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Additional Note on Mass, Energy and Relative Motion

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Abstract: *The controversy of a body gaining mass and energy when set in motion, is further discussed in this note to demonstrate that the total sum energy of any material body always remains constant regardless of its motion in space.*

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1-Introduction: I have already explained the problems of the apparent anomalous mass increase with motion in an online paper on GSJ[1] recently. It can be regarded as the main reference for this note. It was shown that all material bodies in the universe possess two types of energy such as the total energy of a body consists of two parts: static rest mass conversion energy (mc^2) plus kinetic energy of motion. Thus if E_e is the total energy of a body (a train) at rest on the track then: $E_t = m_t c^2 + E_k$ where m_t is mass of the body, c velocity of electromagnetic waves (*EMW*) and E_k is the kinetic energy of the body as part of the Earth total added up kinetic motion in space. If the body is, however, moving on the surface of the Earth such as that of a train, then the total energy of the train in motion is given by: $E_{tv} = m_{tv} c^2 + E_t + E_k$. Here m_{tv} is mass of the train, E_t is the train kinetic energy relative to the Earth Surface. But, we customarily take the Earth as being our *Reference Rest Frame (RRF*). and therefore we ignore its kinetic energy of motion ($E_k=0$). Thus: $E_{tv} = m_t c^2 + E_t$. Is the total energy of the train while in motion where $E_t = mv^2/2$ and v is the velocity of the train relative to the Earth. It therefore follows that in Special Relativity (*SR*) *the total energy of the train becomes higher while in motion*. Therefore the mass of the train increases due to motion because $E_{tv} > E_t$ and the train mass while moving is given by: $m_{tv}c^2 = m_t c^2 + E_t$. Since $E_t = mv^2/2$ therefore $m_{tv} c^2 = m_t c^2 + mv^2/2$ or $m_{tv} = m_t /(1-v^2/c^2)$. Thus the mass must be increased.

It is difficult to accept that the total energy of material bodies, particularly that of fundamental particles, is variable and subject to where they are located in the Universe. The electron characteristics, as an example, must remain the same regardless of the motion of the frame to which it belongs. As an alternative theory, we may consider the following *tentative principle:* ***"a body's total energy is an invariable quantity that remains constant irrespective of motion".*** Therefore, in case of the train $E_t = E_{tv}$ or: $m_t c^2 = m_{tv} c_v^2 + m_{tv} v^2 /2$. *Therefore rest mass can vary in size but the total energy of a material body remains constant regardless of frame states of motion*. Thus the static mass of the train in our example, m_{tv} must be lighter when in motion. Empirically we have good evidence that when a body acquires kinetic energy its static mass becomes lighter. A good example is that of *air molecules: when they gain heat (Kinetic energy), they become lighter and rise into the air or to the top of a their confined container*. Another experimental proof is that of a radio transmitter in motion, its output frequency becomes lower per unit common time[2] which indicates a lighter rest mass for the emitting electrons when in motion.

However, hence the online publications of my paper, I was kindly alerted by Mrs Muriel Williams about her father's Dr Theodore Theodorsen[3] paper dealing partly in its first section with the same question of total energy of a body remaining constant while in motion. However he differentiated between two distinct cases: the first case is that of energy gained from an external source such as that of a moved billiard ball or an electron gaining motion from an electrostatic field whereby the mass is *assumed* to become heavier the result of motion and in case-II when the source is internal such that of a train run by on-board batteries. In this case II he suggested the mass and therefore the total energy remains constant as when the body was at rest. Thus if E_o = total rest energy of the body in case I and E_v is the total energy of the body when in motion then in case I:

$$E_v = E_o + E_o \frac{1}{2}(\frac{v^2}{c^2}) \text{............} (1)$$

and in case II where E_s is the static rest energy:

$$E_o = E_s(1 + \frac{v^2}{2c^2}) \text{..................} (2)$$

hence the total energy in case II remains the same size according to Dr Theodorsen.

