GALILEAN ELECTRODYNAMICS

Experience, Reason, and Simplicity Above Authority
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EDITORIAL POLICY

Galilean Electrodynamics aims to publish high-quality scientific papers that discuss challenges to accepted orthodoxy in physics, especially in the realm of relativity theory, both special and general. In particular, the journal seeks papers arguing that Einstein's theories are unnecessarily complicated, have been confirmed only in a narrow sector of physics, lead to logical contradictions, and are unable to derive results that must be postulated, though they are derivable by classical methods.

The journal also publishes papers in areas of potential application for better relativistic underpinnings, from quantum mechanics to cosmology. We are interested, for example, in challenges to the accepted Copenhagen interpretation for the predictions of quantum mechanics, and to the accepted Big-Bang theory for the origin of the Universe.

On occasion, the journal will publish papers on other less relativity-related topics. But all papers are expected to be in the realms of physics, engineering or mathematics. Non-mathematical, philosophical papers will generally not be accepted unless they are fairly short or have something new and outstandingly interesting to say.

The journal seeks to publish any and all new and rational physical theories consistent with experimental fact. Where there is more than one new theory that meets the criteria of consistency with experiment, faultless logic and greater simplicity than orthodoxy offers, none will be favored over the others, except where Ockham's razor yields an overwhelming verdict.

Though the main purpose of the journal is to publish papers contesting orthodoxy in physics, it will also publish papers responding in defense of orthodoxy. We invite such responses because our ultimate purpose here is to find the truth. We ask only that such responses offer something more substantive than simple citation of doctrine.

The journal most values papers that cite experimental evidence, develop rational analyses, and achieve clear and simple presentation. Papers reporting experimental results are preferred over purely theoretical papers of equally high standard. No paper seen to contradict experiment will be accepted. But papers challenging the current interpretation for observed facts will be taken very seriously.

Short papers are preferred over long papers of comparable quality. Shortness often correlates with clarity; papers easily understandable to keen college seniors and graduate students are given emphatic preference over esoteric analyses accessible to only a limited number of specialists. For many reasons, short papers may pass review and be published much faster than long ones.

The journal also publishes correspondence, news notes, and book reviews challenging physics orthodoxy. Readers are encouraged to submit interesting and vivid items in any of these categories.

All manuscripts submitted receive review by qualified physicists, astronomers, engineers, or mathematicians. The Editorial Board does not take account of any reviewer recommendation that is negative solely because manuscript contradicts accepted opinion and interpretation.

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GED thanks Mr. D.S. Robertson for much meticulous proofreading.

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From the Editor's File of Important Letters:

Accelerating Clocks Run Both Faster and Slower

Background

Einstein's relativity contends that time, as measured by clocks, slows with increasing speed, becoming especially noticeable as the speed of light is approached. Discussions of this usually focus on constant speeds, albeit near the speed of light, and phenomena such as muon decay (near light speed), or even the Hafele-Keating experiment (at much slower speeds), are cited as 'proof.' Dissident scientists often contend that time remains invariant, although clocks may appear to run slower at increasing speeds. At least one such scientist contends that accelerated clocks can run both slower and faster, an interesting departure that I decided to examine via some examples. To the extent that my examples are correct, I too would agree with this conjecture, namely that, while time remains invariant, clocks can run faster and slower when accelerated (but not at constant velocity).

While perusing Don E. Sprague's website on "Complex Relativity" (http://complexrelativity.com), I read the following discussion:

"Clocks lose time but also gain time. The Hafele and Keating experiment has atomic clocks going around the world showing less time in one direction but time gain in the other direction. We know that Einstein predicts that time slows with movement and eventually time is varied to a singularity where time end which is an impossibility. Since Einstein predicts that time slows, the Hafele and Keating experiment refutes Einstein. The clocks in the Hafele and Keating experiment show both a time loss and a time gain. According to Einstein, they just have time loss. Thus, the time gain portion goes against Einstein. However; the clock gain and loss is accurately predicted using CM [Classical Mechanics] and ChR [Classical hierarchy Relativity] with relative c. That is because ChR specifies that acceleration of a clock will result in a clock change in reading or clock error. Any examination of the Hafele-Keating experiment must consider the total acceleration of the clocks as they relate to the known universe. Consider an atomic clock experiment with the clock moved up a foot and down a foot resulting in a clock reading variation or error. This acceleration of the clock caused a loss of synchronization in the clock as predicted in ChR. The combination of the Hafele and Keating and the atomic clock one foot elevation experiments are confirmation that Maxwell/Einstein constant c relativity is wrong. It is proof that ChR with relative c is correct.

"The combination of the Hafele and Keating experiment and the atomic clock 1 foot acceleration could loosely be considered to be the ChR equivalent of the Eddington observation about Einstein's relativity where he interpreted a gravitational lens bending light as confirmation that the time changed. In the case of the accelerating clocks, there isn't any way to interpret the clock gain as conformation of Einstein that predicts just time loss. There can only be clock error with accelerated clocks as specified in ChR. It isn't a matter of if Einstein is wrong while CM and ChR with constant space and constant progression of time and relative speed of light is correct in a hierarchy of frame relativity. It is just a question of when and how the physics world will acknowledge the truth I have shown."

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Defending Einstein's Mathematics

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Some of Einstein's critics point to mathematical errors in Einstein's original 1905 paper and in his book **Relativity** to discredit his derivation of the Lorentz transformations, and hence invalidate his theory. This paper will analyze his derivations and show that he made absolutely no mathematical mistakes in either his 1905 paper or his book. The so-called errors are entirely due to the critics' not understanding the physical situation the equations are intended to describe. There is absolutely no validity to the claim that he made mathematical errors that undermine his results.

Introduction

This paper reviews two of Einstein's derivations of the Lorentz transformations that are the object of much criticism and even ridicule for so-called mathematical errors. The first derivation is in original 1905 paper [1] and the second is a simplified derivation in the appendix of his book **Relativity** [2]. He has also been accused of making mathematical errors in his 1912 manuscript on relativity, but they are the same errors as in {1, 2}, so it will not be addressed separately.

The analysis of his 1905 paper is based on the original German-language version (since there is no authorized translation that I could find). I wanted to avoid any possibility of analyzing an error that may have been introduced by a translator. When I provide my own translations,[1] I will also provide the original German in the footnotes along with the page number in the original paper.

