Thus, with increased velocity, a body's rest mass becomes larger in *CCS* time unit as well as the kinetic energy increases but the *total energy content of the body remains constant.* Else, if we keep to a local clock (*SR*), we can only arrive at the right answer by converting gained kinetic energy to the rest mass, that is by placing the horse behind the cart! Moreover, in *SR* local time units, the principle of energy preservation is violated since $E_v = m_v c_o^2$ is larger than $m_o c_o^2$ without accounting for the origin of the kinetic energy added to the system. It thus appears the *CCS* would be a more consistent time measure unit with less conflicts and, retrospectively, is more likely to be in harmony with our *own extensive theoretical construction* of the so called *physical laws* of Nature.

6-The Change In The Frequency Of a Radiator When In Motion Is In Favour Of CCS Unit of Time. **The Planck constant of action, *h,* must be an invariable constant in the same system of units irrespective of the motion of the frame. At rest at frame F_o, the classical energy equation for an electron orbiting at radius r_o from the nucleus is given in terms of frequency as : $h\upsilon_o = e^2/r_o$. But when its *frame* is moving with relative velocity *v* at F_v, the radius enlarges to r_v ($r_v = r_o / (1-v^2/c^2)^{1/2}$) and since the electron's charge, *e,* is constant, we obtain: $h\upsilon_v = e^2/r_v = e^2(1-v^2/c^2)^{1/2}/r_o$. Thus the frequency is reduced to $\upsilon_v = \upsilon_o (1-v^2/c^2)^{1/2}$ but *h* remains the same sized constant. Likewise, in terms of mass-energy expressions and since the kinetic energy is not involved here as already shown, we similarly obtain at F_o when using common time duration unit *(CCS)*:**

$$h\upsilon_o = m_0 C_0^2 t_o \quad \ldots\ldots\ldots (11)$$

and at F_v:

$$h\nu_V = m_V C_V^2 t_0 \quad \ldots\ldots\ldots\ldots (12)$$

Since at F_v, $m_v = m_o/(1-v^2/c^2)^{1/2}$ and $C^2_v = C_o^2(1-v^2/c^2)$ we end up with : $\upsilon_v = \upsilon_o\,(1-v^2/c^2)^{1/2}$, that is the frequency is lower as confirmed experimentally. Because Doppler effects alter the frequency of a radiator they must be eliminated before changes due to *pure* extension or contraction (motion) is correctly detected. Though this task was very difficult to overcome, it was finally achieved, in 1938, by H. Ives and G. Stilwell[5] precision and delicate experiment. They confirmed that at an angle of $\pi/2$ to the direction of the radiator, the frequency of the clock was lower by Lorentz's factor $\gamma^{-1} = (1-v^2/c^2)^{1/2}$. Their conclusion, however, was that the result also confirmed the contraction of the apparatus and that the clock became slower beating which is anticipated. When in motion, a clock's tick duration becomes longer but that *does not prove time as such dilates or matter contracts*. Consequently, for an observer on the moving frame, F_v, using a *CCS* (common duration clock), the frequency of the same radiator when measured is lower than its rest state at F_o. On the other hand keeping to a local clock (*SR*), the radiator output frequency appears to be the same as on F_o (platform) to a local observer on the moving frame because he counts the same number of waves by the now longer duration (time dilation) of his local clock's ticks. But, on the platform at F_o, the received frequency from the same radiator when in motion, must be longer in wavelength. Thus using a local clock (*SR)* on the train or plane in motion:

$$h\nu_{v\,o} = m_v c_o^2 t_v \quad \ldots\ldots\ldots (13)$$

Since υ_o remains the same number of vibrations per the now longer t_v duration at F_v and m_v is, therefore, a *lighter mass* at F_v using local (proper, *LCS*) clock duration unit, $m_v = m_o(1-v^2/c^2)^{1/2}$ and bearing in mind that $t_v = 1$ at F_v, thus keeping to *SR*, *LCS* unit, h_v is no longer the same size on F_v. ($h_v = h_o\,(1-v^2/c^2)^{1/2}$)

