SECTION 7

Relativistic Effects on the Flow Waveform

THE PROBLEM

As found in Section 6, a *Spherical-Center-of-Oscillation* naturally sends a *Propagated Outward Flow* of *Medium* uniformly radially outward in all directions from itself at velocity c, the speed of light. As presented on page 51 at "The Speed of the Flow – The Speed of Light" the speed of that flow is set by the μ_0 and ε_0 of the flowing *Medium* to the exact value of c by virtue of their controlling the cyclical alternating exchange of the oscillation between the two forms in which it exists.

When the center is not in motion that presents no problem, but with the *Spherical-Center-of-Oscillation* moving in some direction the center's motion and its propagation are in conflict. In the direction of motion the velocity of the center, v, tends to add to the natural value of the speed, c, of propagation of the *Propagated Outward Flow* and in the opposite direction it tends to subtract. But, the speed of the flow is fixed; set at c by μ_0 and ε_0.

That conflict forces an adjustment of the oscillation of the *Spherical-Center-of-Oscillation* to modify the propagation speed of its *Propagated Outward Flow.*

THE SPHERICAL-CENTER-OF-OSCILLATION AT CONSTANT VELOCITY

The treatment is of the *Spherical-Center-of-Oscillation* at constant velocity because that is the most direct and simple case of motion, and at constant velocity one cannot detect absolute motion. That is, one can say that there is a relative difference of velocity between two systems at constant velocity in one of which the observer is located, but the observer cannot say which system is moving and which, if any, is at rest.

To describe the behavior of the center its propagation will be modeled resolved into three components: forward, rearward, and sideward relative to the direction of the center's velocity, as depicted in Figure 7-1. [In the figure the "up", "down", "left" and "right" are all "sideward".] These orthogonal components represent the propagated wave in all directions. The wave in any particular direction is the "resultant" of that directions' projection on the forward or rearward component (whichever is at a nearer angle) and on the sideward component. (The "resultant" is the hypotenuse of the right triangle having the projection components as its other two sides.)

Where λ_r and f_r are the wave length and frequency of the *Propagated Outward Flow* when its center is at rest [absolute "rest" relative to its propagation] then propagation of waves is the same in all directions at speed $c = \lambda_r \cdot f_r$.

A Center-of-Oscillation at Rest

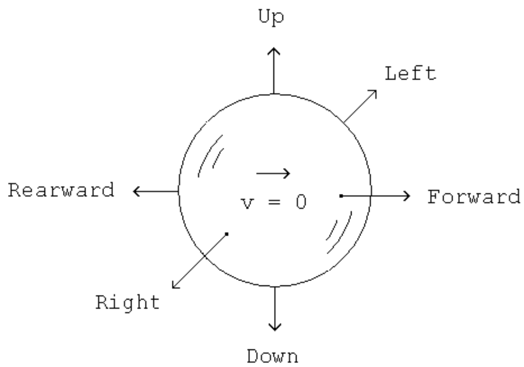

Figure 7-1

As described earlier the speed of flow of centers' propagation is fixed at c by the μ_0 and ε_0 of the flowing *Medium*. The center moving at velocity v would find (in the forward direction) its freshly emitted propagation "thrown" forward at speed $[c + v]$ interfering with the flow just ahead of it at speed c and conflicting with the μ_0 and ε_0 of the *Medium*. It finds the propagated wave not moving out of the way at the needed $[c + v]$ in time for the next cycle as set by the at-rest frequency of the center. The result is an imperative to reduce the center frequency ["delay" the next cycle] by the factor $[1 - v/c]$. That "interfering" and "conflicting" tends to force on the center a change in its oscillation, a reduction by the factor $[1 - v/c]$. That is, with the center moving forward at v,

(7-1) Propagated Speed would become $c \cdot [1 - v/c] = (c - v)$

Flow speed = propagated speed + v = $(c - v) + v = c$

In the rearward direction the opposite is the case, an imperative to increase the center frequency by the factor $[1 + v/c]$. But, the *Spherical-Center-of-Oscillation* can only oscillate at one specific frequency at a time. It cannot both increase and decrease its oscillation frequency at the same time. It responds by adopting a compromise change in frequency, the geometric mean of the two conflicting factors as in equation *7-1*.

With subscript v meaning "at velocity v" the center's oscillation frequency decreases and its oscillation wavelength correspondingly increases, the product still being c.

(7-2)

$$f_v = f_r \cdot \left[1 - \frac{v^2}{c^2}\right]^{1/2}$$ [Center frequency decreases]

$$\lambda_v = \lambda_r \cdot \frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{1/2}}$$ [Center wavelength increases]

$$\lambda_v \cdot f_v = \lambda_r \cdot f_r = c$$ [Wave velocity still at c]

While the center can oscillate at only one frequency, it can propagate at different wavelengths in different directions. To maintain propagated wave velocity at c in the direction of center motion the wave must be actually propagated forward by the center at $c-v$ relative to the center itself so that the wave velocity relative to at rest is the propagated velocity, c, plus the center velocity, v, that is $(c-v)+v = c$.