The underlying reason that critics disparage Einstein for these derivations can be summed up by this erroneous assertion from one of his critics:

"The advantage of a mathematical approach is that it is objectively measurable. Mathematical conclusions are not based on what terms mean; they are based on the adherence to certain mathematical rules. Either the rules are followed or they are not." [3]

This seems like a reasonable assertion, but it is wrong. When dealing with the real world one must not let the mathematics alone dictate the derivation. Mathematical conclusions in physics are absolutely based on what terms mean. Richard Feynman said it best: "If there is something very slightly wrong in our [mathematical] definition of the theories, then the full mathematical rigor may convert these errors into ridiculous conclusions." [4]

By focusing exclusively on the mathematics, his critics completely miss the fact that the 'errors' they have discovered are really their own errors in misapplying the equations to the physical situation at hand. They then use the "full mathematical rigor to convert these errors into ridiculous conclusions."

[1] Lest the reader worry that the author is relying on Google translations, be assured that he is fluent in German.

2. Preliminaries

In his 1905 paper, Einstein's derivation of the Lorentz Transforms started in his Sect. 3, which is titled "Theory of Coordinate and Time Transformations from a stationary system to a system with uniform translational motion relative to the former."[2] In this Section, he defined the two coordinate systems referred to in the title of the Section. He called the stationary system K, and the moving system k. Each axis of each system is parallel to its respective axis in the other system. The coordinate system for K has the space and time coordinates of x, y, z, and t. The coordinate system for k has the coordinates of ξ, η, ζ for space and τ for time. To the moving system k is imparted a velocity $\mathbf{v}$ in the positive (increasing) x direction while the ξ and x axes are coincident and the other two axes remain parallel to their respective axis in the other system. He defined the clocks in these two systems to have been synchronized according to his description in his Section 1. I will give a brief summary of how clock synchronization is done, since his derivation is based on validating the consistency of this definition with the principle of relativity (*i.e.* physics is the same in all uniformly moving frames.)

Distance must be defined by comparison to some arbitrary but specific measuring 'stick' that is declared to be the reference. Similarly, time must be defined by an arbitrary but specific measuring 'tick' from a clock that is declared as the reference. To synchronize a distant clock with a reference clock, Einstein defined the following process:

1) Emit a ray of light from the reference clock at time t_0.

2) It will arrive at the distant clock at an unknown time t_1 and be reflected by a mirror back to the reference clock.

3) It will arrive back at the reference clock at time t_2

This gives two known times and one unknown time. All we know about time is that it must lie between times t_0 and t_2, and that in the limit, if the speed of light were infinite, all three times would be equal. The equation that satisfies these two requirements is:

[2] P. 897: Theorie der Koordinaten- und Ziettransformation von dem ruhenden auf ein relativ zu diesem in gleichförmiger Translationbewegung befindliches System.

$$t_1 = t_0 + \varepsilon(t_2 - t_0) \quad , \quad 0 < \varepsilon < 1 \quad . \tag{1}$$

If the speed of light is the same in both directions, then $\varepsilon = 1/2$. This is the value that Einstein *defined* to be a constant in his theory. The critics of his theory point out that this definition is wrong, and that the ε value should be a function of the velocity of the frame. Although there are other definitions he could have chosen that these critics think would be 'better', their criticism of Einstein is unjustified. Einstein made it very clear in both his original paper and in his book that the constancy of the speed of light was a *stipulation* or a *definition*, not a statement of fact about the physical behavior of light. [5] His mathematician critics should understand what a definition is. It can't be WRONG or RIGHT! It is only useful or not useful. Einstein's definition is very useful because it results in equations that are symmetric and quite easy to manipulate in comparison to other choices for ε.

Unfortunately, modern academia has indoctrinated today's physicists into thinking this is a *postulate* that is provable instead of a *definition*. They think that their experiments confirming the constancy and isotropy of the speed of light have proven this Postulate. But all they have really proven is that when you use clocks synchronized according to Eq. (1) with $\varepsilon = 1/2$, the Lorentz transformations are the correct equations to use to give the right answer. If we pick a different value or function for we will get a different set of equations. With an alternate definition of how to synchronize clocks, those same experiments would 'prove' that you must use the alternate transformation equations to get the right answer. You cannot prove a definition is true! You can only prove whether or not it is consistent with the equations you are using.

The point I am making to Einstein's critics is that if you use his equations and his definitions properly, you get the right answers to real physical problems. Just because overzealous mathematicians and physicists have given the equations a life of their own and created a ridiculous space- time continuum that creates all kinds of paradoxes and contradictions in the real world is no reason to disparage Einstein. It's like blaming the inventor of rope when someone is given enough rope to hang themselves (like the aforementioned zealots.

My own opinion is that Einstein's definition that resulted in the Lorentz equations is the most useful when doing most calculations because the symmetry makes them particularly easy to use. But the price Einstein paid for that symmetry is the relativity of simultaneity. A different definition that preserves absolute simultaneity and allows the speed of light to vary can be more useful in other situations.

To illustrate the confusion caused by relative simultaneity [6], assume that a point source emits a spherical light wave. The constancy of the speed of light means that every observer will see this wave propagating as a spherically symmetric wave in his own frame. But if you 'freeze' the wave front in one frame and transform it into another frame *the points on the sphere will transform into different radii and times*! In every case, the product ct will equal the radius of the sphere at time t, but it is very confusing when the points on a *single* radius in one frame transform to different radii at different times in another frame. The reason is that when simultaneity is relative, different points on the sphere are each different space-time events that will transform into different *times* in the receiving frame, depending on their x position. The wave front only looks like a sphere if all of the points on the wave are sampled at the *same* time in the receiving frame. For these types of situations, a different definition of ε that preserves absolute simultaneity (and admits that light speed isn't really isotropic) might be more useful. For example,

$$\varepsilon = \frac{c + v\cos\theta}{c - v\cos\theta} = \frac{1 + \beta\cos\theta}{1 - \beta\cos\theta} \quad \text{where } \beta = v/c \quad . \tag{2}$$

But you can see that this will result in a more complicated set of transformation equations that are much more unwieldy than just using the constant 1⁄2. That is why Einstein's selection of 1⁄2 is so useful, and is the best choice for most situations as long as you understand exactly what it does, and does not, mean.

By synchronizing clocks using Einstein's choice of 1⁄2, clocks will always measure the speed of light to be isotropic and of constant magnitude c.[3] Given this Definition and the Principle of Relativity, his task was to find a linear transformation of coordinates between relatively moving frames that is consistent with this Definition and the Principle of Relativity.

3. Derivation from Einstein's 1905 Paper

In his 1905 paper, Einstein started by making the following definition: "If we set $x' = x - vt$, it is clear that a stationary point in system k becomes a specific, time- independent system of values x', y', z'."[4] In spite of Einstein having said 'it is clear', this is a very unclear statement that I'm sure is the cause of much confusion. Part of the problem is that there are no diagrams in his paper. I have produced Figure 1 below to illustrate the physical situation he describes with words in his paper.