5-The Mass And Energy of The Electron at Very High Velocity. **From the forgoing discussion we have to re-examine the *SR* hypotheses of mass increasing with motion. As we have already shown, the speed of light though still physically constant, decreases numerically in a *CCS* clock system in terms of longer waves measure units which make up for the conservation of the energy of the body. Therefore, by proper substitutions, we can re-write the energy equation for an electron at high speed relative to its rest frame F_v :**

$$E_v = m_v c_v^2 + E_{kv} = \frac{m_o}{\left(1 - v^2/c_o^2\right)^{1/2}} c_v^2 + \frac{m_o v^2}{2} = m_o c_o^2 \left(1 - v^2/c_o^2\right)^{1/2} + \frac{m_o v^2}{2} = m_o c_o^2 \quad \ldots\ldots (14)$$

Thus the total energy E_v at F_v including the acquired kinetic, is equal to the initial rest energy, $E_o = m_o c^2$, at F_o. This is in accord with the principle of preservation of energy. It is obvious, from the above expression, if we consistently keep to a *CCS* unit of duration on the moving frame F_v, the decrease in relativistic rest-mass energy (*RRME*) is replaced by an equally gained kinetic energy such that the *zero momentum rest energy* (*ZMRE*) of the electron or *any body* is not exceeded and remains conserved. Let us consider a *zero momentum rest frame -ZMRF-* (having no kinetic energy of motion) such that: $E_\infty = m_\infty C_\infty^2$ (numerically: m_∞ is minimum; C_∞ is maximum index) is the maximum possible *zero momentum rest energy* (*ZMRE*) of a body instead of $E_o = m_o C_o^2$, as we normally do, relative to the Earth frame laboratory. Thus $E_\infty = E_o + E_k$ where E_k is the total kinetic energy of the body at the Earth frame due to overall motion. In another context, it is not possible to add external energy to a body (electron) such that its mass becomes heavier and its total energy exceeds its *zero momentum rest-frame* value (*ZMRE*). In *CCS* units, the velocity of *EM Waves* become numerically smaller (because of longer wavelength or extended measuring rods owing to motion) which balances the *virtual metric numerical increase of the mass* of the body in the now changed units as was experimentally discovered with electrons. Obviously, the mass does not increase with higher velocity to an imaginary hypothetical size but the units simply change. This change in units does not imply the total energy has physically changed. On the other hand, if we keep to *SR* on F_v with a constant velocity for light unchanging numerically then the product of the assumed increased mass by the constant velocity C_o^2 would far exceeds the *zero momentum rest energy, ZMRE,* which violates the principle of conservation of energy. Thus $E_v = m_o C_o^2 / (1-v^2/c^2)^{1/2}$ results in a substantial *intangible* amount of energy as the velocity of the body or particle approaches the limiting speed *C*. The *SR* explanation of dilated time effects on velocity that prevent a particle reaching the limit velocity *C*, is unfounded for by the same second principle of relativity it must remain a numerical constant irrespective of a frame translation. Even energetic cosmic ray particles reaching Earth with very high speed approaching the velocity of light, do not exhibit such an imaginary increase of energy. Clearly *Nature* keeps to a common-clock-system that is confirmed by the increase of the electron mass when moving with high velocity as detected by the change in the e/m ratio. However though having an apparent larger mass due to the change of units, the total real potential *relativistic rest mass energy* (*RRME*) of the moving electron is less than its rest-frame value by the changed amount of kinetic energy it has gained. Thus:

$$E_k = \frac{m_o v^2}{2} = m_o c_o^2 - m_v c_v^2 \quad \ldots\ldots\ldots (15)$$

Therefore, *gained kinetic energy is not converted into mass* that increases the total energy and mass of the electron as formulated in Eqn (1). This was the simple obvious solution to explain the phenomena of an electron's mass increasing with velocity which remained unfortunately non-falsified and unchallenged for such a long time. We can not blame the early investigators, including the great Dr Albert Einstein, to have based

their faith and theory on this anomaly. In general, the total energy of a body at frame F_x is $E_x = m_x c_x^2 + E_{kx}$ while at frame F_y, where the mass is moving relatively faster, is $E_y = m_y c_y^2 + E_{ky}$. Since the *maximum total energy is a constant* for the same body (electrons, etc) such that $E_y = E_x = E_\infty$ in all frames of relative references, therefore in general:

$$m_y c_y^2 + E_{ky} = m_x c_x^2 + E_{kx} \quad \text{.....} (16)$$

Leading to:

$$m_y c_y^2 = m_x c_x^2 + E_{kx} - E_{ky} \quad \text{.....} (17)$$

If F_x is the Earth reference frame, and is taken as the *relativistic reference rest frame* (*RRRF*), then E_{kx}= zero and this confirms why the kinetic energy, E_{ky} , must be deducted not added as is now the common practice. But, to be consistent with *Nature's own metrics*, we must keep to a common clock system (*CCS)* which expresses the velocity of *EM Waves* in the corresponding units : $C_y = C_x (1-v^2/c^2)^{1/2}$ and ends up with the correct increased magnitude: $m_y = m_x / (1-v^2/c^2)^{1/2}$ in the above expression as was discovered by J.J. Thomson back in 1887[6] and other experimenters.