To propagate forward at $[c - v]$ while maintaining the frequency at f_V requires that the wavelength change to a smaller value, λ_{fwd}. Likewise, rearward the wave must be actually propagated by the center at $[c + v]$ relative to the center with a greater wavelength, λ_{rwd}. Those adjusted propagation wavelengths are as follows.

(7-3)

$$\lambda_{fwd} = \frac{c-v}{f_v} = \frac{c\cdot\left[1-\frac{v}{c}\right]}{f_r\cdot\left[1-\frac{v^2}{c^2}\right]^{\frac{1}{2}}} = \lambda_r\cdot\frac{\left[1-\frac{v}{c}\right]^{\frac{1}{2}}}{\left[1+\frac{v}{c}\right]^{\frac{1}{2}}} = \lambda_r\cdot\left[\frac{c-v}{c+v}\right]^{\frac{1}{2}}$$

$$f_{fwd} = \frac{c}{\lambda_{fwd}} = f_r\cdot\left[\frac{c+v}{c-v}\right]^{\frac{1}{2}}$$

$$\lambda_{rwd} = \lambda_r\cdot\left[\frac{c+v}{c-v}\right]^{\frac{1}{2}}$$

$$f_{rwd} = f_r\cdot\left[\frac{c-v}{c+v}\right]^{\frac{1}{2}}$$

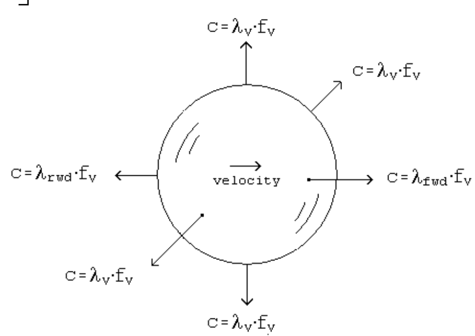

Figure 7-2, The Wave as Propagated by the Center at Velocity v (relative to the center)

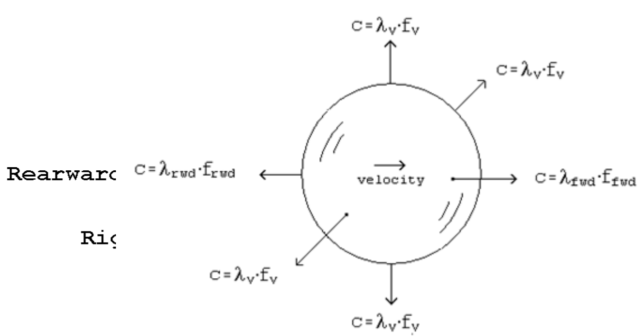

Figure 7-3, The Above Propagation (as Observed from At-Rest)

As the center "sees" it, per the above Figure 7-2, it is oscillating at f_v, with the forward and rearward wavelengths adjusted for the velocity so that the wave travels in each direction at speed c. As "at-rest" would "see" it, per Figure 7-3, above, the center appears to propagate different forward and rearward frequencies, f_{fwd} and f_{rwd}.

Thus the field of propagated waves is traveling at c in all directions as observed by the center that is in motion and doing the propagating and as observed from at-rest.

The Effect of Velocity on Mass

With the oscillation frequency corresponding to the rest mass of the particle it represents the development so far of decreasing oscillation frequency. Equation *7-2*, demonstrates a decrease in rest mass due to the *Spherical-Center-of-Oscillation's* velocity. That is more properly referred to as a decrease in that part of the mass effect due to the overall frequency of oscillation of the center, to be referred to as "mass in rest form", m_r'.

(7-4)
$$m'_r = m_r \cdot \frac{f_v}{f_r} = m_r \cdot \left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}$$

Newton's Second Law and it as restated by inversion are:

Force = Mass · Acceleration

Acceleration Resulting = Force Applied × $^1/_{Mass}$

which translates in terms of the waves of *Propagated Outward Flow*s and *Spherical-Centers-of-Oscillation*s into

$$\begin{bmatrix}\text{Acceleration}\\ \text{Resulting}\end{bmatrix} = \begin{bmatrix}\text{Wave}\\ \text{Impulse}\end{bmatrix} \cdot \begin{bmatrix}\text{Responsiveness}\\ \text{of the Center}\end{bmatrix}$$

or, more succinctly,

Acceleration = Wave × Responsiveness.

