Ideas on the origin of the Lorentz Factor

Michael Gunning Jan 2026
michael_gunning@hotmail.com

Abstract

In this paper I put forward some ideas for a physical explanation of the origins of the Lorentz Factor, γ, and how it explains relativistic time dilation, length contraction and Inertia (mass) increase.

Introduction

This paper is an extension of some of the ideas put forward in an earlier paper[1] so it is advisable to read it first before reading this one. To summarise the relevant ideas of the earlier paper, I proposed that there is an aether and that the aether is an elastic tetrahedral lattice structure. The inverse of the permittivity of free space, $1\backslash\varepsilon_0$ is its shear modulus and that the permeability of free space, μ_0 is its density. The speed of a wave (light) in this medium is therefore the familiar $1/(\mu_0\varepsilon_0)^{1/2}$. In order for the units of $1\backslash\varepsilon_0$ and μ_0 to have the same units as shear modulus and density respectively it is only necessary for the units of electric charge to be m^2 instead of Coulomb. The reason why electric charge should be measured in m^2 is because in the model electric charge is caused by waves emitted by particles and the energy in a wave is proportional to its amplitude squared. The tetrahedral lattice is essentially two interpenetrating face centred cubic lattices as shown in fig 1 and within each of these FCC cells is the structure shown in fig 2. In my model this structure in one of the FCC lattices is the electron and in the other it is the positron. The fundamental frequency of vibration of the tetrahedral lattice is caused by the two FCC lattices moving in opposition to each other.
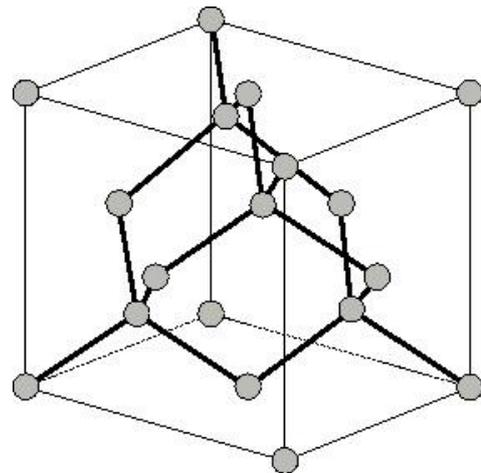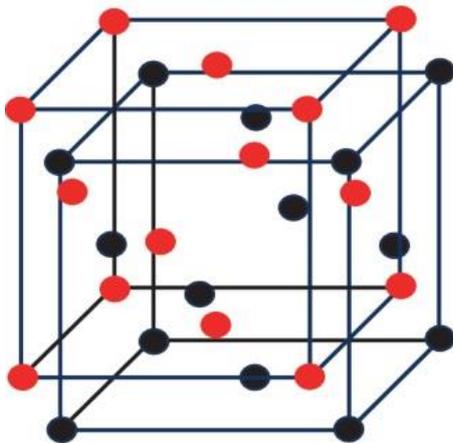
The Lattice Spring Constant

In my model the lattice is described as nodes connected by springs under compression. The current length of the compressed springs is l_0. If the length of the uncompressed/unstretched spring is σl_0 and the spring constant is k, then we can write the following expression for the force exerted by the spring

$$F = k(\sigma l_0 - l_0) \tag{1.1}$$

General Relativity states that when a particle moves with velocity v, it contracts in length in the direction of motion by a factor γ where

$$\gamma = \sqrt{\frac{1}{1 - \frac{v^2}{c^2}}} \tag{1.2}$$

For a moving particle we can rewrite equation 1.1 as

$$F = k\left(\sigma l_0 - \frac{l_0}{\gamma}\right) \tag{1.3}$$

$$F = k l_0 \left(\sigma - \frac{1}{\gamma}\right) \tag{1.4}$$

As γ is always greater than 1 the expression 1/γ will always be less than 1 and if we assume that σ is significantly greater than 1 then equation 1.4 can be approximated as

$$F = k\sigma l_0 \qquad = k' \, l_0 \tag{1.5}$$

In my model the pressure exerted by the lattice springs is $1/\varepsilon_0$ and if we look at just a square lattice then the area of the square is $l_0{}^2$. The force exerted by the springs is therefore the pressure multiplied by this area