6- Relativistic Mass-energy Equivalence . **I have already given the physical reasons why the energy equation (1) as quoted in section 1 above should be revised. Therefore, instead of $E_k = m_v c^2 - m_o c^2$ we should re-position the terms on the right such that:**

$$E_k = m_o c_o^2 - m_v c_v^2 \quad \text{.....} (18)$$

Since $m_v = m_o / (1-v^2/c^2)^{1/2}$ and $C_v = C_o (1-v^2/c^2)^{1/2}$ at the moving frame F_v when keeping to *CCS* units as outlined in sections 3 and 4 , then re-writing (18) and substituting for m_v and C_v we obtain:

$$E_k = m_o c_o^2 - \frac{m_o}{\left(1 - v^2/c_o^2\right)^{1/2}} c_o^2 \left(1 - v^2/c_o^2\right) = m_o c_o^2 - m_o c_o^2 \left(1 - v^2/c_o^2\right)^{1/2} \quad \text{.....} (19)$$

Now expanding the binomial $(1-v^2/c^2)^{1/2}$ on the right, in the above:

$$E_k = m_o c_o^2\left(1 + \frac{V^2}{2c_o^2} + \frac{3V^4}{8c_o^4} + \frac{5V^6}{16c_o^6} + \ldots - 1\right) \quad \ldots\ldots\ldots(20)$$

which is the relativistic expression for kinetic energy. Therefore, relative to the rest frame, a body in motion possesses both mass-energy $m_v c_v^2$ as well as kinetic energy of motion E_k.

7-The Energy Constancy of Orbiting Electrons.

The same previous analysis can be applied to bounded orbital electrons within an atomic frame that is set in relative motion. This arises from Bohr's classically equating the angular force to the electrostatic force between the electron and the proton as well as the Planck constant of action:

$$h\nu = m(\alpha c)^2 = \frac{e^2}{r} \quad \ldots\ldots\ldots (21)$$

Here h is the Planck constant of action, m is mass of the electron , _ is the frequency per unit time, α is the fine structure constant while αc is the orbital velocity of the electron, v, at separation r from the proton and e^2 is the product of the charge of the electron and proton. Therefore at the Earth rest frame:

$$E_o = h\nu_o + \frac{m_o v_o^2}{2} \quad \ldots\ldots\ldots\ldots (22)$$

In the above, E_o is the total energy of the electron. Since we ignore our own earth frame motion and consider it at *absolute* rest, we normally let velocity $v_o = 0$ at F_o and start with zero kinetic energy. But when moving in, say, frame F_v (train), the electron total maximum energy becomes exceeded by the extra acquired kinetic energy of motion such that the flexible radiative energy of the atom has now to adjust for this additional increase. This seems to be achieved by forcing the electron into a slightly higher orbit. Thus the separation of the electron from the nucleus is increased and results in making the electromagnetic mass of the electron lighter not heavier relative to the platform metrics as otherwise postulated. This is clearly evidenced by longer wavelengths of the radiated energy and longer durations in clocks rates on the moving train. We should not be confused as to accept the

suggested kinetic increase in the mass of the orbital electron when bounded in its atomic frame and wrongly conclude that the electron moves slower at the higher orbit to make up for the assumed increase in its mass due to change in the lateral motion of the atom. Therefore it is imperative that the product *αc,* the orbital velocity of the electron, remains always a constant. It follows that on frame F_v (the moving train) the total energy of the bounded electron is:

$$E_v = h\nu_v + \frac{m_o v_v^2}{2} \quad \text{.....} \quad (23)$$

Here ν_v is the lower output frequency as measured by a common clock (*CCS)* at the moving train. Hence $E_v = E_o$ and the total energy of the electron remains a constant referenced in this particular case to the Earth frame. However, if we do not ignore the overall kinetic energy of the Earth frame, the constant energy of the electron, is $E_\infty = E_o + E_k$. referenced to the *zero momentum rest frame* (*ZMRF).* Obviously, the change in the electromagnetic mass of the electron is referenced to the frame of the atom itself while the change in the kinetic (gravitational) mass is referenced to the gravitational frame in which the atom is moving.