Of the total wave traveling outward from a source *Spherical-Center-of-Oscillation*, the only part that interacts with another *Spherical-Center-of-Oscillation* is the part intercepted by that encountered center. The *Spherical-Center-of-Oscillation* intercepting the larger portion of incoming wave receives the greater impulse, the greater momentum change. Thus center responsiveness depends on the encountered center's cross-section target for interception of *Propagated Outward Flo*w waves and total mass depends inversely on that.

Per equation *7-4* the particle's rest mass decreases, however, overall the total mass increases because the effects so far have reduced the cross-section target for interception of *Propagated Outward Flo*w. From the forward or the rearward point of view the center's cross-section is proportional to the area of the circle of radius λ_v, the sideward direction per equation *7-2*, repeated below.

(7-2)
$$\lambda_v = \lambda_r \cdot \frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}}$$

That means that relative to the center's rest mass, m_r, the overall mass at velocity, m_V, is

(7-5)

$$m_v = m'_r \cdot \left[\frac{\lambda_v}{\lambda_r}\right]^2 = m_r \cdot \left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}} \cdot \left[\frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}}\right]^2$$

$$= m_r \cdot \frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}}$$

From the sideward point of view the cross-section is no longer a circle, however. In the forward direction the at-rest circle's radius has become λ_{fwd} instead of λ_v and in the rearward direction λ_{rwd} instead of λ_V.

(7-6)

$$\lambda_{fwd} = \frac{c - v}{f_v} = \frac{c \cdot \left[1 - \frac{v}{c}\right]}{f_v} = \frac{\left[1 - \frac{v}{c}\right]}{\lambda_v} \qquad \text{therefore} \qquad \frac{\lambda_{fwd}}{\lambda_v} = \left[1 - \frac{v}{c}\right]$$

(7-7)

$$\lambda_{rwd} = \frac{c + v}{f_v} = \frac{c \cdot \left[1 + \frac{v}{c}\right]}{f_v} = \frac{\left[1 + \frac{v}{c}\right]}{\lambda_v} \qquad \text{therefore} \qquad \frac{\lambda_{rwd}}{\lambda_v} = \left[1 + \frac{v}{c}\right]$$

The product of the change factors, equations 7-6 and 7-7, is $[1 - v^2/c^2]$, a reduction of cross-section, the same amount of increase in mass as equation 7-5. Thus in all directions the effect of velocity is an increase in mass per equation 7-5.

THE CENTER OF OSCILLATION "AT REST" AND "IN MOTION"

In motion at a constant velocity, v, the *Spherical-Center-of-Oscillation* experiences the asymmetrical distortions of equation 7-3 and figures 7-2 and 7-3. The distortions indicate the motion and the motion enhanced energy of the center. At rest, in the absence of motion the center is spherically symmetrical.

Thus the rest mass and rest energy correspond to the spherically symmetrical portion of the center's oscillation [the only portion if v = 0] and they are "mass in rest form" and "energy in rest form". The overall distorted portion corresponds to the total "mass in kinetic form" and "energy in kinetic form" of the center.

Those distortions of the Propagated Outward Flow mean that that flow conveys information about the location, motion direction, velocity, mass and energy of its source *Spherical-Center-of-Oscillation*. Inasmuch as that flow is radially outward from every matter particle it constitutes a speed of light comprehensive communication among all of the particles of the universe

THE LORENTZ CONTRACTIONS, LENGTH AND TIME

Logic requires of the overall universe that in all frames of reference at constant velocities relative to each other [*i.e.* inertial frames]:

- The equations describing the laws of physics have the same form, and
- The universal constants appearing in those equations be the same,

This is called the Principle of Invariance, and means that the speed of light, c, a universal constant, is the same in all inertial frames, which appears to conflict with our instinctive assumption that the speed of light should vary with the speed of the light's source.

That logic combined with experiments showing that the speed of light actually is of the same value independent of whatever inertial frame, required the development of the Lorentz Transformations to account for the constancy of the speed of light. The transformations are coordinate transformations between two inertial frames. The Lorentz contractions are the related change in the fundamental quantities: mass, length, and time.

This brings up the point that, contrary to Einstein, there is an absolute frame of reference, an "at rest" frame. Einstein contended that there was not because he thought that an absolute frame could have different physical laws and constants. But, rather the opposite is the case. The absolute prime frame of reference is why the Principle of Invariance is valid. That is why it is required of the overall universe that in all frames of reference at constant velocity relative to each other [*i.e.* inertial frames]:

- The equations describing the laws of physics have the same form, and
- The universal constants appearing in those equations are the same,

The speed of light, c, a universal constant is the same everywhere.

They are all part of the same one overall absolute frame of reference, the rest frame. The rest frame is not special in that its laws and constants are not different. It is special in that all other frames are relative to it. It is simply the actual frame of the "Big Bang"

When the *Spherical-Center-of-Oscillation*'s oscillation is perfectly spherically symmetric then the center's velocity is zero and it is completely at rest. That is the universe's absolute frame to which all motion and all other frames are relative.