The first source of confusion is that, in modern physics textbooks, the prime mark is used to indicate the coordinates in the *moving* system. But Einstein was not using it in that way. He used x (as opposed to ξ) to show that this is a value measured in the *stationary* system, and he used the prime to show that x is a specific value – not a generic coordinate. In fact it is a fixed *distance* in K.

The fact that x' is fixed is not immediately apparent from his definition, which looks suspiciously like a function of time. To see why x' is a fixed value, we can rewrite his definition of x' as

$$x = x' + vt \quad . \tag{3}$$

Remember that x and t are coordinates in the stationary frame K. Remember also that the moving frame k is moving at speed v in the positive x direction. Since Einstein's definition above referred to a stationary point in k, that point would be moving at velocity $\mathbf{v}$ in K. The variable x in the above

[3] Einstein used the symbol V for the speed of light and v for the $x = x' + vt$ for relative velocity between the systems. I will use the modern notation of c for the speed of light instead of V.

[4] P. 897: Setzen wir $x' = v\, t$, so ist klar, dass einem im System k ruhenden Punkte ein bestimmtes, von der Zeit unabhäniges Wertsystem x', y, z zukommt.

equation is the position of that point as it moves through K. Its position in k is as shown in Fig. 1. Its distance from the origin of k is measured in K as the fixed distance x'. The relationships between these variables and the systems K and k are shown in Fig. 1.

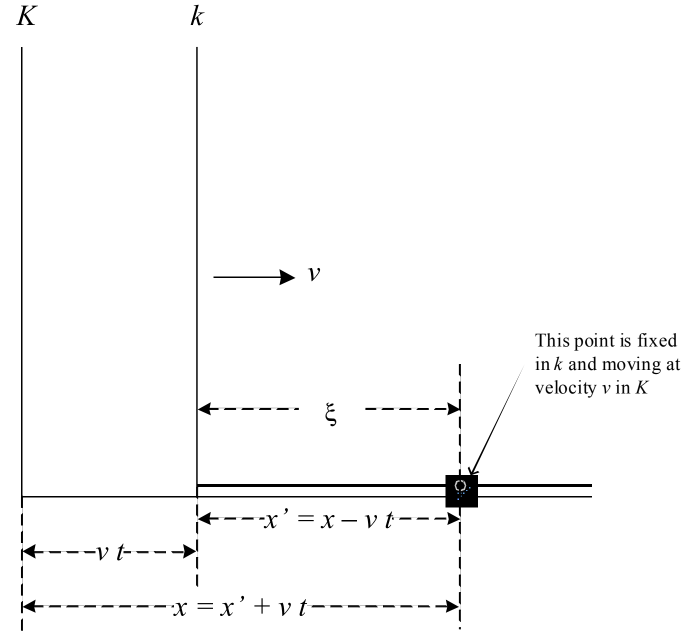

Figure 1. Frames K and k with a point moving in K but fixed in k.

When Einstein referred to the time-independent system of values x', y, z, he simply means that the equation describing the position x in terms of the coordinates of k is a function of these three time-independent values in K. They are time independent because y and z are unaffected by v, and because x' is a fixed distance from the origin in k as measured in K.

He next defined the time τ in k to be a function of these same spatial coordinates plus the time coordinate. Of course, the clocks in k are all synchronized according to his earlier description. He represented this time function as

$$\tau = \tau(x', y, z, t) \quad . \tag{4}$$

Einstein used the symbol τ for both the function and the result of the function, which adds to the confusion in following his logic. Since τ is independent of both y and z we will not repeat these variables in the functional notation, even though Einstein did. In this function, x' refers to the ξ coordinate in k as measured in K. (Again, refer to Fig. 1.) In other words, if we take any stationary point in k (which is moving in K), and while in K measure this point's distance from the origin of k, we will get x' for that point. Inserting that value along with t into the *function* will give the value of τ at that point,

With these definitions in place, Einstein next described the measurement for synchronizing clocks in the moving frame as observed from the stationary frame.

From the origin of k, he emits a light ray at time τ_0 in the direction of the positive x axis. The light ray gets reflected by a mirror located a distance x' from the origin of k as measured in K (or position ξ in k) at time τ_1 and returns to the origin at time τ_2. It is important to note that all three times are measured in k but the distance x' is measured in K. Because the clocks are synchronized so that the speed of light in k will be c in all directions (*i.e.* $\varepsilon = 1/2$), we have the following relationship between these three times.

$$\frac{1}{2}(\tau_0 + \tau_2) = \tau_1 \quad . \tag{5}$$

Since the speed of light is also constant in the stationary system K, these times can be expressed using the function of Eq. (4) and the coordinate values from K taking into account the speed and direction of the light ray with respect to the moving frame.

$$\frac{1}{2}\left[\tau(0,t) + \tau(0,t) + \frac{x'}{c-v} + \frac{x'}{c+v}\right] = \tau\left(x', t + \frac{x'}{c-v}\right) \quad . \tag{6}$$

Einstein did not explain that the x' in this equation refers to the specific x' where the reflecting mirror is located in k. Since there is a clock at every point in k and since x' could represent any point in k, Einstein allowed it to represent any x'. But later, when he differentiated this equation, it became important to treat it as the specific point where the mirror is located. So that we don't get confused, we add a subscript 'm' to indicate that this refers to the specific x' at the mirror.

Rewriting Eq. (6) using the subscript, we get

$$\frac{1}{2}\left[\tau(0,t) + \tau\left(0, t + \frac{x'_{\mathrm{m}}}{c-v} + \frac{x'_{\mathrm{m}}}{c+v}\right)\right] = \tau\left(x'_{\mathrm{m}}, t + \frac{x'_{\mathrm{m}}}{c-v}\right) \quad . \tag{7}$$

The next step in Einstein's paper is difficult to follow because he didn't explicitly say what he was doing. He simply said, "Therefore, if we choose x' to be infinitesimally small, it follows that:"[5]

$$\frac{1}{2}\left(\frac{1}{c-v} + \frac{1}{c+v}\right)\frac{\partial\tau}{\partial t} = \frac{\partial\tau}{\partial x'_{\mathrm{m}}} + \frac{1}{c-v}\frac{\partial\tau}{\partial t} \quad . \tag{8}$$

When Einstein said "choosing x' to be infinitesimally small", he simply meant to take a very small step in x'_{m} – *i.e.*, he desired to see how the function changes with a small change in x'_{m}. Of course, this is just differentiation with respect to x'_{m}.