7-The Constancy of the Velocity of Orbiting Electrons.

Since the time for an electron to complete an ground level orbit is $2\pi r/\alpha c$ we can substitute ν in equation (21) by $ac/2\pi r$ and arrive at:

$$\alpha_o = \frac{2\pi e^2}{c_o h} \quad \text{.....} \quad (24)$$

here α_o is the fine structure coupling constant which is invariable if we keep to local or proper clock (*SR*). This is the *LCS* derivation of α_o, but as we have already shown by using a common clock (*CCS*) on the train, the velocity of light changes units such that C_o is replaced by $C_v/(1-v^2/c^2)^{1/2}$ in the above expression and this changes α_o to α_v since e , h and π are all constants resulting in:

$$\alpha_v = \alpha_o / \left(1 - v^2/c^2\right)^{1/2} \quad \text{.....} \quad (25)$$

Thus the product $\alpha_o C_o = \alpha_v C_v$ is a universal constant in all frames of reference irrespective of the frame velocity because the Lorentz gamma factors cancel each other. That is, instead of *C* being numerically universal, it is the electron orbital

velocity, αC, that is now a numerical constant provided we keep to the same system of units on all frames.

7- <u>The Slower Decay Of High Velocity Muons.</u> **What applies to electrons when they absorb extra kinetic energy, also affects muons similarly. The muon mass increases in relative size when thus gaining kinetic energy at their moving frame. Since the time duration unit is common at both: the rest and the moving frame, the same equation (10) is therefore applicable by replacing the muon mass, m_u, for the electron such that:**

$$m_{uv} = \frac{m_{uo}}{\left(1 - V^2/c_v^2\right)^{1/2}} \quad \ldots\ldots\ldots\ldots (26)$$

It is obvious that at the moving frame, F_v, metrics, the *mass of a muon is heavier and it would therefore take a longer time to decay by the very gamma factor γ.* However, the slower decay rate was strongly put forward by advocates of *STR* as evidence of "time dilation" !

In conclusion, we have to revise our present physical theory to conform with these new synthesis which possibly lead to yet more fresh contradictions but meantime culminate in a better understanding of the subject. Effectively, we may be returning to Newton's mechanics and the concept of 'common duration time'[(7)] that was ostracized by *The Special Theory of Relativity* since 1905. In another paper soon to follow, I will demonstrate how other physical hypothesis and constants are similarly modified.

(1) A. Einstein: D*oes the Inertia of a Body Depend Upon its Energy-Content*? Annalen der Physik , xviii. p. 639 (1905). http://www.fourmilab.ch/etexts/einstein/E_mc2/www/
(2) Lewis, G. N. (1908). "*A revision of the Fundamental Laws of Matter and Energy*" Philosophical Magazine,1908,616(95):705–717,http://hdl.handle.net/2027/uc1.b3728275
http://en.wikisource.org/wiki/A_revision_of_the_Fundamental_Laws_of_Matter_and_Energy#cite_ref-2
(3) J.J. Thomson, Philosophical Magazine, 44, 293 (1897). http://web.lemoyne.edu/~giunta/thomson1897.html
(4) A. Einstein's *On the Electrodynamics of Moving Bodies*, Annalen der Physi*k*. 17:891, 1905), sec10-*Dynamics of slowly accelerated electrons, http://www.fourmilab.ch/etexts/einstein/specrel/www/*
(5) H. E. Ives and G. R. Stilwell, "*An Experimental Study of the Rate of a Moving Atomic Clock*", *Journal of the Optical Society of America* 28(7) (1938) 215-219 *www.conspiracyoflight.com/**Ives**/Herbert**Ives**1938a.pdf*
(6) J. J. Thomson, *Carriers of Negative Electricity*, Nobel Lecture in Physics, December 11, 1906. http://web.lemoyne.edu/~giunta/jthomson.html
(7) Though not the concept of *absolute time,* since dating is impossible to achieve.