Experimentally there is laboratory evidence of mass increasing with velocity from charged atomic particles (electrons) when subjected to the attraction of high electrostatic fields. No other experiments on other heavier bodies substantiated such a proof. But, as I have explained in my paper on mass and energy increase, this mass increase anomaly can be explained by considering a common clock (CCS) on the moving frame of the electron whereby the velocity of light is no longer numerically constant and hence the measure unit of mass is effected and the mass, though now reduced, appears to be *numerically* larger in size. Obviously in the design of cyclotrons, for example, we still have to allow for the virtual increase of mass as the ratio of charge and mass is actually effected. Hence our calculation must be based on a common duration clock system (*CCS*) on the moving frames where C, though still a universal physical constant is, now nonetheless, numerically smaller. As an example, if our measure unit is now in miles instead of kilometres than C becomes a smaller sized number. We thereby reach the conclusion that time itself is not subject to *dilation* as stipulated by Einstein's Special Theory of

Relativity, it is only our clocks that run slower with motion and accordingly, mass becomes then larger in size when in motion when keeping to a constant clock system as Nature does!

2-The Correct Expression For A Body's Mass And Energy In Motion. Since rest mass energy is actually less in motion and the energy of a body remains an invariable natural constant whether the body is driven by internal or external source of energy, I propose the following expression for a body when it acquires kinetic motion:

$$E_v = m_o(1 - v^2/2c^2)c^2 + \frac{1}{2}m_o v^2 = E_o \text{ ....} (3)$$

Thus the expression reduces to $E_v = E_o$ regardless of the body's state of motion. However, when v approaches c, than the total energy of the body is now divided into two equal parts, half static or rest mass energy and the other half is kinetic energy of motion. Obviously, a body retains half of its static rest energy even when its speed reaches the limitation velocity of electromagnetic waves. But the kinetic energy is now so huge which shows its marked effects on the targets of cyclotrons and other such accelerators.

3-An Alternative Treatment Of The Problem: as I had suggested in my previous paper (ref.1) we can write the expression as follows accepting the variable change in the velocity of *EMW* as a result of frame motion by keeping to a constant duration clock (*CCS*) and holding to my tentative principle that ***the total energy of a body is always preserved regardless of motion:***

$$E_o = m_o c^2 = m_v c_v^{\ 2} + \frac{1}{2} m_v v^2 \text{ ....} (4)$$

here m_v is mass of the body in motion as correctly found by experiment and m_o is the rest mass of the body. $C_v = C_o (1-v^2/c^2)^{1/2}$ is the numerical velocity of *EMW* when keeping to a common-clock-system. Therefore by inserting the appropriate transformations we arrive at:

$$E_o = m_o c^2 = m_v c_o^2 (1 - \frac{v^2}{c_o^2} + \frac{1}{2}\frac{v^2}{c_o^2}) = m_v c_o^2 (1 - \frac{v^2}{c_o^2})^{1/2} \text{......} (5)$$

It follows that $m_v = m_o / (1-v^2/c^2)^{1/2}$ which leads to the larger sized mass of the body on the moving frames units as found experimentally.

4-A Brief Conclusion: Apparently, Nature preserves total energy by a flexible system whereby a body balances its energy whenever it gains extra kinetic energy from converting either some of its own internal rest mass energy or else what is acquired from external sources. If kinetic energy is gained, then the rest mass becomes reduced accordingly. Equally, when a body releases or transfers its kinetic energy, its motion is reduced but this leads, in its turn, to an equal increase in its rest static mass energy: a happy situation that satisfy the laws of conservation of mass and energy in Nature. Mass becomes converted to motion whitest the loss of motion is equally compensated by gaining static rest mass! We are fortunate nothing is lost in this universe unlike what is widely experienced in our own world's busy stock exchanges!

1- Akil M. Z, General Science Journal, Feb 7, 2013. **http://gsjournal.net/Science-Journals/Essays/View/4341**
2- 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
3-Theodore Theodorsen, Relativity and Classical Physics, General Science Journal, Feb 27, 2013. http://gsjournal.net/Science-Journals/Research%20Papers-Relativity%20Theory/Download/4343