But before we do the differentiation, we need to point out a subtlety concerning the use of the function in Eq. (4) and an ambiguity in Einstein's choice of symbols. Eq. (4) is the time at x' for any x'. In other words, for every x' the time *at that point* is given by an as yet unspecified function that Eq. (4) represents. But when Einstein took the derivative of Eq. (7) with respect to x'_{m}, he was taking the derivative with respect to the x' where the mirror was located – NOT the x' at the location of the light source and reference clock.

This is where keeping track of the point at the mirror x'_{m} is important. For taking the derivative, the first term in Eq. (7)

[5] P. 899: Hieraus folgt, wenn man x' unendlich klein wählt:

represents the location of the reference clock and the light source. It has a derivative of zero with respect to its x' because by definition it remains stationary at the origin of k and doesn't move as x'_{m} is changed. In other words, the x' in the function τ at the origin is zero and never changes. This is an important point for the mathematicians because, since the *function* τ is a function of x', the chain rule would normally dictate taking the whole derivative and then afterwards substituting the coordinates to calculate the value of the derivative at that particular point. Because Einstein simply set the derivatives with respect to x' equal to zero for the terms at the origin, he has been criticized for not using the chain rule properly. His mistake was in showing the same function τ at the light source (left side of his equation) as at the mirror (right side of his equation) without explaining that he was only differentiating with respect to the x'_{m} at the mirror.

For the first term on the left of Eq. (7), the time term in the function τ represents the time at which the light ray is emitted, so it is independent of x_{m}. This makes the total derivative for that term equal to zero – just as Einstein said. For the second term on the left (representing τ_2), its x' term is zero and also independent of x'_{m}, but its time term does change with x'_{m} because it is affected by the flight time for the down and back trip. For that reason, Einstein only differentiated the t term. Which again is correct. Only the term on the right half of the equation (representing τ_1) has both its x' term and its t term dependent on x'_{m} and for this term Einstein correctly did a full chain rule differentiation of both terms. The bottom line is that Einstein did differentiate Eq. (7) properly, even though the mathematicians who look at the equation without looking at what the equation represents, accuse him of getting it wrong.

Einstein further simplified Eq. (8) to

$$\left[v\big/(c^2-v^2)\right]\partial\tau/\partial t+\partial\tau/\partial x'=0 \quad . \tag{9}$$

Both the x' term and the τ terms in this equation refer to the position and time at the same point. We have dropped the m subscript because this equation now only involves a single point at any arbitrary x'. In other words, this relationship between time in k and distance and time in K holds for any point.

Einstein pointed this out by saying we could have selected any arbitrary point for the source of the light ray and hence Eq. (9) is valid for any x', y, z.

Because τ is a linear function, it follows that

$$\tau=a\left[t-x'_{\mathrm{m}}v\big/(c^2-v^2)\right] \quad . \tag{10}$$

Einstein didn't explain why this 'follows', so here is a quick derivation. A linear function τ that is linear in both x'_{m} and t must have the form

$$\tau(x'_{\mathrm{m}},t)=at+bx'_{\mathrm{m}} \quad . \tag{11}$$

There could also be an arbitrary constant term, but it does nothing but shift every clock in the system by a fixed offset, so we can choose to set it to zero. Substituting this into Eq. (9) and taking the derivative results in

$$a\left[V\big/(c^2-V^2)\right]+b=0\Rightarrow b=a\left[V\big/(c^2-v^2)\right] \quad . \tag{12}$$

Substituting this for the value of b in Eq. (11) results in Eq. (10) above. The value a is an unknown constant that is a function of v.

Eq. (10) is the expression for the time on a clock in k as a function of the time and position as measured in K. It was derived by assuming that clocks are synchronized so that the velocity of light will be measured to be constant in every frame. If we define the time $\tau=0$ at the origin of k when $t=0$, then the position of a light wave that is sent from the origin of k at time $\tau=0$ is

$$\xi=c\tau \quad . \tag{13}$$

Substituting Eq. (10) into Eq. (13) gives

$$\xi=ac\left[t-x'v\big/(c^2-v^2)\right] \quad . \tag{14}$$

For each distance x' from the origin of k (as measured in K), there is a corresponding ξ in k. What Eq. (14) is telling us is that the position of a light ray that leaves the origin of k at time $\tau=0$ will arrive at a position ξ as measured in k at time t as measured in K, and that this will occur when the light ray is a distance x' from the origin of k, as measured in K. (Whew! That was a mouthful wasn't it?) The bottom line is that all terms on the right hand side are measured in K. On the left, obviously ξ is measured in k.

As observed from K, the light ray is moving at speed c. But k is moving in the same direction at speed v. So the relative velocity of the wave with respect to the origin of k is measured in K as $c-v$. This means that if the light ray left the origin of k at time $t=0$, then at any time t in K the distance x' that the light ray has moved from the origin of k is

$$x'=(c-v)t\Rightarrow t=x'/(c-v) \quad . \tag{15}$$

Einstein then substituted this expression for t into Eq. (14) to get an expression for ξ in terms of x'.

$$\xi=\left[a\,c^2\big/(c^2-v^2)\right]x' \quad . \tag{16}$$

This equation says that if an observer in K measures the distance from the origin of k to any fixed point in k to be x', then the corresponding ξ coordinate of that point in k is given by this expression.

He then derived the lengths as measured in the directions of η and ζ. As measured in k by a light ray, obviously the length in the η direction is the speed of light times the time it takes to traverse the distance. Since the time in k is given by Eq. (10) this means:

$$\eta = c\tau = ac\left[t - vx' / (c^2 - v^2)\right] \quad . \tag{17}$$

As measured in K, a light ray that is moving in the η direction is moving in both directions x and y. In the x direction it is moving at velocity $\mathbf{v}$ and in the y direction it is moving at a velocity such that the sum of the squares of the two velocities is equal to c. Thus (this equation is not in Einstein's paper)

$$c^2 = v^2 + u_y^2 \quad , \quad u_y = \sqrt{c^2 - v^2} \quad . \tag{18}$$

Therefore, the time to move a distance y in the y direction is

$$t = y \big/ \sqrt{c^2 - v^2} \quad . \tag{19}$$

When following a light ray from the origin along the η (y) axis, x' is zero. Substituting this into Eq. (17) gives

$$\eta = ac\left(y \big/ \sqrt{c^2 - v^2}\right) = a\left(c \big/ \sqrt{c^2 - v^2}\right) y \quad . \tag{20}$$

From symmetry, the z direction will have the same z result.

