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Space, Time and Mass Complementary Dimensions

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Abstract: ***Special Relativity shows space, time, and mass value dependence on its kinetic energy component, changing space-time scaled values by the inverse of Lorentz gamma factor and mass scaled value by the gamma factor. Later, General Relativity provided fields of local energy-stress presence, curving its local space-time scaled values. Where,for being fully described, local three longitudinal dimensions depend on its local energetic 4th dimension λ (total energy wavelength). Time will also need its 2nd temporal dimension 1/ν (total energy period), for the same reason. Idem to mass 2nd mass dimension E/C² (total energy-mass expression). These energetic space-time-mass dimensions can be expressed as adding of all the individual manifestations of energy, providing extra complementary dimensions.***

Keywords: Theory of relativity, energy 4th dimension, multidimensional space, string theory, Time-mass invariance

1. Introduction

Einstein's wonderful paper in 1905 [1] gave a physical meaning to the initial thought of W. Voight [2], H. Poincare [3] and H. A. Lorentz [4] among others. The relation between inertial moving frames includes a constant speed of light C. It will finally conclude into the well-known Lorentz gamma factor $\gamma = 1/\ \mathrm{SQRT}\ (1 - V^2/C^2)$, affecting space with a scale contraction, idem, to time with a scale dilation. The travel through time (passage through time) is the same for all inertial reference frames since a particle can be together later in time, whatever its scaled value shows. The same happens with the space occupied or space traveled; the view from different inertial reference frames will only imply a scale change; meanwhile, they will be at the same place independent of the reference frame.

This scaled consideration is understandable when atmospheric muons reach sea level with a relativistic speed of 98% C (Lorentz gamma = 5). From the earth view, the muon travels about 10 km in 11 µs; meanwhile from the muon view it only travel 2 km in 2.2 µs. Besides these differences in values, both express the exact moment and the exact place when they reach sea level. The travel through space and time are the same, and it is only an issue considering the scale for each reference frame.

In the twin paradox, one clock will have a greater value than the dynamic twin clock but both can meet together in the future even if they have different time values. The time values of each twin are different, but they are at the same epoch; their time scale is just different values for each one depending on their kinetic energy. The same reasoning is considered for the train in the tunnel paradox; the train at relativistic speed will occupy the same space. Meanwhile, its value will be smaller but still will have the same part out of the tunnel. There is also no contradiction with the conductor view of the tunnel length being contracted; the Lorentz $1/\gamma$ factor deals only with scale variation on each inertial frame of reference. An example is the scaled ruler that engineers and architects use, it will have six different total length values depending on each of the six scales that it contains; but the total length of the ruler is the same for all the cases, it's only a scale value difference.

The physical magnitudes-values of space and time depend on the scale applied. This scale depends on the energy involved; so, physical magnitudes-values need the energetic information to be fully described.

Minkowsky's [5] gave helpful diagrams for event analysis where the four dimensions involve the where&when information. Simultaneity, evolution in space over time, and information transmission limit (light cone limit) are well represented in this fourth dimension of space-time (3D plus t or properly Ct). But for a local presence, this time evolution of events is not the local 4th longitudinal dimension that completes local 3D x-y-z scale information, as seen in the following paragraph.

2. Local Space-Time-Mass

Taking Poincare's invariant up to a local view at atomic scale, or the quantum package dimension, this in-variance can be written as:

$$\Delta x^2 + \Delta y^2 + \Delta z^2 + (i C \Delta t)^2 = \text{Invariant} \qquad (1)$$

Where Δx, Δy, Δz expresses the squared length of the quanta (sometimes express as Δr^2), Δt is the proper time τ or the quanta periodicity; and Cτ is the contra-variant longitudinal dimension or total energy wavelength. So, equation (1) will be:

$$\Delta x^2 + \Delta y^2 + \Delta z^2 + \text{Constant} = (C\tau)^2 = \lambda^2 \qquad (2)$$

Like Einstein's field equation, curved space at one side and energy-stress tensor at the other side of the equation. Poincare invariant scaled longitudinal dimension at one side and energy wavelength at the other side. A shorter wavelength and so a local space scaled contracted when higher energy is involved and vice versa.

The same reasoning for the time, the equation will be:

$$\Delta t^2 + (i\tau)^2 = \text{Invariant} \qquad (3)$$

$$\Delta t^2 + \text{Constant} = \tau^2 \qquad (4)$$

A shorter periodicity is involved when higher energy is present, and so a local time-scaled dilation. And for local mass, the equation will be:

$$\Delta MLocal^2 + (i\Delta M_{tot})^2 = Invariant \quad (5)$$
$$\Delta MLocal^2 + Constant = \Delta MTot^2 \quad (6)$$

A greater mass is involved when higher energy is present, and so a local mass-scaled increment.

