

THE ISOTROPIC NATURE OF TIME

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PART I: TRAGEDY OF THE TRANSFORMATIONS

1 – Relative Problem

The following is derived in a spacial medium free of electromagnetic or gravitational fields as pertaining to the special theory of relativity by Albert Einstein. The concept of relativity cannot be ascertained as absolute. The derivation of the Lorentz transformations is based on the concept of absolute relativity by introducing the relation:

$$x'^2 - c^2 t'^2 = x^2 - c^2 t^2$$

This asserts that both reference frames are identical when they are in fact not identical. The first postulate of Einstein's special theory of relativity should state that the laws of physics are identically derived in all inertial frames, therefore being a postulate of the measuring reference frame. Clearly, there is a regulating medium which regulates the speed of light. This medium must therefore regulate the speed of light to itself. Therefore, there is an absolute distinction between inertial frames even though one cannot be readily measured by the reference frames themselves. Due to this fact, the equations for motion must be derived using the properties of motion as measured in the inertial frame of measurement. The second postulate of the constancy of the measured velocity of light has been verified by Ole Christensen Roemer, Albert A. Michelson and others. The following is the Lorentz transformations as derived in Einstein's special theory of relativity for events along the x-y axis.

$$x' = (x \pm vt) / (1 - v^2/c^2)^{1/2}, \text{ sign is relative to the velocity vector } v \text{ of the inertial system}$$

$$y' = y / (1 - v^2/c^2)^{1/2}$$

$$z' = z / (1 - v^2/c^2)^{1/2}$$

$$t'_x = (t \pm vx/c^2) / (1 - v^2/c^2)^{1/2}, \text{ sign is relative to the velocity vector } v \text{ of the inertial system}$$

$$t'_y = t / (1 - v^2/c^2)^{1/2}$$

$$L'_x = L(1 - v^2/c^2)^{1/2}, x = L$$

$$L'_y = L$$

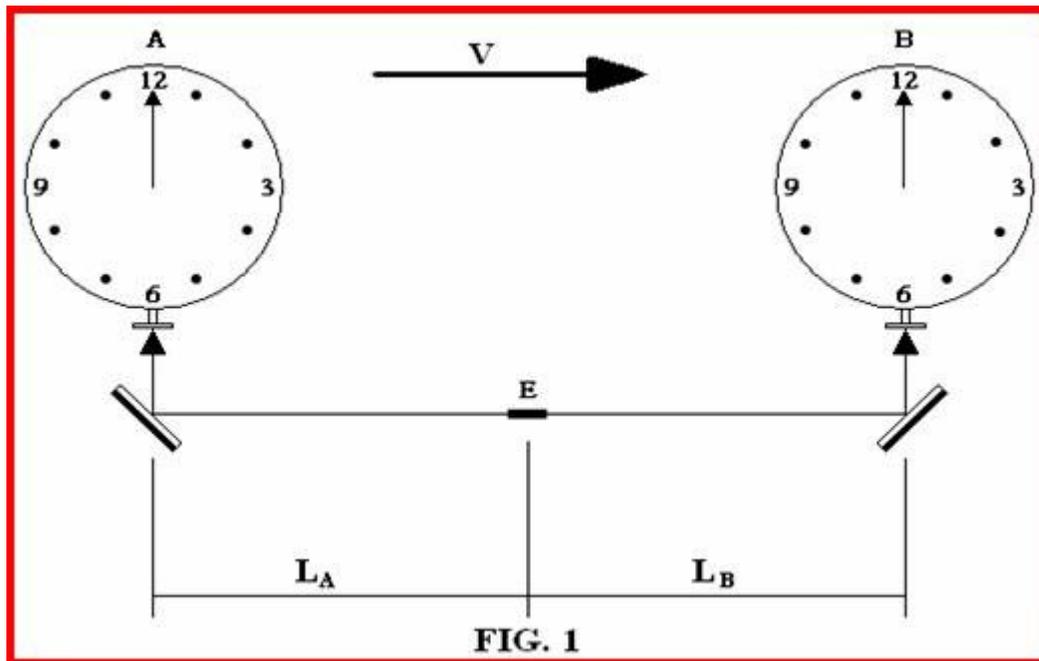


FIG. 1

Consider FIG. 1, where two identically constructed clocks A and B are synchronized in a reference frame considered to be at rest (unprimed). At rest, $L_A = L_B = L$ which is the rest length. The distance between clocks is large enough to allow sufficient comparison between time intervals. A source of light is sent from E simultaneously by means of a beam splitter in both directions to start the clocks. The inertial system A-B (primed) is now given a uniform velocity v . At time (t_1) in the unprimed system a signal is sent to the clocks to stop them. At time (t_2) the signal arrives at the clocks to stop them. The span of time to send a signal to stop clock A (t'_A) and clock B (t'_B) as measured by the unprimed system as time (t) is given by the following:

$$t_2 - t_1 = t$$

$$L_A = L_B = L(1 - v^2/c^2)^{1/2}$$

t = Time interval in the reference frame considered to be at rest.

$$t'_A = (t - vx/c^2)/(1 - v^2/c^2)^{1/2}, \text{ where } x = ct$$

$$t'_A = (t - vt/c)/(1 - v^2/c^2)^{1/2} = t(1 - v/c)/(1 - v^2/c^2)^{1/2}$$

$$1-1 \quad t'_A = t[(1 - v/c)/(1 + v/c)]^{1/2}$$

$$t'_B = (t + vx/c^2)/(1 - v^2/c^2)^{1/2}, \text{ where } x = ct$$

$$t'_B = (t + vt/c)/(1 - v^2/c^2)^{1/2} = t(1 + v/c)/(1 - v^2/c^2)^{1/2}$$

$$1-2 \quad t'_B = t[(1 + v/c)/(1 - v/c)]^{1/2}$$

$$\Delta t = t'_B - t'_A$$

$$\Delta t = t[(1 + v/c)/(1 - v/c)]^{1/2} - t[(1 - v/c)/(1 + v/c)]^{1/2}$$

$$\Delta t = t(1+v/c)/(1-v^2/c^2)^{1/2} - t(1-v/c)/(1-v^2/c^2)^{1/2}$$

$$\Delta t = t[(1+v/c)/(1-v^2/c^2)^{1/2} - (1-v/c)/(1-v^2/c^2)^{1/2}]$$

$$\Delta t = (t/(1-v^2/c^2)^{1/2})(1+v/c - 1+v/c)$$

$$1-3 \quad \Delta t = [(2vt)/c]/(1-v^2/c^2)^{1/2}$$

Motion is ascertained using this light experiment. The only way that the principle of relativity can hold is if time intervals are isotropic regardless of velocity. With time intervals being isotropic:

$$t'_A = L_A/(c+v)$$

$$t'_B = L_B/(c-v), \quad t'_A = t'_B$$

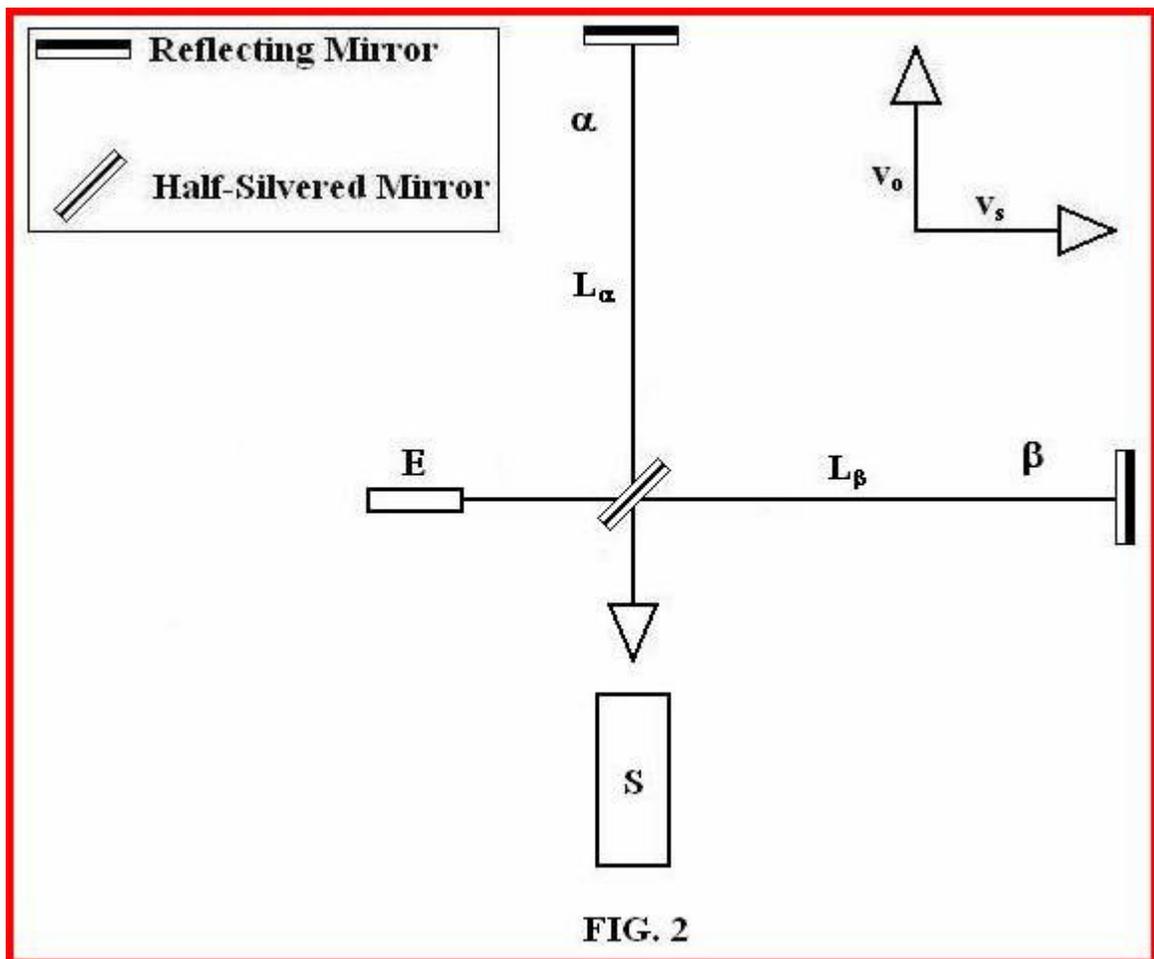
$$L_A/(c+v) = L_B/(c-v)$$

$$L_A/L_B = (c+v)/(c-v)$$

The only way to equate the two is to specify path lengths differently with respect to angular displacement relative to the velocity vector. The Michelson-Morley experiment and others are a measure of the round trip paths for the light involved. No direct or indirect measurement has been ascertained for the path in one direction. The new length due to relative motion was assumed the same for opposite directions. It is this assumption that is in question.

2 – Experiment: The Isotropic Nature Of Light

The Michelson-Morley experiment taught some fundamental properties of light as it travels relative to an inertial system. Consider the following diagram of a simplistic design of this experiment.



In fig. 2, a monochromatic source (E) of light is sent to the half-silvered mirror where it travels two paths α and β . Only the intended light path is shown. The light then reflects back in the opposite direction where the two paths meet and combine. The light then is analyzed for wavelength by the interferometer (S). The apparatus, during counter-clockwise rotation, will at one time rotate from v_s to v_o . It was found that both paths were completed, round-trip, in equal time. The time for path α in each direction is:

$$t' = t\gamma,$$

$$\gamma = (1 - v^2/c^2)^{-1/2}$$

This time $t\gamma$ is borne out of the fact of aberration discovered by James Bradley. Aberration measurements show that the transverse length must remain unchanged at any velocity, for this assumption yields the correct equation which matches experiment.

For path β parallel to the velocity vector v_s :

$$t'_p = d_p/(c-v), \quad d_p = \text{length of the path parallel to the velocity vector } v_s$$

For the direction opposite the velocity vector v_s :

$$t'_A = d_A/(c+v), \quad d_A = \text{length of the path parallel but in opposite direction to the velocity vector } v_s$$

The null result of the experiment confirmed the relation:

$$2t\gamma = d_p/(c-v) + d_A/(c+v), \text{ or more generally}$$

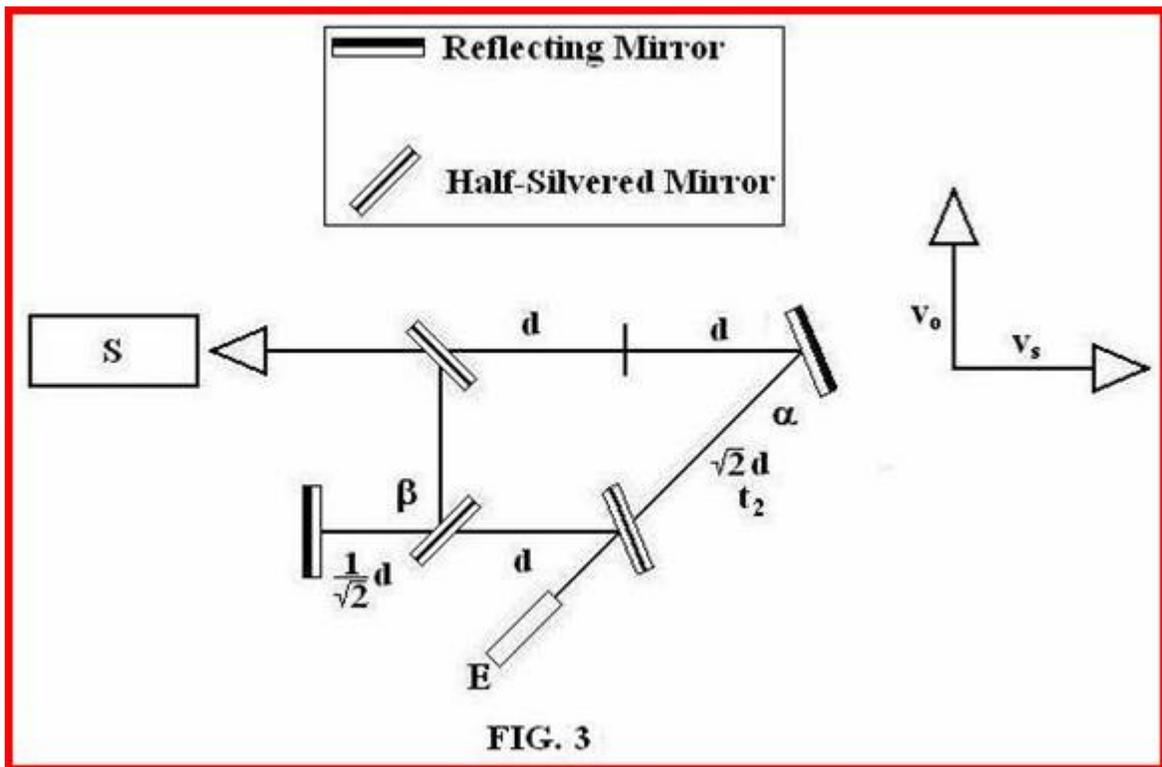
$$2-1 \quad 2t\gamma = d_{\theta}/c'_{\theta} + d_{\theta+\pi/2}/c'_{\theta+\pi/2}, \text{ where}$$

d- Path length at angle θ or $\theta+\pi/2$ relative to the velocity vector of the inertial system.

c'- The speed of light relative to the inertial system as measured by the stationary system.

The following experiment is simplistic in design for easy calculation. Varying the unit distance (d) will not affect the results as long as each path leg is in proper proportion to the others. Extra lenses to compensate for the added time the light takes to go through the mirrors are left out for simplicity. The entire experiment is split into three stages.

Stage 1



In Fig. 3, a source (E) of monochromatic light is sent to the half-silvered mirror where it travels two paths α and β . Only the intended light path is shown. At the end of each path, the two paths are converged into one by a half-silvered mirror and sent to an interferometer (S). At rest, the time of travel for both paths are equal. Path directions parallel to the velocity vector are designated as (d_p) while those opposite the velocity vector are designated as (d_A). The time to complete the hypotenuse is designated as (t_2). The apparatus, during counter-clockwise rotation, will at one time rotate from v_s to v_o , where the time t_2 is equal for both these directions due to rotational invariance.