$$\zeta = ac\left(z \big/ \sqrt{c^2 - v^2}\right) = a\left(c \big/ \sqrt{c^2 - v^2}\right) z \quad . \tag{21}$$

Einstein next substituted the definition of $x' = x - vt$ into the above equations and defined

$$\varphi(v) = ac \big/ \sqrt{c^2 - v^2} = a\gamma \quad . \tag{22}$$

Eqs. (10), (16), (20) and (21) then became

$$\begin{aligned}
\tau &= \frac{\varphi(v)}{\gamma}\left[t - v(x - vt)\big/(c^2 - v^2)\right] = \\
&= \frac{\varphi(v)}{\gamma}\left[c^2 t\big/(c^2 - v^2) - vx\big/(c^2 - v^2)\right] = \\
&= \varphi(v)\gamma(t - vx / c^2) \quad , \\
\xi &= \frac{\varphi(v)}{\gamma}\left[c^2(x - vt)\big/(c^2 - v^2)\right] = \varphi(v)\gamma(x - vt) \quad , \\
\eta &= \varphi(v) y \quad , \quad \zeta = \varphi(v) z \quad .
\end{aligned} \tag{23}$$

It is important to recognize that the x in these equations is the x coordinate in K of a point moving at velocity $\mathbf{v}$, such that it is a fixed point in k. But every fixed point in k has a coordinate ξ, so this is the same as saying that the x in these equations represents the coordinate in K that corresponds to the coordinate ξ in the moving frame k.

At this point Einstein said: "We now need to prove that any ray of light propagates at speed c as measured in the moving system, if, as we have assumed this is the case in the stationary system; for we have not yet provided proof that the principle of the constant speed of light is consistent with the principle of relativity."[6]

At time $t = \tau = 0$, when the origins of both systems coincide, a spherical wave is emitted from the origins and propagates at speed c in system K. If (x, y, z) is a point at which the wave front has arrived at time t, then

$$x^2 + y^2 + z^2 = c^2 t^2 \quad . \tag{24}$$

Using Eqs. (23), the sum of the squares of the space coordinates and the square of the time in k are

$$\begin{aligned}
\xi^2 + \eta^2 + \zeta^2 &= \phi(v)^2\left[\gamma^2(x - vt)^2 + y^2 + z^2\right] \\
c^2\tau^2 &= c^2\varphi(v)\gamma^2(t - vx / c^2)^2 \quad .
\end{aligned} \tag{25}$$

Setting these equal to each other and simplifying, we get

$$\begin{aligned}
\gamma^2(x - vt)^2 + y^2 + z^2 &= c^2\gamma^2(t - vx / c^2)^2 \\
\Rightarrow y^2 + z^2 + x^2 &= c^2 t^2 \quad .
\end{aligned} \tag{26}$$

This proves that the wave is traveling at speed c in the moving frame as well as the stationary frame, which also proves that the definition of constant light speed is consistent with the Principle of Relativity.

Einstein then solved for the unknown function $\varphi(V)$ by doing two transformations: one from K to k and the other from k back to K. To keep the variables straight, he uses K' and primed variables to represent the coordinates in the reverse transformation. This transformation must produce the exactly same space-time point as was transformed into K'. The principle of relativity requires all frames to be equivalent so the reverse transformation is the same as the forward transformation except the sign of the velocity is reversed. We will look only at the τ transformation to show that the value of $\varphi(V)$ must be 1, just as Einstein asserted. To transform from τ to t', we have from Eqs. (23)

$$t' = \varphi(v)\gamma\left(\tau + v\xi / c^2\right) \quad . \tag{27}$$

But we can replace τ, ξ with their transformed values:

$$t' = \varphi(-v)\varphi(v)\gamma^2\left[(t - vx / c^2) + (v / c^2)(x - vt)\right] \quad . \tag{28}$$

This simplifies to:

$$t' = \varphi(-v)\varphi(v)t \quad . \tag{29}$$

Since these two times must be the same value, this means that we have proven that

[6] P. 900-901: Wir haben nun zu beweisen, daβ jeder z =j(v)z Lichtstrahl sich, im bewegten System gemessen, mit der Geschwindigkeit c fortpflanzt, falls dies, wie wir genommen mit der Geschwindigkeit c fortpflanzt, falls dies, wie wir genommen haben, im ruhenden System der Fall ist; denn wir haben den Beweis dafür noch nicht geliefert, das Prinzip der Konstanz der Lichtgeschwindigkeit mit dem Relativitäts-prinzip vereinbar ist.

$$\varphi(v) = \varphi(-v) = 1 \quad . \tag{30}$$

Substituting this into Eqs. (23), we have arrived at the Lorentz transformation equations.

$$\begin{gathered} \tau = \gamma(t - vx/c^2) \quad , \quad \gamma = 1\Big/\sqrt{1-(v/c)^2} \quad , \\ \xi = \gamma(x - vt) \quad , \quad \eta = y \quad , \quad \zeta = z \quad . \end{gathered} \tag{31}$$

This completes the proof that Einstein's derivation of the Lorentz transformations in his original 1905 paper is sound and valid algebraically.

It is important to note that distance measurements for deriving these equations were made with a light ray and clocks synchronized according to Einstein's definition of time. Some have asserted that this means that length contraction is merely a byproduct of his definitions, and that a different definition would result in no length contraction. They have said the same thing about time dilation. There is certainly nothing in our mathematical definitions that requires the real world to behave as we dictate. But unfortunately for the critics, both time dilation (or more precisely, slowing of clocks) [7] and length contraction have been verified experimentally [8] so there is more to his theory than just mathematics.

On the other hand, there are times when time dilation and length contraction really do seem artificial. The twin paradox is a good example where the time dilation seen by each observer is real for one twin. There are length contraction scenarios (muons moving at near the speed of light that reach Earth before decaying) with similar one- sided 'real' contractions, but these discussions must be deferred to another paper. We simply point out that SRT has been an amazingly successful theory at predicting a number of experimentally verified results.

4. Einstein's Simplified Derivation of LT's

In Appendix 1 of' his book **Relativity: The Special and General Theory,** Einstein gave a "Simple Derivation of the Lorentz Transformation", starting on page 131. This derivation has been derided by his critics as full of "numerous mistakes" [9] and "algebraically inconsistent" [10], and hence invalid. These critics are wrong. The problem is that they have made the common mistake of separating the mathematical equations from the physical reality of what the equations are describing. Mathematicians are especially prone to this mistake, but physicists are also guilty of letting equations get a life of their own instead of always keeping in mind the *additional constraints* that a physical problem imposes on the equations that describe that problem.