The Lorentz Contractions

The Lorentz Contractions are as follows.

(7-8)

$$L = L_r \cdot \left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}$$ [Observed Length in the Direction of motion shortens.]

$$f = f_r \cdot \left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}$$ [Observed frequency slows.]

$$t = t_r \cdot \frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}}$$ [Observed time periods length, Time passes more slowly.]

$$m = m_r \cdot \frac{1}{\left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}}$$ [Observed mass increases.]

Time and frequency are reciprocals of each other and the above equation 7-2 decrease in center frequency with velocity validates the f and t Lorentz Transforms. [The increasing λ_r to λ_v of that equation is compensating for the frequency decrease to keep the sideward propagation speed at c. Sideward is not the direction of v so the Lorentz Contraction does not apply to that λ.]

The equation 7-5 overall increase in center mass with velocity validates the mass, m, Lorentz Transform. Remaining to be validated is the length, L contraction. The λ_{fwd} and λ_{rwd} contraction equations 7-6 and 7-7 are a *Spherical-Center-of-Oscillation* length contraction in the velocity direction, a Lorentz Contraction.

However on the macroscopic scale it is necessary to investigate two centers and the distance between them in order to develop a velocity-caused contraction of length in matter. In bulk matter composed of multiple particles, atoms and their components, the spacing of the atoms depends on the balance of the various electrostatic forces acting as a result of the centers-of-oscillation, protons and electrons, of which the matter atoms are composed.

Considering just two *Spherical-Centers-of-Oscillation* at rest in a fixed position relative to each other, the effect of their moving jointly at velocity v in the direction of the line joining them should be a Lorentz Contraction to closer spacing of the two centers by the Lorentz Contraction factor.

The position of each of the two centers is the balance of all of the forces acting on the centers, an equilibrium position. If the velocity is to change the distance between the two centers then the force acting between the two centers must change so that a new closer equilibrium spacing exists and determines the new distance between the two centers. For the centers to need to be closer in order to re-establish equilibrium the effective charge of each of the centers must be decreased by the velocity.

In other words, for the Coulomb force between the two centers

(7-9)
$$F = \frac{Q_1 \cdot Q_2}{4\pi \cdot R^2}$$

to be unchanged even though R is reduced by the Lorentz Contraction by the factor

(7-10)
$$\frac{R_{vel}}{R_{rst}} = \left[1 - \frac{v^2}{c^2}\right]^{\frac{1}{2}}$$

so that R^2 is changed by the factor

$$\frac{R^2{}_{vel}}{R^2{}_{rst}} = \left[1 - \frac{v^2}{c^2}\right]$$

then $Q_1 \cdot Q_2$ must be so reduced by the same factor as is R^2.

But, that is exactly the case. It has already been shown by equation 7-3 that the forward wave propagation speed is reduced by the factor $[1-{}^{v}/c]$ to $c' = c-v$ and that the rearward wave propagation speed is analogously changed by the factor $[1+{}^{v}/c]$ to c’’ = c+v.

The charge Q corresponds to the impulse that the wave can deliver which depends directly on the above propagation speeds. The Q of the trailing center "looking" forward is reduced by the reduction of its c to $c' = c - v$, a factor of $[1-{}^{V}/c]$.

Similarly the charge, Q, of the leading center "looking" backward is increased by the increase of its c to $c'' = c + v$, a factor of $[1+{}^{V}/c]$.

Therefore, the equation 7-9 $Q_1 \cdot Q_2$ is reduced by the product of the two factors which is $[1 - v^2/c^2]$, which matches the Lorentz Contraction of R^2 and therefore of R and validates the length, L, Lorentz Contraction.

COMMENT

In this Section 7 we have, on page 55, development from fundamentals of the mechanism of the *Propagated Outward Flow* and the speed of light.

We have, on pages 61-62 development from fundamentals of the mechanism of the Lorentz Contractions.

In the pages 55-59 we have development from fundamentals of the reasons, the mechanism, that it is impossible for matter to have a velocity equal to or greater than the speed of light.

These developments make the point that every physics phenomenon, every material event, has a physics, a material, mechanism which causes and controls it. A phenomenon cannot be considered understood until its mechanism has come to be understood.

Further the validity of any contended phenomenon or behavior for which there is no developed mechanism is in question.

These observations apply specifically to the various "quantum" behaviors contended by Quantum Mechanics. For those the terminology "Mechanics" does not refer to mechanisms but only to contended phenomena.

For more information on the *Propagated Outward Flow*, specifically how it causes Coulomb's Law [electrostatic effects], Ampere's Law [magnetic effects] and Newton's Laws [gravitation and motion] see the References page ix.