$$F = \frac{l_0^2}{\varepsilon_0} \tag{1.6}$$

If we now combine equations 1.5 and 1.6, we get

$$k'l_0 = \frac{l_0^2}{\varepsilon_0} \tag{1.7}$$

$$k' = \frac{l_0}{\varepsilon_0} \tag{1.8}$$

Lorentz Factor

If a stationary particle receives energy from e.g. an electric force F, that impinges at right angles to one face of a cubic cell it will cause the cell to compress and the face to rotate relative to the rest of the cell as is depicted in fig 2.1.
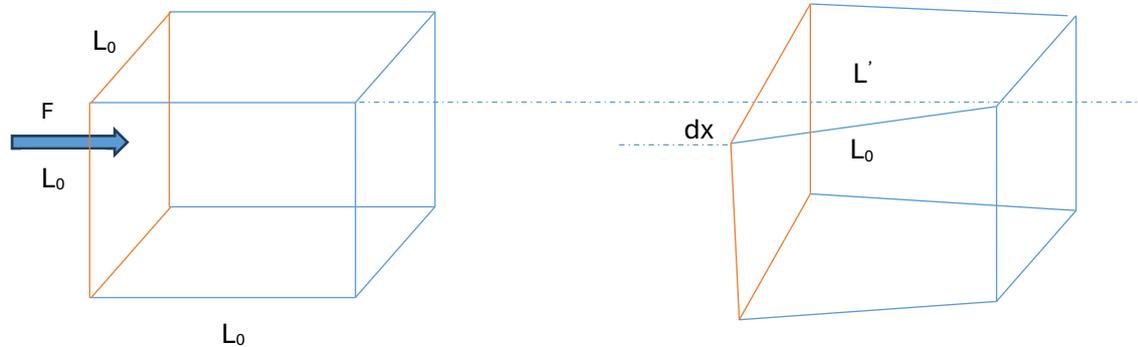

Fig 2.1

When the face rotates and the cell contracts in width from l_0 to l' we can see that the lengths l_0, l' and dx form a right angle triangle and therefore we can write

$$dx^2 + l'^2 = l_0^2 \qquad\qquad 2.1$$

$$dx^2 = l_0^2 - l'^2 \qquad\qquad 2.2$$

$$dx^2 = l_0^2\left(1 - \frac{l'^2}{l_0^2}\right) \qquad\qquad 2.3$$

The energy associated with rotating the face a linear distance dx is k'dx^2 and using the expression for the spring constant from equation 1.8 we get an expression for the energy

$$E = k'.dx^2 \qquad\qquad 2.4$$

$$E = \frac{l_0}{\varepsilon_0} l_0^2\left(1 - \frac{l'^2}{l_0^2}\right) \qquad\qquad 2.5$$

$$E = \frac{l_0^3}{\varepsilon_0}\left(1 - \frac{l'^2}{l_0^2}\right) \qquad\qquad 2.6$$

As the cell gets compressed in the direction of motion the area of the two faces, front and back, will increase in order that there is no change in the volume of the cell. The energy expression in equation 2.6 is equal to the VdP work done on the cell (i.e. change in pressure at constant volume) so therefore we can write

$$\frac{l_0^3}{\varepsilon_0}\left(1 - \frac{l'^2}{l_0^2}\right) = VdP \qquad\qquad V = Volume = l_0^3 \qquad\qquad 2.7$$

$$\left(1 - \frac{l'^2}{l_0{}^2}\right) = \varepsilon_0 dP \qquad\qquad 2.8$$

$$\frac{l'^2}{l_0{}^2} = 1 - \varepsilon_0 dP \qquad\qquad 2.9$$

$$\frac{l'}{l_0} = \sqrt{1 - \varepsilon_0 dP} \qquad\qquad 2.10$$

$$\frac{l_0}{l'} = \frac{1}{\sqrt{1 - \varepsilon_0 dP}} \qquad\qquad 2.11$$

$$\frac{l_0}{l'} = \frac{1}{\sqrt{1 - \frac{\mu_0 \varepsilon_0 dP}{\mu_0}}} \qquad\qquad 2.12$$

$$\frac{l_0}{l'} = \frac{1}{\sqrt{1 - \frac{\frac{dP}{\mu_0}}{c^2}}} \qquad\qquad 2.13$$

As the ratio on the LHS is the definition of the Lorentz Factor γ then we can write

$$\gamma = \frac{1}{\sqrt{1 - \frac{\frac{dP}{\mu_0}}{c^2}}} \qquad\qquad 2.14$$

The term dP/μ_0 has units of velocity squared and refers to the velocity of the particle, therefore

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad\qquad 2.15$$

From this derivation we can see that when a particle receives energy by virtue of a force being applied to it then this energy increases the pressure within the particle. This pressure difference in combination with the density of the lattice determines the velocity of the particle.