This author concedes that Einstein did not always explain clearly what the equations really mean physically – and this has contributed to the confusion of his critics. But I will show in this analysis that with a proper understanding of what the equations were really describing, the derivations were done with complete mathematical consistency and that his final results are absolutely correct and valid.

This Section presents the same equations as he does in his book, (with a few additions of my own) but my textual description is expanded beyond Einstein's so that it is absolutely clear why each algebraic step is justified by the physics he is describing.

Einstein started with the equations for a light wave originating at the origin of both frames a time zero in both frames. The wave is propagating along the positive x axis in a stationary frame K. If the principle of the constancy of light speed of is valid, then for an observer in a moving frame K', this same light wave must be propagating at c in his frame. These two equations (one from each frame) describing the motion of a point on the wave front propagating along the positive x axis are then given as:

$$x - ct = 0 \quad , \tag{32}$$

$$x' - ct' = 0 \quad . \tag{33}$$

Einstein's mathematician critics disparage his next step as being completely unjustified algebraically. It was:

$$x' - ct' = \lambda(x - ct) \quad . \tag{34}$$

The critics point out that, given Eqs. (32) and (33), Eq. (34) is completely meaningless because any value of λ can make zero equal to zero. Since Einstein went on to solve for λ, they cry foul again, and claim that he violated the condition that both sides equal zero.

This would all be true, if the only information given were Eqs. (32) and (33), with no other context. But the critics have conveniently forgotten that x and x' in these equations describe the *same physical point in space* as observed from two different frames. They are not just two equations that happen to be equal to zero. The other constraint they have forgotten is that the assumption going into this derivation is that the relationship is linear for transforming distances between frames and time between frames.

Furthermore, Einstein never claimed that Eq. (34) followed from Eqs. (32) and (33). What he said was that Eqs. (32) and (33) are satisfied when Eq. (34) "is fulfilled *in general*." Why did he use the words "*in general*"? Because he was readily admitting that he was proposing a more general relationship than Eqs. (32) and (33) describe, but one which nevertheless also satisfied the more restrictive relationship of those two equations. In other words, Eq. (34) is a hypothesis – it is not a derivation from Eqs. (32) and (33)! Here are Einstein's exact words before giving Eq. (34) (I've changed the equation numbers to match the equation numbers in this paper.):

> "Those space-time points (events) which satisfy (32) must also satisfy (33). Obviously, this will be the case when the relation (34) is fulfilled *in general*, where λ indicates a a constant." (emphasis added) [2]

Clearly, Einstein would not have needed the words "*in general*" if he were just deriving his statement from the previous equations. What he was saying is this: if there is a linear transformation of points between frames of the general form of Eqs. (34), then this assures that tıhe specific case of a single point on a wave emitted from the origins at time zero as observed from two different frames will also be satisfied.

He then said that a similar transformation equation can be proposed for a wave moving in the negative x direction with a different constant of proportionality.

$$x' + ct' = \mu(x + ct) \quad . \tag{35}$$

The different constant is a recognition that when the velocity of the wave is in the same direction as the relative velocity, it may transform differently than a wave moving in the opposite direction of the relative velocity.

I agree that Einstein's description of exactly why each step is justified was short on clarity. But instead of trying to understand exactly how these two equations might be correct, his critics take a lazy and naïve approach and claim that an accomplished physicist like Einstein was completely inept at algebra.

Allow me to explain in terms that everyone should be able to understand. We are trying to derive a linear relationship between time and position coordinates in one frame and time and position coordinates in another frame. Additionally, we *stipulate* that this transformation must result in light speed being measured within each frame as the same constant value and that it be isotropic within each frame. Because we define the frames' origins to coincide at time zero in both frames, we know what the position and time coordinates are at this point and time. But knowing a single point on a line (remember our relationship is linear) tells us nothing about the line itself. We must search for a linear relationship that satisfies the requirement that it goes through this point.

Einstein started at this single, known point and used Eqs. (32) and (33) to describe how time and distance must be related if a light wave originating at this space-time point is observed in both frames. He then proposed the general relationship of Eq. (34), which also satisfies the special case at time 0 and position 0, to describe a light wave that originates at *any* point in space-time.

Although he says that λ in Eq. (34) is a constant, he did not make it clear that it is a different constant for every point in space-time from which a wave could originate. For example, for a space-time point (x,t) in K [that is, not at point (0,0)], we see that a wave propagating in the positive x direction from that point will have a proportionality constant of

$$\mu_1 = \frac{(x_1' + \Delta x') - c(t_1' + \Delta t')}{(x_1 + \Delta x) - c(t_1 + \Delta t)} = \frac{x' - ct'}{x - ct} \quad , \tag{36}$$

where $c = \Delta x / \Delta t = \Delta x' / \Delta t'$.

But because light must be isotropic, if we follow a point on the wave going in the opposite direction, it must have a different proportionality constant, given by

$$\mu_1 = \frac{(x_1' + \Delta x') + c(t_1' + \Delta t')}{(x_1 + \Delta x) + c(t_1 + \Delta t)} = \frac{x' + ct'}{x + ct} \quad . \tag{37}$$

The next step in Einstein's derivation really gets his critics howling. He added Eqs. (34) and (35) together and derived the sum as if the x and t in Eq. (34) were the same as the x and t in (35). What gets his critics upset with this step is that Eq. (34) is clearly a point moving to the right and Eq. (35) is clearly a point moving to the left. Obviously the x terms in these two equations cannot be the same. This makes it mathematically illegal to add the two equations and combine the terms into one x .

Not so! You have to remember this is Physics, not just *math*. This is again a case of separating the equations from the physics. The question the critics needed to ask before accusing Einstein of being an incompetent mathematician is, "Under what circumstance would it be correct to set them equal to each other?"

Go back and look at Eqs. (36) and (37). What happens at the exact moment when the light source emits the wave? We see that this means $\Delta t = 0$, $\Delta x = 0$. Under that circumstance, Eqs. (36) and (37) can be written as

$$x_1' - ct_1' = \lambda_1(x_1 - ct_1) \quad , \quad x_1' + ct_1' = \mu_1(x_1 - ct_1) \quad . \tag{38}$$

Well, look at that! Einstein wasn't as stupid as the critics though he was. The x and t terms are exactly same in both equations and for both frames. It is perfectly legitimate, at the moment of emission, to combine these two equations into a single, linear system and solve for the primed coordinates – which is exactly the next step in Einstein's derivation.