At v_s , the time for each path is:

$$2.A \quad t_{\alpha} = t_2 + 2d_A/(c+v)$$

$$t_{\beta} = d_A/(c+v) + 2^{-1/2}d_A/(c+v) + 2^{-1/2}d_p/(c-v) + t\gamma, \quad 2^{1/2}t\gamma = 2^{-1/2}d_p/(c-v) + 2^{-1/2}d_A/(c+v)$$

$$2.B \quad t_{\beta} = d_A/(c+v) + 2^{1/2}t\gamma + t\gamma$$

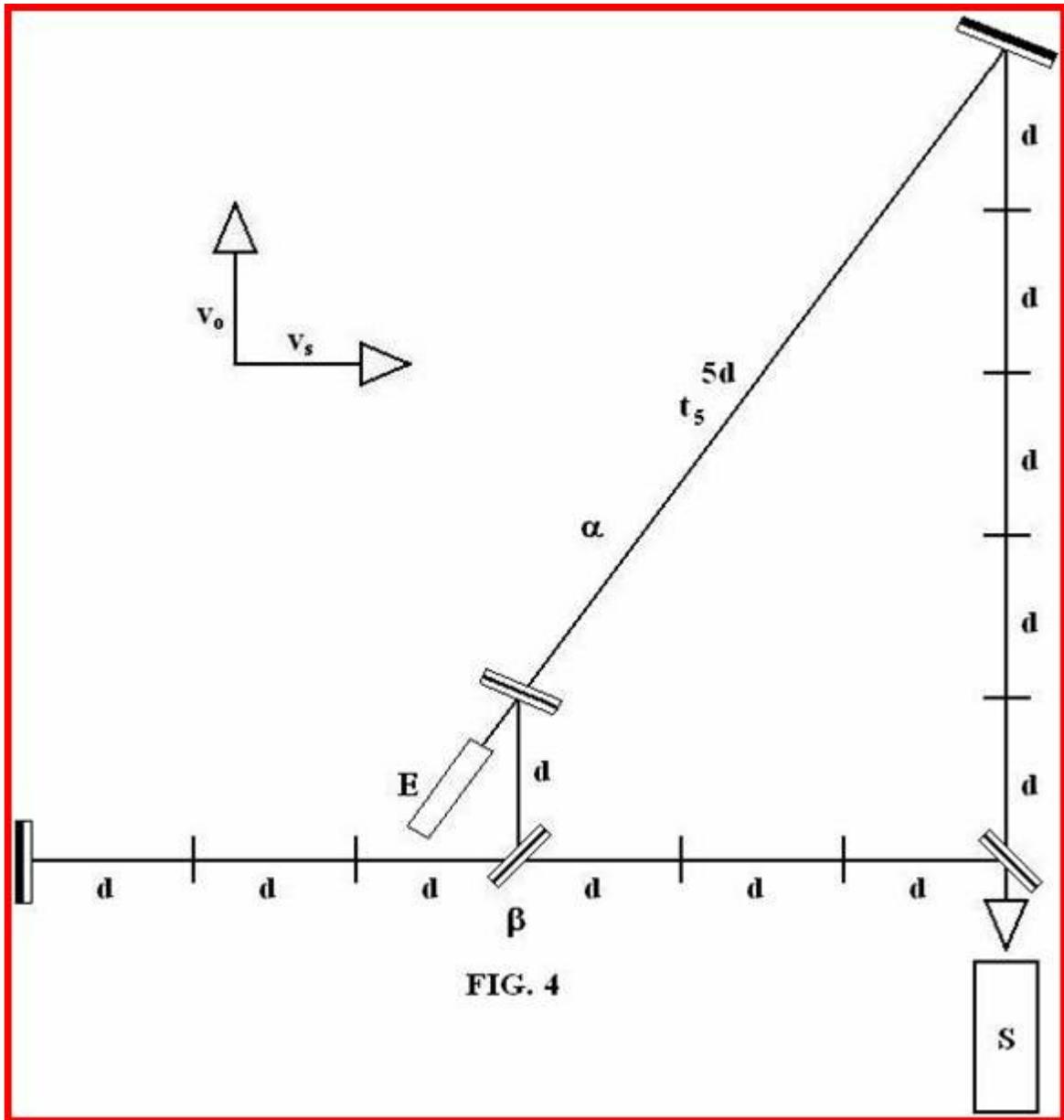
With no interference, the following is deduced;

$$t_{\alpha} = t_{\beta}$$

$$t_2 + 2d_A/(c+v) = d_A/(c+v) + 2^{1/2}t_{\gamma} + t_{\gamma}$$

$$2.C \quad t_2 = 2^{1/2}t_{\gamma} + t_{\gamma} - d_A/(c+v)$$

Stage 2



The unit of distance (d) is the same. The time to complete the hypotenuse is designated as (t_{γ}). The apparatus, during counter-clockwise rotation, will at one time rotate from v_s to v_0 , where the time t_{γ} is equal for both these directions due to rotational invariance.

At v_s , the time for each path is:

$$2.D \quad t'_\alpha = t_5 + 5t\gamma$$

$$t'_\beta = t\gamma + 3d_A/(c+v) + 6d_P/(c-v),$$

From the Michelson-Morley experiment:

$$2t\gamma = d_P/(c-v) + d_A/(c+v)$$

$$2.E \quad t'_\beta = 7t\gamma + 3d_P/(c-v)$$

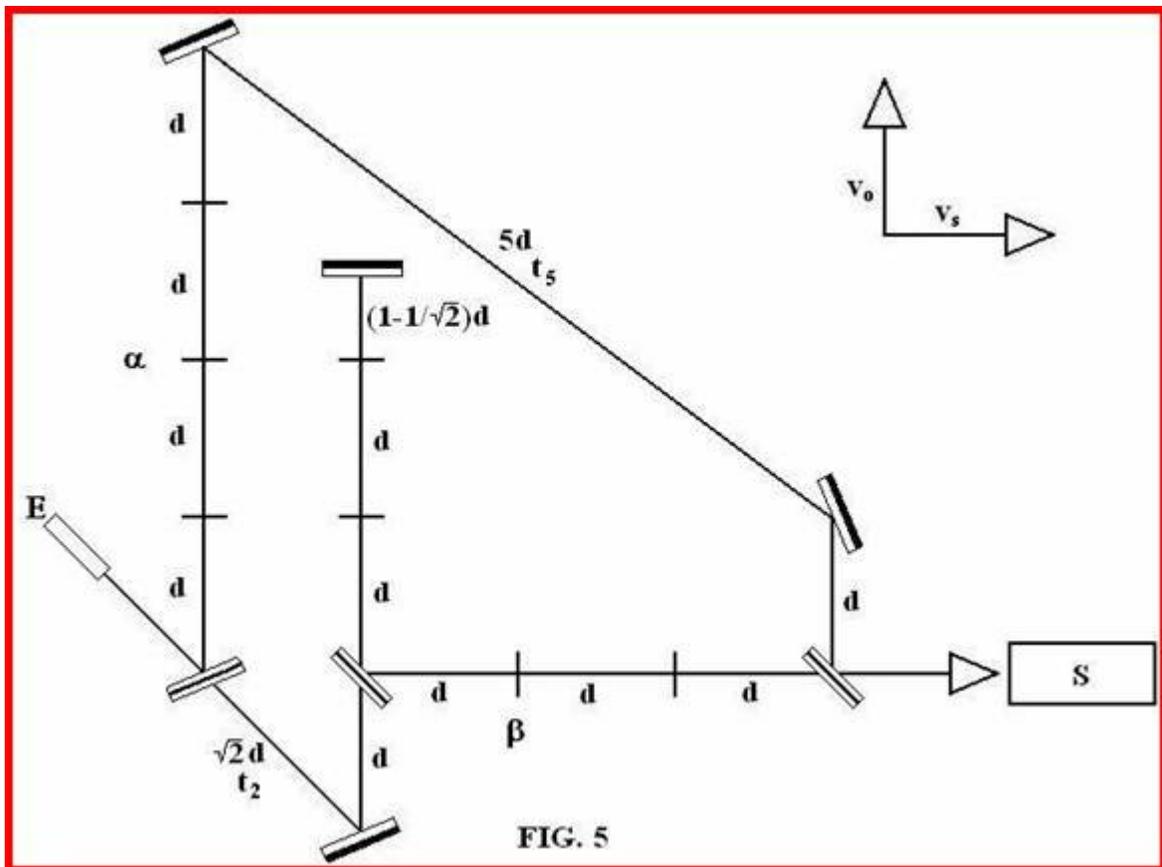
With no interference, the following is deduced;

$$t'_\alpha = t'_\beta,$$

$$t_5 + 5t\gamma = 7t\gamma + 3d_P/(c-v)$$

$$2.F \quad t_5 = 2t\gamma + 3d_P/(c-v)$$

Stage 3



The unit of distance (d) is the same. The apparatus, during counter-clockwise rotation, will at one time rotate from v_s to v_o .

