On the Strange Concept of Rest Mass Energy

Abstract

Rest Mass Energy is derived from the Special Relativity (SRT) Interval equation and its significance examined.

Derivation of Rest Mass Energy

Both Newtonian Mechanics (NM) and SRT are derivable from the same Interval equation, namely

$$x'^2 + I^2 = H^2$$

where x' is the distance an object has moved away from x=0 during the time t and I is the distance the *perpendicular portion* of a light beam moved away from x=0 during the time t at speed c, the speed of light, *i.e.*, $I=ct$. H^2 is simply the sum of those squares and H is the distance between the location of that perpendicular light beam and the moving object x' after the time t. If the light beam moved 'vertically' the distance I, then from the object's point of view the light beam moved not only vertically but also horizontally and after time t is now the distance H away. Since $H>I$, NM says H/t is greater than $(I/t)=c$ so $(H/t)>c$, call it c'. Therefore,

$$H = c't \quad .$$

SRT says light *always* travels at speed c so, since $H>I$, then H is made into

$$H=ct'$$

which is where the 'dilated' time of SRT originates. All equations and concepts of SRT follow from this change of $c't$ to ct'.

Other equations that will be needed are

$$\gamma = ct'/I = c't/I;^{1} \quad V = x'/t; \quad v = x'/t'; \quad P = m\gamma v = mV; \quad V = \gamma v; \quad (V/c)^2 = \gamma^2 - 1 \;^{2}$$

$$I^2 = (ct)^2 - x^2 = (ct')^2 - x'^2 = (ct'')^2 - x''^2 = \ldots ; \quad I = ct \text{ when } x=0$$

where c is the speed of light, γ is the gamma function, V is NM speed, v is SRT speed, P is momentum, and m is mass. The V and v *never* have the same value. The correctness of these equations has been established elsewhere.

So the Interval equations for SRT and NM are:

SRT

$$x'^2 + I^2 = (ct')^2 ; \quad (ct')^2 - x'^2 = I^2$$

Multiply both sides by (mc/t)^2.

$$(mc^2t'/t)^2 - (mcx'/t)^2 = (mcI/t)^2$$

$$(\gamma mc^2)^2 - (mcx'/t)^2 = (mcct/t)^2$$

$$(\gamma mc^2)^2 - (Pc)^2 = (mc^2)^2$$

$$E^2 - (Pc)^2 = (mc^2)^2 = (E_0)^2$$

$(mc^2) = (E_{0)})$ is SRT rest mass energy

NM

$$x'^2 + I^2 = (c't)^2 ; \quad (c't)^2 - x'^2 = I^2$$

Multiply both sides by (mc^2/ct)^2.

$$(mc^2c't/ct)^2 - (mc^2x'/ct)^2 = (mc^2I/ct)^2$$

$$(\gamma mc^2)^2 - (mcx'/t)^2 = (mc^2ct/ct)^2$$

$$(\gamma mc^2)^2 - (Pc)^2 = (mc^2)^2$$

(mc^2) could also be considered NM 'rest mass energy' but makes no sense.

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[1] $\gamma = 1 / (1 - (v/c)^2)^{1/2}$; By squaring and multiplying numerator and denominator by $(ct')^2$, one obtains $\gamma^2 = (ct')^2 / [(ct')^2 - (ct')^2 (x'/ct')^2] = (ct')^2 / [(ct')^2 - x'^2] = (ct')^2 / I^2$; $\gamma = ct'/I = H'/I = ct'/ct$

[2] $\gamma^2 - 1 = [1/(1 - (v/c)^2)] - [(1 - (v/c)^2) / (1 - (v/c)^2)] = (v/c)^2 / (1 - (v/c)^2) = (\gamma(v/c))^2 = (V/c)^2$

Although ‘rest mass energy’, as shown above, “exists” in both SRT and NM, is it ever considered in NM? Perhaps the concept should be examined further.

SRT	**NM**
$(Pc)^2 = E^2 - (mc^2)^2 = (\gamma mc^2)^2 - (mc^2)^2$	$(Pc)^2 = (\gamma mc^2)^2 - (mc^2)^2$
$(P/c)^2 = \gamma^2 m^2 - m^2$	$(P/c)^2 = \gamma^2 m^2 - m^2$
$(P/c)^2 = m^2 (\gamma^2 - 1)$	$(P/c)^2 = m^2 (\gamma^2 - 1)$
$(P/c)^2 = m^2 (V/c)^2$	$(P/c)^2 = m^2 (V/c)^2$
$(P/c) = m\ (V/c)\ ; \quad P = mV = m\gamma v$	$(P/c) = m\ (V/c)\ ; \quad P = mV$

Perhaps someone should have finished their algebra. So-called Rest Mass Energy seems to be the result of not recognizing that as velocity, v or V, approaches 0, γ approaches 1.0 which must be ‘corrected’ so that when v or V is zero, P will also equal zero.

The famous SRT equation $E=mc^2$ is actually incorrect *according to SRT;* it should read $E=\gamma mc^2$. The m does not change with velocity, γ does.

Non-Significance of Rest Mass Energy

So speaking of ‘total energy’, E, makes little sense. Just consider

$$P = mV = m\gamma v = [(E^2 - (E_0)^2)^{1/2}] / c$$

and totally ignore the last expression. *This does not mean that mass cannot interchange with energy*. It only means that mass does not change with velocity, exemplified by the fact that everything has nearly infinite velocities, depending on what you are comparing it to, and thus would have nearly infinite different masses, m, if mass changed with velocity.

Adding the square of Rest Mass Energy, $(mc^2)^2$, a fixed quantity, to $(Pc)^2$, an indicator of movement and kinetic energy, to get a value E^2 whose variation is only a function of $(Pc)^2$ seems pointless.