Einstein added and subtracted Eqs. (34) and (35) to derive two new equations. By adding the two equations, the time term on the left vanishes, and we have

$$x' = \frac{1}{2}(\lambda + \mu)x - \frac{1}{2}(\lambda - \mu)ct \quad . \tag{39}$$

By subtracting them, the position term on the left vanishes.

$$ct' = \frac{1}{2}(\lambda + \mu)ct - \frac{1}{2}(\lambda - \mu)x \quad . \tag{40}$$

Before moving on, it is very important to note that the space-time point in these equations is now completely arbitrary and no longer associated with a wave! When we combined the two equations into a single system, we required that this space-time point must transform between systems in the manner shown at the instant that the wave is emitted. But his means that they must have this same relationship the infinitesimally small instant *before* the wave is emitted. This means that there is no need to emit any wave at all for this relationship to hold true.

What we are really saying is that any set of transforma- tion equations that is derived by solving these two equations is completely general and can be applied to *any* space-time point regardless of whether or not it was obtained from propagating waves. This will be important to remember later on when the critics accuse him of his next misstep.

At this point Einstein used a change of variables to simplify the remaining derivation.

$$a = (\lambda + \mu) / 2 \quad , \quad b = (\lambda - \mu) / 2 \quad . \tag{41}$$

This allows Eqs. (39) and (40) to be written as

$$x' = ax - bct \quad , \quad ct' = act - bx \quad . \tag{42}$$

At the origin of K', we have $x'=0$ permanently. Since these equations must be true for any space-time point, we can use this point in Eq (42) to solve for the x in K, that corresponds to the origin of K' for all times.

$$x=(bc/a)t \quad . \tag{43}$$

But by definition, the origin of K' (and every other fixed point in K') is moving at the velocity of $\mathbf{v}$ in K. Hence

$$v=bc/a \quad . \tag{44}$$

I'm sure readers won't be surprised that the mathematicians who missed the point that the variables are equal at the moment of wave emission, also missed the point that the equations are now general, and no longer refer just to light waves. They complain that Eq. (43) arbitrarily and without justification changed the meaning of x from the position of a light ray moving at velocity $\mathbf{c}$ to the position of the frame moving at velocity $\mathbf{v}$. But we know better.

If we now take a 'snapshot' of K' at in K, we get from the first Eq. (42)

$$x'=ax \quad . \tag{45}$$

Since at time 0 the two origins coincide, x is the distance in K of the point x' in K'. Or more generally, a represents the scale factor for transforming distance in K into distance in K'. For example, if we select a distance that measures 1 in K', it becomes Δx upon transformation to K

$$\left.\Delta x\right|_{\Delta x'=1} \quad . \tag{46}$$

If we now take a snapshot of K from K' when [taking into account Eq. (44)], Eq. (42) becomes:

$$x'=a(x-vt) \quad , \quad t=bx/ac \quad . \tag{47}$$

Substituting t in the first equation by the second equation,

$$x'=a\left(1-bv/ac\right)x=a(1-v^2/c^2)x \quad . \tag{48}$$

Using the same arguments as for Eq. (46), a distance that measures 1 in K must be represented by a distance in K' of

$$\left.\Delta x'\right|_{\Delta x=1}=a(1-v^2/c^2) \quad . \tag{49}$$

But the Principle of Relativity requires that objects that have the same rest length within frames must transform into the same length between frames. Therefore, the right-hand sides of Eqs. (46) and (49) must be equal.

$$1/a=a(1-v^2/c^2)\Rightarrow a^2=1\Big/\left(1-v^2/c^2\right) \quad . \tag{50}$$

Substituting this into Eq. (44), we can solve for b.

$$b=va/c=(v/c)\Big/\sqrt{1-v^2/c^2} \quad . \tag{51}$$

And finally, substituting Eqs. (50) and (51) into (42) gives the complete transformation of time and space for points on the x axis.

$$x'=\left(x-vt\right)\Big/\sqrt{1-v^2/c^2} \;,\; t'=\left(t-vx/c^2\right)\Big/\sqrt{1-v^2/c^2} \quad . \tag{52}$$

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Accelerating Clocks Run Both Faster and Slower

Continued from p. 22

Others have disputed the contention that the Hafele-Keating results support Einstein's relativity (e.g., Spencer and Shama, "Analysis of the Hafele-Keating Experiment," Third Natural Philosophy Alliance Conference, Flagstaff, Arizona, June 1996; Kelly, "Hafele & Keating Tests: Did They Prove Anything?" [http://www.anti-relativity.com/hafelekeating debunk.htm]). Never being one to accept Einstein's conjecture that time slows due to movement at constant velocity, I nevertheless never considered the possibility of clocks (not time) showing variation under accelerated movement. The above discussion prompted me to consider this possibility by postulating three examples of acceleration: (1) change in speed, but not direction; (2) change in direction but not speed; and (3) change in both speed and direction. As my 'clock,' I postulate a gun shooting a projectile into a target, with the time between ejection from the gun and striking of the target becoming the unit of time measurement.

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Charged Body Motion & Magnetic Field in a Medium

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It has been proved by experiment that when a charged body moves, a magnetic field is produced around its trajectory. However, a huge difficulty emerges when the Principle of Relative Motion is applied to the phenomenon, and the conclusion is very confusing and self-contradictory. Using to the Biot-Savart Law, I put forward a hypothesis that can explain the phenomenon easily. I also list four feasible experiments, and hope readers will use them to test the hypothesis given.

Key words: Motion of charged body produces magnetic field; Rowland experiment; Principle of Relative Motion; Magnetic field detector; Measurement of magnetic field; Biot-Savart Law; Magnetic conductivity

1. Introduction

It is a phenomenon proved by experiment that when a charged body moves, it produces a magnetic field around its route. However, there is a question: relative to what reference system does the charged body move, and thereby produce the magnetic field? I have thought this problem for a long time.

Any speed must have a reference system, so moving speed of charged body also must have a reference system. I have analyzed motion between charged body and observer, and charged bodies carefully, in the end, I came to a conclusion, only suppose that **when the charged body has mutual contact relative motion with the surrounding medium, the charged body is able to produce a magnetic field in the medium.** Thus, various kinds of phenomenon can be explained easily.

In my opinion, motion of charged body in vacuum pipe is similar to charged body moving in vacuum following rotation of our Earth, they both can produce magnetic field.

2. Analysis

Suppose there is a body that carries quantity $+Q$ of electric charge. Suppose this charged body is installed on a support. Suppose a magnetic field detector is installed on the support at distance r from the charged body. The whole assembly is placed in an open space, as shown in Fig. 1.