At v_s , the time for each path is:

$$2.G \quad t'_\alpha = 5t_\gamma + t_5$$

$$2.H \quad t'_\beta = t_2 + 7t_\gamma - 2^{1/2}t_\gamma + 3d_P/(c-v)$$

With no interference, the following is deduced;

$$t'_\alpha = t'_\beta,$$

$$5t_\gamma + t_5 = t_2 + 7t_\gamma - 2^{1/2}t_\gamma + 3d_P/(c-v)$$

$$2.I \quad t_5 = t_2 + 2t_\gamma - 2^{1/2}t_\gamma + 3d_P/(c-v)$$

Clearly, with all unit distances being equal, the following becomes readily apparent:

$$t_5 = t_2 + 2t_\gamma - 2^{1/2}t_\gamma + 3d_P/(c-v),$$

From stage 1:

$$t_2 = 2^{1/2}t_\gamma + t_\gamma - d_A/(c+v),$$

$$t_5 = 2^{1/2}t_\gamma + t_\gamma - d_A/(c+v) + 2t_\gamma - 2^{1/2}t_\gamma + 3d_P/(c-v)$$

$$t_5 = 3t_\gamma + 3d_P/(c-v) - d_A/(c+v), \quad d_A/(c+v) = 2t_\gamma - d_P/(c-v)$$

$$t_5 = 3t_\gamma + 3d_P/(c-v) - [2t_\gamma - d_P/(c-v)]$$

$$2.J \quad t_5 = t_\gamma + 4d_P/(c-v)$$

From stage 2:

$$t_5 = 2t_\gamma + 3d_P/(c-v),$$

Inputting this into equation 2.J gives:

$$2t_\gamma + 3d_P/(c-v) = t_\gamma + 4d_P/(c-v)$$

$$2.K \quad t_\gamma = d_P/(c-v), \text{ which shows that time is isotropic in inertial frames.}$$

From the Michelson-Morley experiment:

$$2t_\gamma = d_P/(c-v) + d_A/(c+v),$$

$$d_P/(c-v) = t_\gamma,$$

$$2t_\gamma = t_\gamma + d_A/(c+v),$$

$$2.L \quad t_\gamma = d_A/(c+v)$$

For the hypotenuse paths:

Stage 1:

$$t_2 = 2^{1/2}t\gamma + t\gamma d_A / (c+v), \quad t\gamma = d_A / (c+v)$$

$$t_2 = 2^{1/2}t\gamma + t\gamma - t\gamma$$

$$2.M \quad t_2 = 2^{1/2}t\gamma$$

Stage 2:

$$t_5 = 2t\gamma + 3d_P / (c-v), \quad t\gamma = d_P / (c-v)$$

$$t_5 = 2t\gamma + 3t\gamma$$

$$2.N \quad t_5 = 5t\gamma$$

Conclusion

Having faith in the principle of relativity for the measuring inertial system, it is hereby assumed that no significant interference will be found. This shows that time is isotropic for all inertial frames.

$$2.O \quad t' = t(1-v^2/c^2)^{-1/2}, \text{ for all angles } \theta \text{ relative to the velocity vector } v$$

$$2.K \quad t\gamma = d_P / (c-v)$$

$$2.L \quad t\gamma = d_A / (c+v), \text{ therefore}$$

$$d_P / (c-v) = d_A / (c+v),$$

$$d_P / d_A = (c+v) / (c-v)$$

$$2.P \quad d_P / d_A = (1+v/c) / (1-v/c)$$

The length is derived by equation 2.K:

$$t\gamma = d_P / (c-v)$$

$$d_P = t(c-v)\gamma, \quad \gamma = (1-v^2/c^2)^{-1/2}$$

$$2.Q \quad d_P = [(1-v/c) / (1+v/c)]^{1/2}$$

and by equation 2.L:

$$t\gamma = d_A / (c+v)$$

$$d_A = t(c+v)\gamma, \quad \gamma = (1-v^2/c^2)^{-1/2}$$

$$2.R \quad d_A = [(1+v/c) / (1-v/c)]^{1/2}$$

Length is shown to be dependant upon the angle relative to the velocity vector of the inertial system and is not the same for opposite directions.

3 – Derivation Of The Fundamental Transformations

Interference in the experiment would yield an absolute motion detector. Having faith in the principle of relativity for the measuring inertial system, the following is deduced from no significant interference in the experiment. The fundamental equations of length L and time t should be a linear change of the form $\alpha'/\alpha = \delta$ because only the relative velocity is a factor.

The fundamental transformations are those that are independent of the actions of light or material bodies. These are the equations of length and time. Length is fundamental because a ruler has no knowledge of whether a photon or electron traverses its span. Time is fundamental due to the principle of relativity for the measuring inertial system. We have already confirmed the equation for time;

2.O $t' = t(1-v^2/c^2)^{-1/2}$, for all angles θ relative to the relative velocity vector v

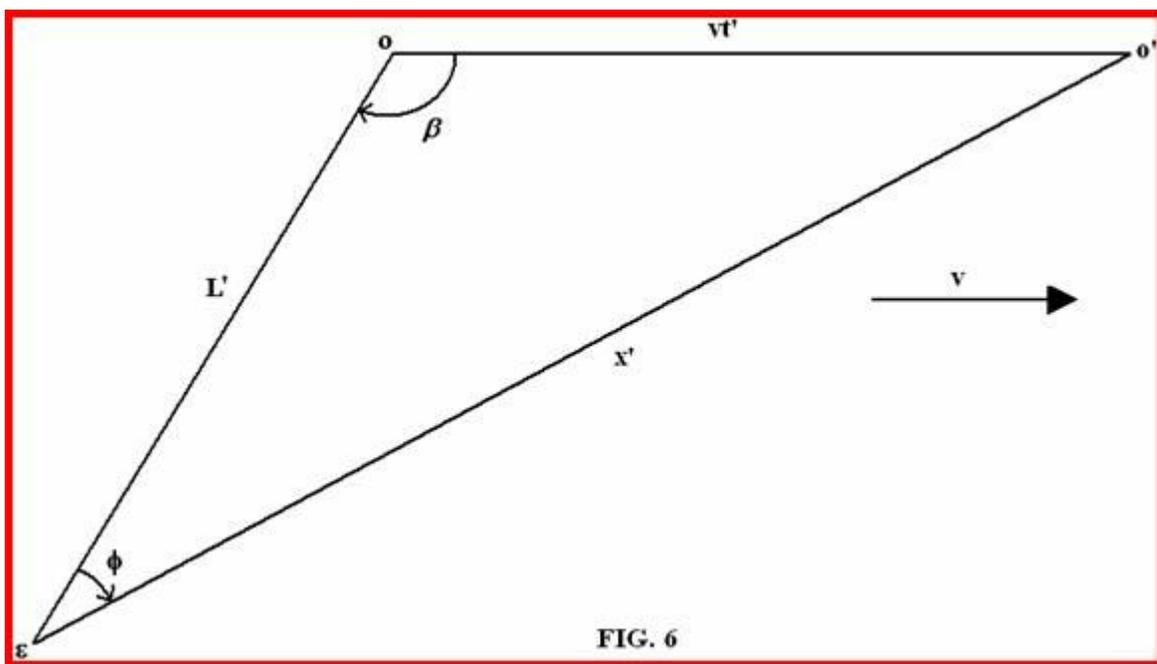


Fig. 6 is the geometric relationship of a light event in a system k' moving at velocity v relative to a system k considered to be at rest. This geometric relation is due to the aberration of light whose value is verified by experiment as;

3.A $\phi = \sin^{-1} [(v/c)\sin \theta]$,

ϕ - The angle of aberration relative to the path vector taken at rest (deviation).

θ - The angle of the path vector relative to the velocity vector v of the inertial system.

As was mentioned earlier, if the transverse length altered due to motion then aberration would not take place according to the above equation. The above formula demands that the transverse length remain constant for any velocity v . The principle of relativity for the measuring inertial system demands that a photon emitted from ϵ pass through the point o' whose distance from the point o is advanced by the term vt' , parallel to the velocity vector, which is the mechanical distance that the point o travels in the time it takes the photon to traverse the distance x' .

The path vector viewed by k' is L' . In motion, aberration produces a path vector x' at an angle of ϕ with L' as viewed by k . The length is L' because this is the length of the path at velocity v . The diagram shows a light event where a photon is emitted at ϵ . As viewed by k' , the path of the light is $\epsilon-o$. At velocity v , aberration produces the path $\epsilon-o'$. Although the observers in k' will still see the path $\epsilon-o$, those in k will see $\epsilon-o'$. The system k' moves a distance vt' parallel to the velocity vector of the system, where t' is the time the photon takes to complete the path $\epsilon-o'$ or x' .

Where the law of sines gives:

$$x'^2 = L'^2 + v^2 t'^2 - 2L'vt' \cos \beta$$

When $\beta = 0$,

$$x'^2 = L'^2 + v^2 t'^2 - 2L'vt'$$

$$x'^2 = (L' - vt')^2,$$

$$x' = L' - vt'$$

This is the situation of the path vector directly opposite the velocity vector.

$$\theta + \beta = \pi,$$

$$\beta = \pi - \theta$$

$$\cos \beta = \cos (\pi - \theta) = \cos [\pi/2 - (-\pi/2 + \theta)] \sin (-\pi/2 + \theta) = \sin [-(\pi/2 - \theta)] = -\sin (\pi/2 - \theta)$$

$$\cos \beta = -\cos \theta$$

$$3.B \quad x'^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta,$$

θ - The angle of the path vector taken at rest with respect to the velocity vector.

