The Special Theory of Relativity and the Scale Principle

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Earlier this year I wrote an article entitled Scale Factors and the Scale Principle. In that article I formulated a new physical principle which describes nature at both quantum and cosmic scales. Now I found that this principle also encompasses, at least, part of Einstein's special theory of relativity. Thus, the purpose of this article is to demonstrate that Einstein's relativistic energy is a special case of the present formulation: the scale principle.

Keywords: *total relativistic energy, momentum, differential.*

1. Introduction

In a previous article [2] I introduced the scale principle or scale law through the following mathematical relationship

(1)

Scale principle or scale law
$\left(\frac{Q_1}{Q_2}\right)^n \left[\leq \middle| = \middle| \geq \right] S \left(\frac{Q_3}{Q_4}\right)^m$

Where

a) Q_1, Q_2, Q_3 and Q_4 are physical quantities of identical dimension (such as Length, Time, Mass, Temperature, etc), or

b) Q_1 and Q_2 are physical quantities of dimension 1 while Q_3 and Q_4 are physical quantities of dimension 2 (e.g. 1 Q_1 and Q_2 could be quantities of Mass while Q_3 and Q_4 could be quantities of Length. e.g. 2 Q_1 and Q_2 could be quantities of Mass while Q_3 and Q_4 could be quantities of Energy x Time, etc.).
Q_1, Q_2, Q_3 and Q_4 can be variables, constants or differentials.
(Q_1, Q_2, Q_3 and Q_4 can be variables, constants or differentials.)

c) The relationship is one of three possibilities: a smaller or equal than inequality ($\leq$), or an equality/equation (=), or a greater or equal than inequality ($\geq$).

d) S is a dimensionless scale factor (this factor could be a real number, a complex number, a real function or a complex function)

e) n and m are integers 0, 1, 2, 3,… (In general these two numbers are different, for example n =1 and m = 2; or n=1 and m=0, etc.)

2. Einstein's Total Relativistic Energy

I shall show that the Einstein's total relativistic energy expression: $E^2 = p^2c^2 + m_0^2c^4$ obeys the scale principle. Let us consider the energy scale table given below (see Table 1).

Energy	Energy	Energy	Energy
E_1	E_2	pc	pc

***TABLE 1**: This simple scale table is used to show that Einstein's relativistic energy obeys the scale law.*

Where

E_1 = energy
E_2 = energy
p = momentum of the particle
c = speed of light in vacuum

According to the above scale table we write

$$E_1 \times E_2 = S \times pc \times pc \tag{2}$$

As always we have introduced the scale factor S (in this case is 1).
Equation (2) can be rewritten in the form of the scale principle

$$\frac{E_1}{pc} = S\frac{pc}{E_2} \tag{3}$$

The meaning of E_1 and E_2 is given by the following definitions

$$E_1 \equiv E + m_0c^2 \tag{4}$$

And

$$E_2 \equiv E - m_0 c^2 \tag{5}$$

Where

E = total relativistic energy of the particle
m_0 = particle's rest mass

Substituting E_1 and E_2 in equation (3) with the second side of equations (4) and (5) respectively we get

$$\frac{E + m_0 c^2}{pc} = S \frac{pc}{E - m_0 c^2} \tag{6}$$

Taking a scale factor of 1 yields the implicit expression for the total relativistic energy in the form of equation (1)

$$\frac{E + m_0 c^2}{pc} = \frac{pc}{E - m_0 c^2} \tag{7}$$

with

$n = m = 1$
$Q_1 = E + m_0 c^2$
$Q_2 = Q_3 = pc$
$Q_4 = E - m_0 c^2$
$S = 1$

Thus equation (7) is the following simple case of the scale law

$$\frac{Q_1}{Q_2} = \frac{Q_3}{Q_4} \tag{8}$$

where $Q_2 = Q_3$

Now let's return to equation (7) and let's rewrite it as follows

$$\left(E + m_0 c^2\right)\left(E - m_0 c^2\right) = \left(pc\right)^2 \tag{9}$$

$$E^2 - \left(m_0 c^2\right)^2 = \left(pc\right)^2 \tag{10}$$

Finally

$$E^2 = p^2c^2 + m_0^2c^4 \tag{11}$$

Thus we have proved that Einstein's formula for the relativistic energy is a special case of the scale law. It is without question that by observing equation (11) it is almost impossible to suspect that this equation obeys the scale law.

There is a shorter an easier way to prove that equation (11) obeys the scale principle. We could have started from equation (11) (without drawing the scale table) and then we could have worked backwards through equations (10), (9), (8) until we get to equation (7). However, this backwards procedure cannot be applied unless we know the final equation which in a real situation is not known.

3. Conclusions

Taking into account that the scale law describes several known laws of physics as I have shown in a previous paper [2] and in this paper, we can consider that the scale law is a more general law than the laws it describes. Therefore the scale principle is a *law model* nature applies to a wide range of phenomena.

REFERENCES

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