I envision that as the particle moves the two faces will oscillate relative to each other but keeping the same distance l' between them. The energy added to the particle in order to cause it to move is initially stored in the compressed springs between the two faces. This energy then transfers to the rotating faces as they rotate in one direction and then back to the springs between the faces as they rotate in the opposite direction.

Lorentz Length Contraction

I have already shown above how the Lorentz factor and length contraction are related.

$$l' = \frac{l_0}{\gamma} \tag{3.1}$$

Relativistic Mass Increase

Many physicists do not interpret the relativistic mass increase formula as an increase in the mass of the particle but as an increase in the inertia of the particle. Expressions for the moment of inertia I_0 of a body of mass m and radius or extension r usually take the form

$$I_0 = f(m).\, g(r^2) \quad Kgm^2 \tag{4.1}$$

The key thing to take from this formula is that the moment of inertia is a function of r^2. The areas of the rotating faces have to increase by a factor of γ in order for the volume of the cell to remain constant. This means that the lengths of the sides of the faces will increase by a factor of $\gamma^{0.5}$ as will all linear dimensions associated with the faces. If we extent the principle that the moment of inertia is a function of r^2 to the oscillating face, then we can state that its moment of inertia is

$$I' = f(m).\, g((\gamma^{0.5}r)^2) \tag{4.2}$$

$$I' = f(m).\, g(\gamma\, r^2) \tag{4.3}$$

$$I' = \gamma\, I_0 \tag{4.4}$$

It would appear that the increase in inertia of a moving particle comes about due to the increase of the cross sectional area of the particle. At a speed of 0.995c, the gamma factor is 10.01 which means that the length of the sides of the rotating faces would increase by a factor of only 3.16. As one tries to accelerate a particle the increasing cross sectional area and moment of inertia makes it more difficult for the particle to move through the lattice.

Lorentz Time Dilation

Quantum Mechanics tells us that a particle is never at rest and always has some minimum energy. From this we can say that the faces of the cell must oscillate with some minimum

amount of energy and therefore at some frequency ω_0. The angular momentum L_0 of the faces of a cell (particle) at the minimum energy level can therefore be written as

$$L_0 = I_0 \omega_0 \qquad\qquad 5.1$$

As I stated earlier, the energy imparted to the particle to start it to move, flows back and forth from the rotating faces to the compressed springs so that over a complete cycle there is no net energy added to the faces. The average angular momentum of the faces is therefore constant and equal to L_0. When energy is added to the cell (particle) the moment of inertia increases by a factor of gamma so in order for the angular momentum to remain constant the angular frequency must decrease by a factor of gamma.

$$L_0 = I_0 \omega_0 \quad = \quad I'.\omega' \quad = \quad \gamma I_0 . \frac{\omega_0}{\gamma} \qquad\qquad 5.2$$

Therefore

$$\omega' \quad = \quad \frac{\omega_0}{\gamma} \qquad\qquad 5.3$$

As frequency is the inverse of time we can write

$$t' \quad = \quad \gamma \, t_0 \qquad\qquad 5.4$$

which is the relativistic time dilation equation.

Conclusions

If this derivation of the Lorentz Factor is correct, then it gives strong support to the existence of an aether and also sheds some light on the properties of this aether. If my assumption in relation to the Spring Constant is correct, i.e. that the uncompressed length of the lattice springs is σl_0, then the Universe is finite and not infinite as many propose. If it were infinite then the force exerted by the springs would be infinite and the permittivity of free space, ε_0, would be zero. The fact that σ is very much greater than one, means that the universe can expand significantly from its current size before the then stretched springs start to contract and reverse the expansion. The contraction will then last for as long as the expansion and when the springs are contracted to their maximum extent it too will reverse and start a new expansion.

General Relativity while maintaining that velocity and time are relative quantities and only make sense when measured with respect to an inertial frame could never explain why acceleration was absolute. This derivation of the Lorentz Factor demonstrates the reasonable hypothesis that an aether exists and that velocity and acceleration are both absolute when measured with respect to the aether. While absolute acceleration can be measured, it appears not to be possible to measure absolute velocity because time dilation and length contraction conspire to prevent us from measuring it as discovered by Michelson and Morley in 1887.

Time Dilation has been demonstrated by measuring the increase in the half-life of relativistic muons created in the upper atmosphere by cosmic radiation. It would appear from this analysis that the half-life of an unstable particle is related to the number of oscillations it experiences.

As the frequency of oscillation reduces by a factor of gamma, the half-life is extended by a factor of gamma.

References

1 http://vixra.org/abs/2512.0075