This equation is general in nature, for it is dependant upon whether a photon or electron is being described. The equation is derived for a material event, but can describe light by using the relations $L=ct$ and $x'=ct'$ in the equation.

Using the subscripts of the inertial systems;

$$3.B \quad x_k'^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

These are the generalized equations for length as derived by the properties of light in k' ;

$$3.C \quad x_k = c_k t'$$

$$3.D \quad L' = c_k t'$$

The constancy of the velocity of light gives;

$$c_k = c$$

$$3.C \quad x_k = ct'$$

By substitution of equations 3.C and 3.D into 3.B yields;

$$c^2 t'^2 = c_k'^2 t'^2 + v^2 t'^2 + 2 c_k' t' vt' \cos \theta$$

$$c^2 = c_k'^2 + v^2 + 2 c_k' v \cos \theta$$

$$0 = c_k'^2 + 2 c_k' v \cos \theta + (v^2 - c^2),$$

where the quadratic equation gives:

$$c_k' = [-b \pm (b^2 - 4ad)^{1/2}] / (2a)$$

$$a = 1$$

$$b = 2v \cos \theta$$

$$d = v^2 - c^2$$

after simplification:

$$c_k' = \pm [c^2 - v^2 \sin^2 \theta]^{1/2} - v \cos \theta,$$

when $\theta = 0$:

$$c_k' = \pm c - v$$

It is known that:

$$c_k' = c - v,$$

Thus, taking the positive root of the quadratic equation validates this.

$$3.D \quad c_k' = (c^2 - v^2 \sin^2 \theta)^{1/2} - v \cos \theta,$$

c_k' - The velocity of light relative to k' as measured by k .

θ - The angle of the path vector taken at rest with respect to the velocity vector.

$$L' = c_k' t'$$

Substitution of 3.D gives:

$$L' = [(c^2 - v^2 \sin^2 \theta)^{1/2} - v \cos \theta] t'$$

$$L' = ct' [(1 - (v^2/c^2) \sin^2 \theta)^{1/2} - (v/c) \cos \theta], \quad t' = t \gamma$$

$$L' = ct \gamma [(1 - (v^2/c^2) \sin^2 \theta)^{1/2} - (v/c) \cos \theta], \quad L = ct$$

$$3.E \quad L' = L \gamma [(1 - (v^2/c^2) \sin^2 \theta)^{1/2} - (v/c) \cos \theta],$$

Fundamental Transformations

➤ $t' = t \gamma$, for all θ

➤ $L' = L \gamma [(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$

$$\beta = v/c$$

$$\gamma = (1-\beta^2)^{-1/2}$$

θ = The angle of the path vector taken at rest with respect to the velocity vector.

4 – Derivation Of The General Transformations

The general transformations are those that apply only to light or material bodies. The derivation is going to be for material bodies. For them to apply to light, the electromagnetic relations $L=ct$ and $x' = ct'$ must be used to simplify the equation.

The generalized equation for total distance traveled for an event in k' as measured by k is:

$$x_k = u_k t'$$

u_k – The velocity of the material body as measured by k .

Substituting this in equation 3.B gives:

$$u_k^2 t'^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

$$u_k^2 = L'^2/t'^2 + v^2 + (2L'v \cos \theta)/t'$$

The generalized equation for the distance traveled relative to the system k' as measured by k is:

$$L' = u_{k'} t',$$

$$u_{k'} = L'/t'$$

Substitution yields:

$$4.A \quad u_k^2 = u_{k'}^2 + v^2 + 2u_{k'}v \cos \theta$$

$$u_{k'} = L'/t'$$

Substituting equations 2.O and 3.E gives:

$$u_k = \{L' \gamma [(1-(v^2/c^2)\sin^2 \theta)^{1/2} - (v/c)\cos \theta] / (t\gamma), L/t = u$$

$$4.B \quad u_{k'} = u [(1-(v^2/c^2)\sin^2 \theta)^{1/2} - (v/c)\cos \theta],$$

u – The velocity as measured by k' .

General Transformations

$$\square \quad x_k^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

$$\square u_k^2 = u_{k'}^2 + v^2 + 2u_{k'}v \cos \theta$$

$$\square u_{k'} = u[(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$$

$$\beta = v/c$$

θ = The angle of the path vector taken at rest with respect to the velocity vector.

u- Velocity of the object as measured by observers in k' .

k- Reference frame considered to be at rest.

k' - Inertial frame at velocity v relative to k .

5 – TRANSFORMATIONS BETWEEN COORDINATES SYSTEMS WITH A UNIFORM VELOCITY BETWEEN THEM

$$\triangleright t' = t\gamma, \text{ for all } \theta$$

$$\triangleright L' = L\gamma[(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$$

$$\square x_k^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

$$\square u_k^2 = u_{k'}^2 + v^2 + 2u_{k'}v \cos \theta$$

$$\square u_{k'} = u[(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$$

$$\beta = v/c$$

$$\gamma = (1 - \beta^2)^{-1/2}$$

θ = The angle of the path vector taken at rest with respect to the velocity vector.

u- Velocity of the object as measured by observers in k' .

k- Reference frame considered to be at rest.

k' - Inertial frame at velocity v relative to k .

$$\triangleright \text{ - Fundamental transformations (independent)}$$

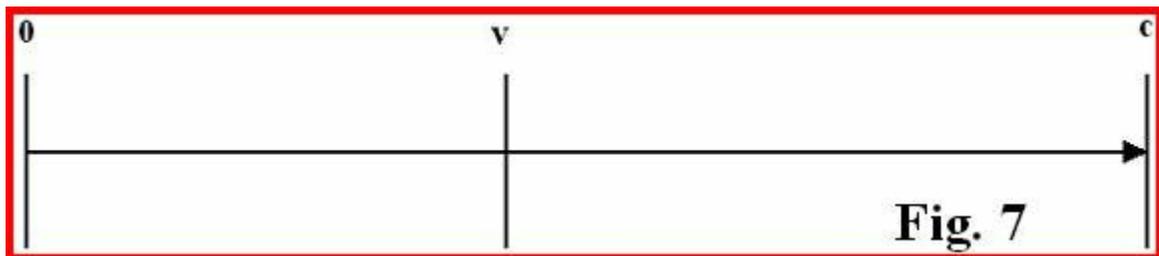
$$\square \text{ - General transformations (material bodies)}$$

6 – Philosophical Implications Of The Principle Of Relativity

The principle of relativity for the measuring inertial system is based on the fact that if an inertial system k' is moving with velocity v relative to a system k considered to be at rest, a slowing of a clock in k' will incur. How can the system k' have its clock slowed if both systems are equivalent? There must be a regulating medium which regulates the speed of light. This shows that there is an absolute distinction between inertial frames even though one cannot be readily measured by the reference frames themselves. Otherwise, both systems clocks would slow when one of them traveled at velocity v . Clearly, this is ridiculous. There must be something that determines which systems' clock is slowed. This is the same thing that regulates the speed of light. There must be a master frame of reference to which all motion is checked, which is classically called the absolute reference frame or ether. This is the only concept that supports the second postulate of the constancy of the measured velocity of light. With this being said, the following becomes readily apparent.

Suppose an observer in the absolute reference frame k . Now suppose two systems k' and k'' who are at velocity v relative to k . System k'' now assumes velocity v_2 relative to k , where $v_2 < v$. Clearly, k'' will have its clock rate increased relative to k' . This would violate the concept of relativity in its accepted sense because k' sees k'' accelerate to a positive velocity causing k'' to have its clock slowed relative to k' . The first case must be true according to the second postulate of the constancy of the measured velocity of light. The special case to be considered is the absolute property of centripetal motion. This case is irregardless of relative motion to the absolute reference frame. All centripetal motion is in excess to relative motion. No matter what the velocity of an inertial frame is, a clock put into centripetal motion in this frame will always slow referenced to this frame. Thus, centripetal motion cannot be ascertained as proof of Einstein's principle of absolute relativity. Light or material body events cannot ascertain this absolute motion. Only time intervals can ascertain this motion, which is a measure of history. Suppose an observer in the absolute reference frame k . Now k' and k'' synchronize their clocks in such a way that the axis that connects them is perpendicular to the relative velocity vector. Now k'' assumes a positive velocity relative to k' , but reduces velocity relative to k . According to k , $\Delta t_{k''} > \Delta t_{k'}$. Therefore, the clock in k' is running slower than the clock in k'' . The clocks measure history. History is the only measurable discernment between different inertial frames.

This situation is analogous to two clocks on a centripetal path with equal radial arms. Now a system k' is rotating at velocity v , while a system k'' is rotating at velocity v_2 . If $v_2 > v_1$, then can k' consider itself to be at rest while k'' is in motion with a slower ticking clock? The spacial properties for these rotating systems demand that k'' has a slower ticking clock than k' . This is the same spacial properties of linear translations. An inertial frame at velocity v falls somewhere between the velocity limits of 0 and c in an absolute sense.