3. Multiple Manifestations of Energy

This is a new interpretation of the 4th longitudinal dimension and a new 2nd temporal dimension; 3D and time need the complementary wavelength and periodicity of its energetic presence. This presence in not only from its proper energy but also from the influence of surrounding energy, as expressed by Einstein in his GTR.

Going further, these energetic complementary dimensions can be decomposed into the different forms that energy manifests providing secondary dimensions. A secondary longitudinal and temporal dimension due to the mass energy, another one due to the linear and angular momentum, in the same way for electromagnetic energy as well nuclear energy, etc.

The wavelength of mass-energy and kinetic energy can be expressed as:

$$EMo = h\nu = hC/\lambda Mo \text{ and } Ek = hC/\lambda k \quad (7)$$

The orthogonal addition of energies:

$E_{tot}^2 = (MoC^2)^2 + p^2C^2$ or

$$h^2C^2/\lambda_{tot}^2 = h^2C^2/\lambda Mo^2 + h^2C^2/\lambda k^2 \quad (8)$$

From Mazzini's [6] equation with total energy wavelength λE, Mo as mass at rest, k for kinetic energy, V for the speed, γ for its Lorentz factor, $\beta x = Vx/C$, $\beta y = Vy/C$, $\beta z = Vz/C$.

$$1/\lambda_{tot}^2 = 1/\lambda Mo^2 + 1/\lambda^2 k = 1/\lambda Mo^2 + 1/\lambda^2 kx + 1/\lambda^2 ky + 1/\lambda^2 kz \quad (9)$$

$$\lambda_{tot} = 1/SQRT\,[1/\lambda Mo^2 + \gamma^2\beta x^2/\lambda Mo^2 + \gamma^2\beta y^2/\lambda Mo^2 + \gamma^2\beta z^2/\lambda Mo^2] \quad (10)$$

So, Poincare's in-variant (1) can be express as mass-energy and kinetic energy secondary longitudinal dimensions:

$$\Delta x^2 + \Delta y^2 + \Delta z^2 + 1/[(i/\lambda Mo)^2 + (i\,\gamma\beta x/\lambda Mo)^2 + (i\,\gamma\beta y/\lambda Mo)^2 + (i\,\gamma\beta z/\lambda Mo)^2] = Invariant\ldots \quad (11)$$

For time, will apply the same equations for mass-energy and kinetic energy secondary temporal dimensions:

$$E_{tot}^2 = h^2/\tau_{tot}^2 = h^2/\tau Mo^2 + h^2/\tau k^2 \quad (12)$$

$$\tau_{tot} = 1/SQRT[1/\tau Mo^2 + \gamma^2\beta x^2/\tau Mo^2 + \gamma^2\beta y^2/\tau Mo^2 + \gamma^2\beta z^2/\tau Mo^2] \quad (13)$$

$$\Delta t^2 + 1/[(i/\tau Mo)^2 + (i\,\gamma\beta x/\tau Mo)^2 + (i\,\gamma\beta y/\tau Mo)^2 + (i\,\gamma\beta z/\tau Mo)^2] = Invariant \quad (14)$$

And for the third magnitude that STR [1] considers, the mass, will also apply the same equations for mass-energy and kinetic energy secondary temporal dimensions:

$$E_{tot}^2 = (M_{tot}C^2)^2 = (MoC^2)^2 + \gamma^2 Mo^2 V^2 C^2 \quad (15)$$

$$M_{tot} = SQRT\,[Mo^2 + \gamma^2 Mo^2\beta^2] \quad (16)$$

$$\Delta M^2 + [(iMo^2 + (i\gamma\beta xMo)^2 + (i\gamma\beta yMo)^2 + (i\gamma\beta zMo)^2] = Invariant \quad (17)$$

The invariant equations of time and mass seems quite obvious or simple, but they contain the same importance as Poincare's longitudinal in-variance. Like in a technical drawing, you can extract each value from there, but the scale used is a must to complete the information of this values.

4. Conclusion

The Lorentz factor applied to the space-time-mass is a consequence of its energetic presence and it completes their physical values; this is known as space scaled contraction, time scaled dilation and mass scaled increment. They will represent the 4th longitudinal dimension, 2nd temporal dimension and 2nd massive dimension, in other words, the total wavelength, the total periodicity and the total inertial mass of its energetic presence. These dimensions can be expressed by their complementary dimensions in correspondence to the multiple energy different manifestations in nature; a multidimensional nature.

Declarations

The author declares no conflicts of interest regarding the publication of this paper.

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