The relation $x'^2 - c^2t'^2 = x^2 - c^2t^2$ now only holds true for light events. Clearly, this is because all inertial frames agree on a photons' velocity, unlike material events. Therefore, the relation $x'^2 - c^2t'^2 = x^2 - c^2t^2$ only applies to electromagnetic events (hence the quantities $c^2t'^2$ and c^2t^2). By using the relations $x = ct$ and $x = ct'$, the transformations can be reduced to a form where the relation $x'^2 - c^2t'^2 = x^2 - c^2t^2$ holds true. By using the relations $x = ct$ and $x = ct'$, the transformations then only apply to electromagnetic phenomenon.

PART II: THE RELATIVITY OF LENGTH

TRANSFORMATIONS BETWEEN COORDINATES SYSTEMS WITH A UNIFORM VELOCITY BETWEEN THEM

$$\triangleright \quad t' = t\gamma, \text{ for all } \theta$$

$$\triangleright \quad L' = L\gamma[(1-\beta^2\sin^2 \theta)^{1/2} - \beta\cos \theta]$$

$$\square \quad x_k'^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

$$\square \quad u_k'^2 = u_k'^2 + v^2 + 2u_k'v \cos \theta$$

$$\square \quad u_k' = u[(1-\beta^2\sin^2 \theta)^{1/2} - \beta\cos \theta]$$

$$\beta = v/c$$

$$\gamma = (1-\beta^2)^{-1/2}$$

θ = The angle of the path vector taken at rest with respect to the velocity vector.

u- Velocity of the object as measured by observers in k'.

k- Reference frame considered to be at rest.

k'- Inertial frame at velocity v relative to k.

$$\triangleright \quad - \text{Fundamental transformations (independent)}$$

$$\square \quad - \text{General transformations (material bodies)}$$

7 – DEBROGLIE-DOPPLER EFFECT

At an angle 0° parallel to the velocity vector:

$$x_k' = L' + vt',$$

It becomes clear that the quantity vt' is due to the spacial offset of translation.

$$x_k' = L' \pm \text{spacial offset, at } \theta = 0^\circ \text{ or } 180^\circ$$

Suppose a projection screen which projects an image of a real time clock face. This device can be turned on and off for any time span. The device is turned on at time t_0 and off at time t . The result is an event column of light showing the clock advancing from time t_0 to t .

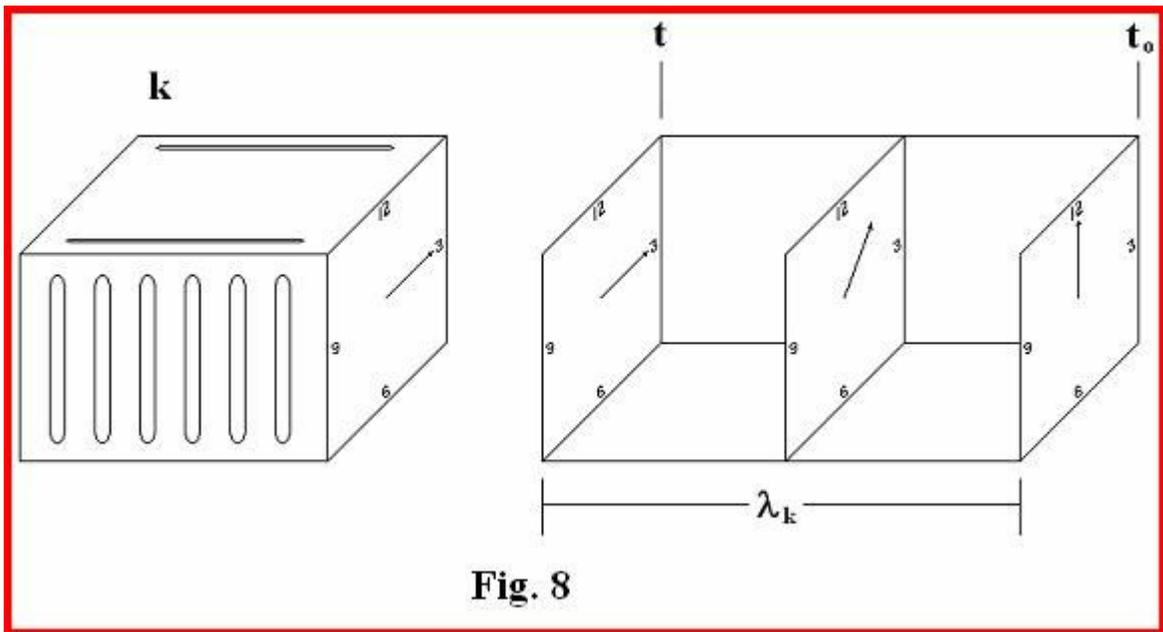


Fig. 8

$$\lambda_k = c(t-t_0), \Delta t = t-t_0$$

$$\lambda_k = c\Delta t$$

If this system is given a uniform velocity v , this inertial system k' will still start at t_0 , but will stop at some new time t' due to relativistic time dilation.

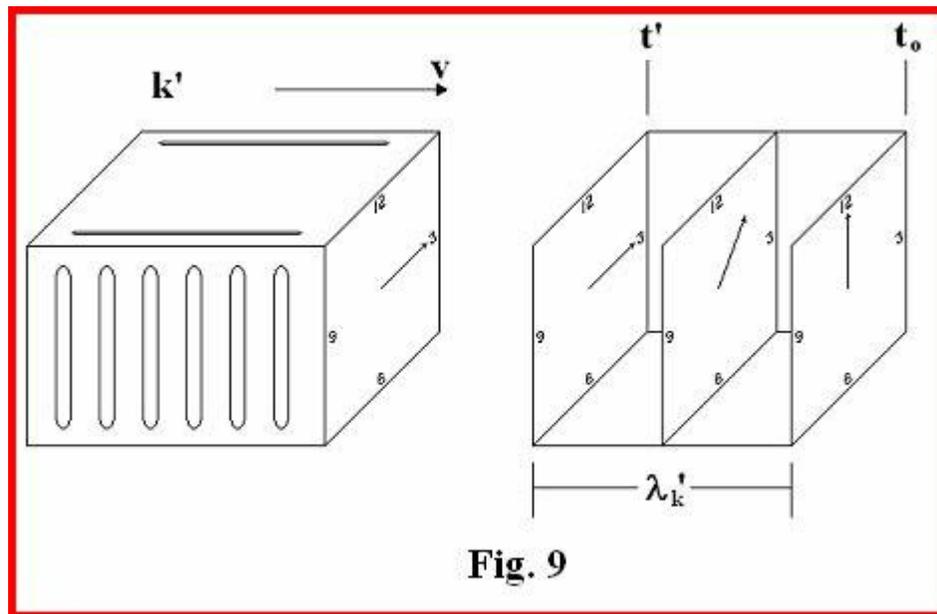


Fig. 9

$$\lambda_{k'} = (c-v)(t'-t_0), \Delta t' = t'-t_0$$

$$\lambda_{k'} = (c-v) \Delta t', \Delta t' = \Delta t\gamma$$

$$\lambda_{k'} = \lambda_k(1-v/c)\gamma$$

For a receding velocity:

$$\lambda_{k'} = \lambda_k(1+v/c)\gamma$$

For the transverse event column:

$$\lambda_{k'} = \lambda_k \gamma$$

This is nothing more than the Doppler Effect. This analogy illustrates the spacial mechanism for the Doppler Effect, for the wavelength of light will change according to this equation.

For light:

$$7.A \quad \lambda' = \lambda \gamma [(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$$

$$7.B \quad \nu' = \nu \gamma [(1 - \beta^2 \sin^2 \theta)^{1/2} + \beta \cos \theta]$$

$$7.C \quad E' = h\nu' = E \gamma [(1 - \beta^2 \sin^2 \theta)^{1/2} + \beta \cos \theta],$$

λ - Wavelength of light.

ν - Frequency of light.

E- Energy of light.

which produces equations for the (x,y) axes as given by Dr. Einstein.

Optically, k will observe the $\Delta t'$ of the parallel event column as:

$$\Delta t' = \lambda_{k'} / c, \text{ for it is traveling at } c \text{ relative to } k$$

$$\Delta t' = \Delta t (1 - v/c) \gamma,$$

but the column is traveling at $c-v$ relative to k' which gives the proper $\Delta t'$ relative to k' as:

$$\Delta t' = \Delta t \gamma$$

It is important to note here that the length in the system k' is:

$$\lambda_{k'} = \lambda_k \gamma$$

This is due to the fact that the event column gets shortened by the factor $(1-v/c)$ due to emission in k' , but gets elongated by the factor $(1+v/c)$ due to absorption in k' leaving the only remaining factor γ .

&The factors that cause a change in the event column length is the finite velocity of light in combination with the geometric properties of the spacial medium with respect to the inertial frame k' . A Doppler effect must be associated with the fundamental fields of material objects. But, transmissions of electromagnetic phenomenon are affected by the Doppler Effect. The property of physics which would allow a Doppler effect to be associated with matter is the wave property of material objects as given by Louis DeBroglie, which is known as the DeBroglie wave.

At rest, a field expansion occurs at time Δt :

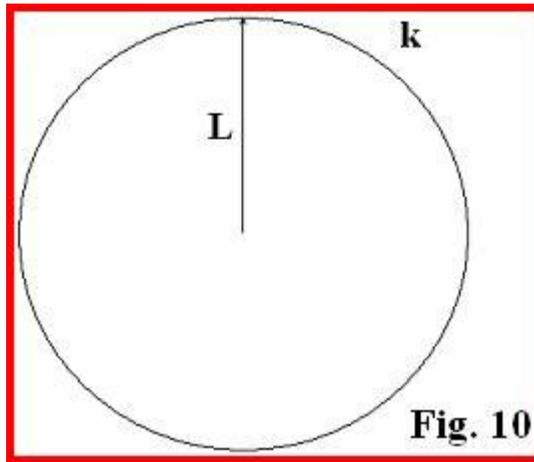


Fig. 10

where the circle is the propagation of the field at every point around the center. At rest, the radius of the circle will be constant throughout θ .

At a velocity v , an expansion in Δt gives:

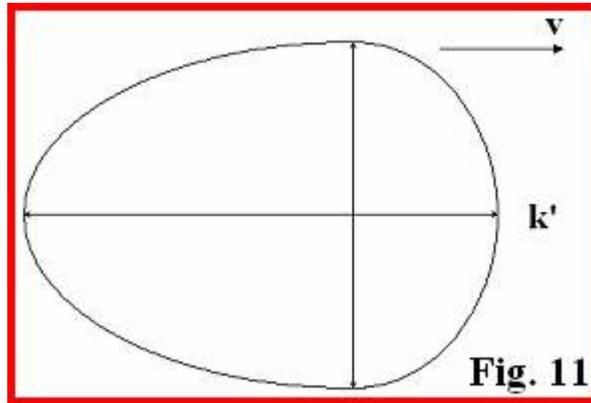


Fig. 11

Where, due to the finite velocity of light, the radii become:

Transverse $L' = L/\gamma$

Parallel $L' = L(1-v/c)$

Opposite $L' = L(1+v/c)$

The transverse expansion must extend to the original transverse length in order for the principle of relativity for the measuring inertial frame to be satisfied. This means that the expansion must be based on a change in time $\Delta t\gamma$, where the radii become:

Transverse $L' = L$

Parallel $L' = L(1-v/c)\gamma$

Opposite $L' = L(1+v/c)\gamma$

The quantity γ must be the relativistic field dilation for the fundamental fields of material bodies. All fundamental fields must dilate according to this quantity in order to satisfy the principle of relativity for the measuring inertial frame.

For a radius r of a unit force $F(r)$ at rest, the unit force in motion becomes:

$F(r') = F(r\gamma)$

Thus, fundamental fields increase in strength by a factor of γ due to the mass increase associated with objects in motion.

Clearly, the finite velocity of light in combination with the geometrical properties of space is the cause of this length change. The equation for the new length parallel to the velocity vector can be broken into the quantities:

$$L' = L\gamma(1-\beta^2\sin^2 \theta)^{1/2} - L\gamma\beta\cos\theta$$

Suppose the following simultaneous emission of two photons occur parallel and perpendicular to the velocity vector of this system in motion:

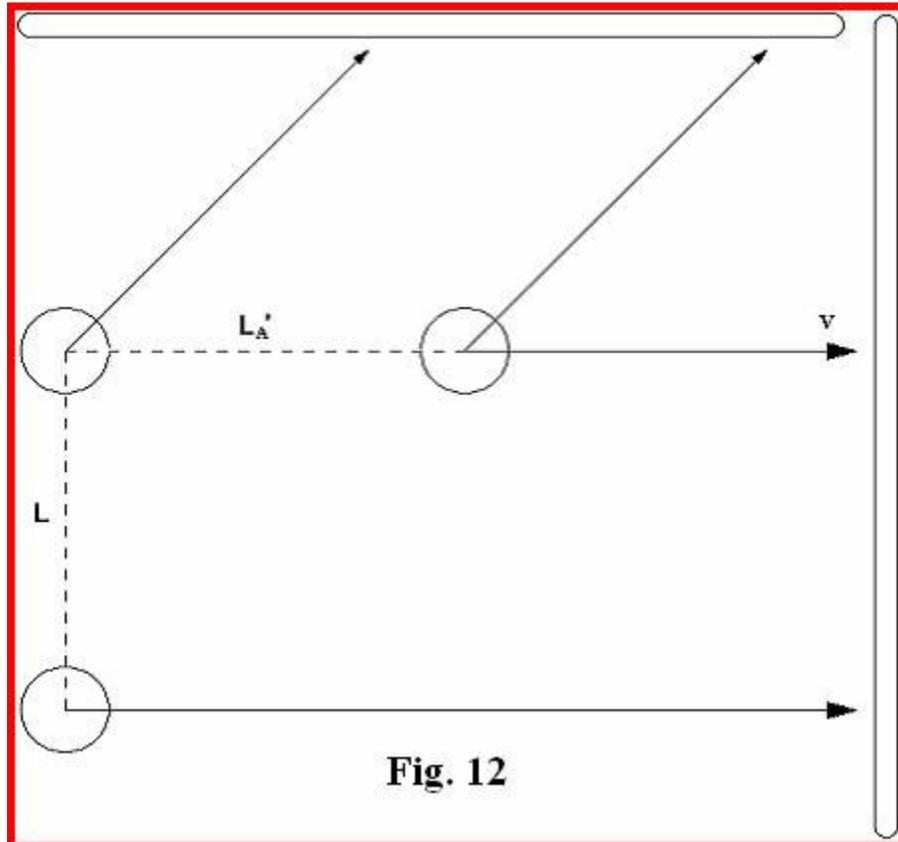


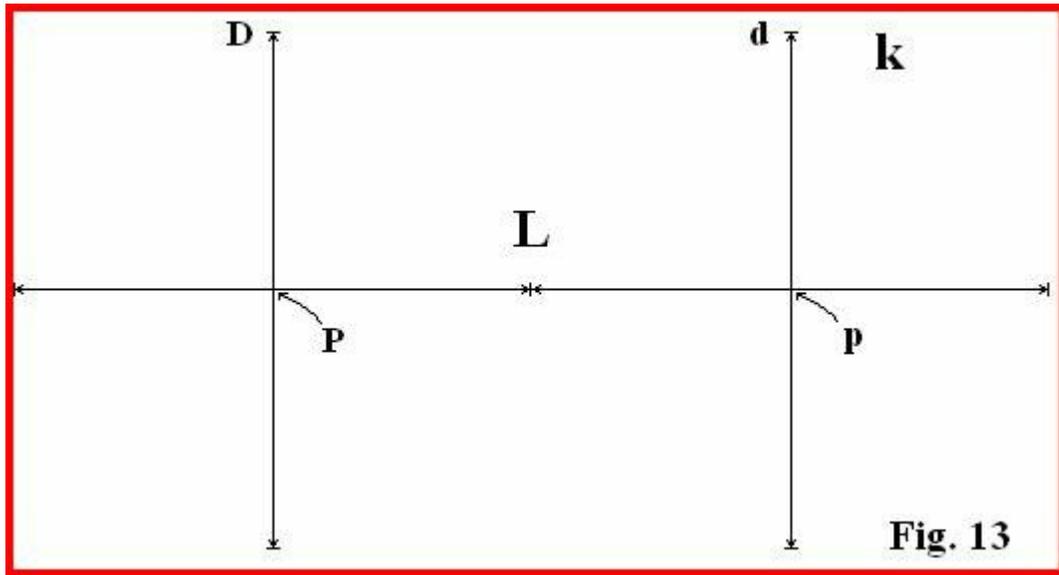
Fig. 12

It becomes apparent that the length between the photons emitted perpendicular and parallel must not involve any Doppler Effect term ($L\gamma\beta\cos\theta$), for they would be affected by identical factors. Thus, the length between the perpendicular emitted photons must be equal to the relativistic field dilation. This is the absolute length (L_A'). This leads to the equation:

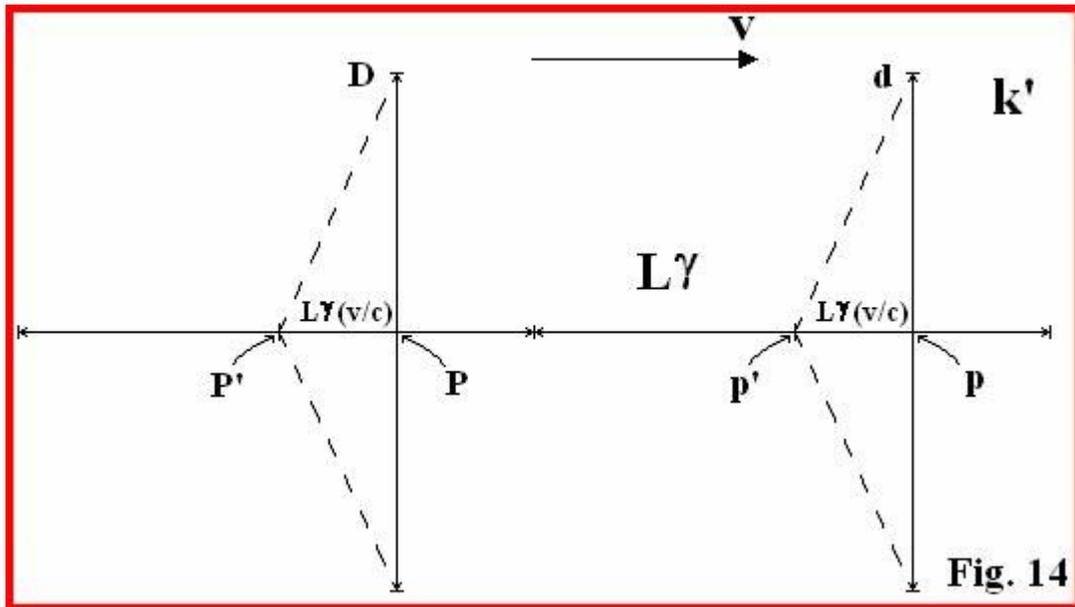
$$7.D \quad L_A' = L\gamma(1-\beta^2\sin^2 \theta)^{1/2}$$

This is the absolute interval between objects in motion as measured by the system k . The quantity γ is seen as the relativistic field dilation factor. The quantity $L\gamma$ is the relativistic field dilation. The quantity $L\gamma\beta\cos\theta$ is the DeBroglie-Doppler offset.

The Doppler-DeBroglie offset is illustrated in the following diagram:



Two point source masses D and d are separated by the distance L at rest. The point of origin for their perspective fundamental fields of force is designated as P and p.



In motion, the DeBroglie-Doppler offset induces a shift in the geometric origins, due to field distortion, creating the apparent origins P' and p'. Figure 4 shows how the absolute point of origin can remain constant while the fields' geometrical equivalent point of origin varies. This is the difference between the absolute and relative point of origin, where the absolute points of origin are P, p and the relative points of origin are P', p'.

$$7.E \quad P_R = P_A - L\gamma\beta\cos\theta$$

P_R - Relative point of origin for the fundamental fields of force.

P_A - Absolute point of origin for the fundamental fields of force.

It becomes clear that events shared between these two masses occur between the points P-p' and P'-p. Radiation emitted from D will be emitted from the absolute point of origin P, but will be absorbed through the distorted fields' geometrical equivalent point of origin p'. Radiation emitted from d will be emitted from the absolute point of origin p, but will be absorbed through the distorted fields' geometrical equivalent point of origin P'. The transverse interaction is not affected by this DeBroglie-Doppler effect because the point of origin on the transverse axis is not affected by motion. The geometrical properties of an object in motion become:

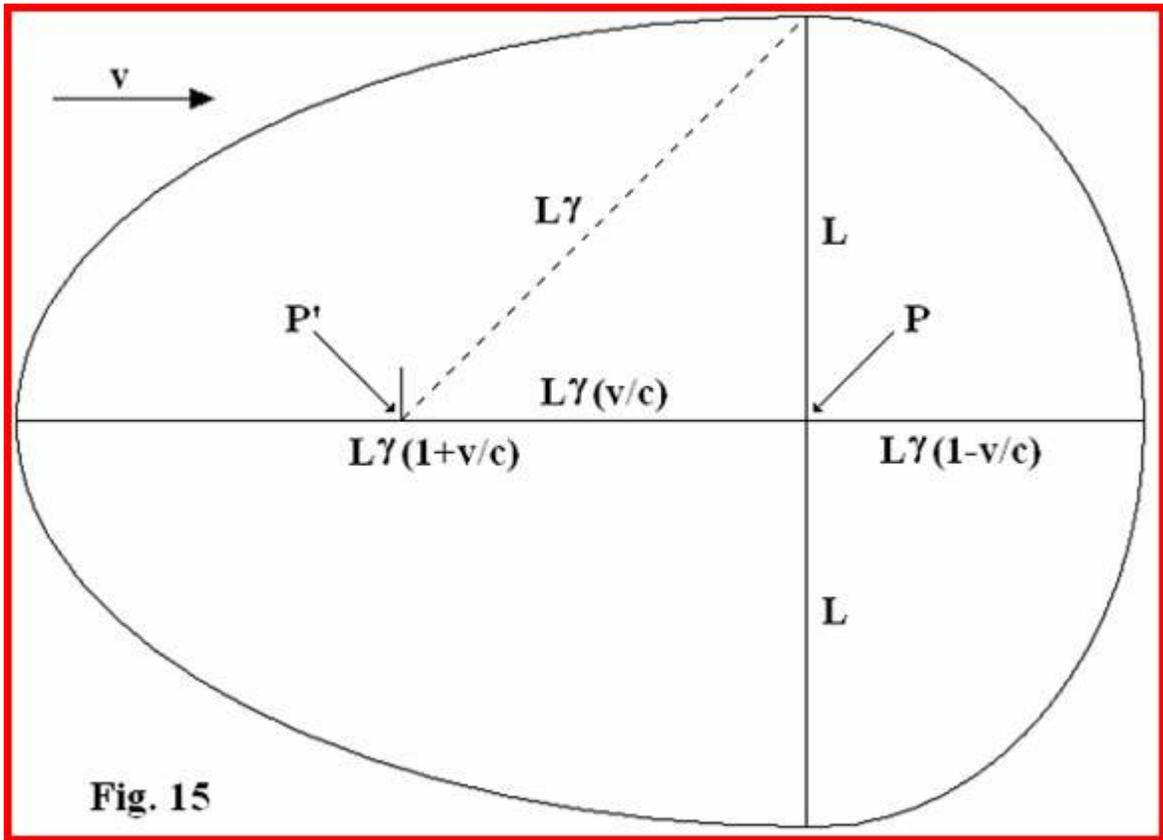


Fig. 15

P- Absolute point of mass origin.

P'- Relative point of mass origin.

L- Radius of unit of force $F(r)$ at rest.

$L\gamma$ - Geometrical transverse length at velocity v .

$L\gamma(v/c)$ - DeBroglie-Doppler offset.

$L\gamma(1-v/c)$ - Radius of unit of force $F(r')$ parallel to the velocity vector.

$L\gamma(1+v/c)$ - Radius of unit of force $F(r')$ opposite to the velocity vector.

TRANSFORMATIONS BETWEEN COORDINATES SYSTEMS

WITH A UNIFORM VELOCITY BETWEEN THEM

- $t' = t\gamma$, for all θ
- $L' = L\gamma[(1-\beta^2\sin^2\theta)^{1/2}-\beta\cos\theta]$
- $L_A' = L\gamma(1-\beta^2\sin^2\theta)^{1/2}$
- $L_D' = L\gamma\beta\cos\theta$

$$\triangleright \quad P_R = P_A - L\gamma\beta\cos\theta$$

$$\square \quad x_k^2 = L'^2 + v^2 t'^2 + 2L'vt' \cos \theta$$

$$\square \quad u_k^2 = u_{k'}^2 + v^2 + 2u_{k'}v \cos \theta$$

$$\square \quad u_{k'} = u[(1 - \beta^2 \sin^2 \theta)^{1/2} - \beta \cos \theta]$$

$$\beta = v/c$$

$$\gamma = (1 - \beta^2)^{-1/2}$$

θ - The angle of the path vector taken at rest with respect to the velocity vector.

L' - The relative spacial interval between masses in motion.

L_A' - The absolute spacial interval between masses in motion.

L_D' - The DeBroglie-Doppler offset.

P_R - Relative point of origin for the fundamental fields of force.

P_A - Absolute point of origin for the fundamental fields of force.

u - Velocity of the object as measured by observers in k' .

k - Reference frame considered to be at rest.

k' - Inertial frame at velocity v relative to k .

\triangleright - Fundamental transformations (independent)

\square - General transformations (material bodies)