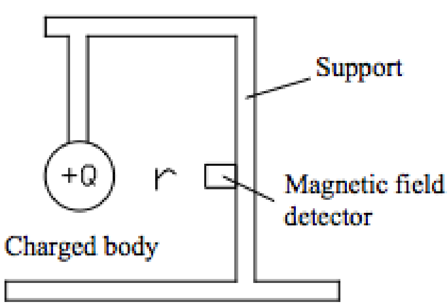

Figure 1. Charged body in open space.

Suppose there is some reference A, presumed to stay still. Suppose I take the whole assembly and move toward A with speed of V, in the direction normal to the paper surface. Rowland's experiment [6] proved that when the charged body moves, it produces a magnetic field around the route of the motion. With a magnetic field detector, I can measure this magnetic field, and the direction of the magnetic field can be judged by the right-hand rule. From viewpoint of A, one also can measure magnetic field produced by charged body due to motion of the charged body.

According to the Principle of Relative Motion, the situation where reference A is kept motionless and the assembly moves to A is equivalent to the situation where the assembly is motionless, and the reference A moves to the device at speed V.

Now, the assembly stays motionless. The assembly and I are both motionless, so the charged body does not produce a magnetic field for me, so I cannot measure a magnetic field. If reference A moves to the device with speed V, then will the charged body produce magnetic field, and will the reference A detect magnetic field?

The current Paradox is that, from viewpoint of relative motion, if the charged body produces magnetic field, reference A shall be measured with magnetic field. However, from my point of view, the charged body does not produce magnetic field, and I cannot measure magnetic field.

If there are four reference substances, namely A, B, C, D, A stays still, moving speed of A is $V_A = 0$, B, C, D are moving substance, their speeds are V_B, V_C, V_D respectively, and $V_B = V_C = V_D = 0$. Now, I hold the device and move to reference A, B, C, D with speed of V.

With respect to A, the speed of the moving device is $V + V_A$;

With respect to B, the speed of the moving device is $V + V_B$;

With respect to C, the speed of the moving device is $V + V_C$;

With respect to D, the speed of the moving device is $V + V_D$.

Now, the Paradox is that, because $V_A \neq V_B \neq V_C \neq V_D$, then what is the value of the magnetic field produced by charged body?

If the device moves relative to a certain reference substance, then charged body will produce magnetic field relative to the certain reference substance, when I use magnetic field detector to measure magnetic field produced by charged body at position of

r, which is the distance between charged body and me, then the magnetic field measured by me is not an exact value. As for reference A, there is magnetic field strength B_A; for reference B, there is magnetic field strength B_B, for reference C, there is magnetic field strength B_C; for reference D, there is magnetic field strength B_D. There are countless reference substances, and moving bodies in the Universe, so relative to which reference do I actually measure? This is very confusing, and the conclusion is unreasonable.

In fact, when I use magnetic field detector to measure magnetic field produced by charged body, there is an accurate value for strength of magnetic field. The value does not exist due to existence of reference A, B, C, D, so is the existence of the value caused by me? Then who am 'I'?

According to principle of relative motion, as for A, B, C, D, they each are installed with magnetic field detector, when they pass by position of r which is distance between them and charged body, from point of view of them, the strength of magnetic field measured by them are also different. If so, then the result is artificial selection, difference of strength of magnetic field of charged body is caused by different of observers, and its existence is due to subjectivity of human. There are countless reference substances and moving bodies in universe, and then the "Artificial selection principle" will result in countless different conclusions. According to the current opinion, the result is just like this, however, people have not done the experiments, and there is no experiment to support the opinion, this cannot be assumed as a matter of course.

If the device is fixed and motionless, move the reference A, B, C, D to the device. As for me, because charged body does not move, $V = 0$, so the charged body does not produce magnetic field, I can not measure magnetic field. As for reference A, from the point of view of A, because A does not move, $V_A = 0$, so A cannot measure magnetic field. As for reference B, C, D, from point of view of B, C, D, they move relative to charged body with speed of V_B, V_C, V_D, it can be said that charged body moves relative to reference B, C, D with speed of V_B, V_C, V_D, because $V_B \neq V_C \neq V_D \neq 0$, so they can measure magnetic field, and the measured strength of magnetic field, namely BB, BC, BD, are different. Now the Paradox is that, for different reference substances, different results will be obtained, and the problem is that whether the charged body has produced magnetic field at this very moment.

For example, I fix the device on roadside and keep it stationary. I take magnetic field detector and pass by the charged body with different speed, then whether the charged body will produce magnetic field, whether I can measure different strength of magnetic field? In accordance with principle of relative motion, the charged body shall produce magnetic field in theory, and I can measure strength of magnetic field under different speed. Whether it is available in practice? I have checked that no body ever done the experiment, so no experiment to support the conclusion.

In conclusion, when the Principle of Relative Motion is adopted to explain the magnetic field produced by charged body, huge difficulty is met, and the obtained conclusion is very confusing and self-contradictory. If people are able to accept the hypothesis proposed by me, these problems can be explained easily. Of course, the hypothesis proposed by me has its basis, and it is not imagination of mine. My hypothesis is: precondition of charged body produces magnetic field is that if charged body has mutual contact relative motion with its surrounding medium, then the charged body is able to produce magnetic field in the medium, it has no relation with reference substances and moving bodies. If the charged body has no mutual contact relative motion with surrounding medium, then, no matter other reference substance and moving body has motion or not, the charged body will not produce magnetic field.

The magnetic field produced by a charged body in medium is just like ripple produced by small stone when it is thrown into pool. According to Biot-Savart Law, when charged body moves in medium, the strength B of the magnetic field at radial position r from the charged body is:

$$B = \mu Q V / 4\pi r^2 \quad ,$$

where μ is the magnetic conductivity of medium, Q is the quantity of electric charge of the charged body, V is the relative speed of the charged body in the medium.

Until now, the explanation to above is smooth.

On the surface of Earth, air is usually motionless. When I take the device and move to reference A, B, C, D with speed of V, because charged body moves relative to air medium with speed of V, so magnetic field produced by charged body in air medium has no relation with reference A, B, C, D. Even though I move with the device, magnetic field produced by charged body is not produced by my existence, and it will not disappear due to my inexistence, so I can measure magnetic field produced by charged body. On the contrary, if I measure magnetic field produced by charged body, by applying the Biot-Savart Law to solve in reverse, motion speed V of the charged body relative to the air medium will be obtained.

As for reference A, B, C, D, their motion speed relative to Earth surface is just the motion speed of motionless air. So they will not produce any effect on relative motion of charged body and air medium. Therefore, as for observers of reference A, B, C, D, the magnetic field measured by them produced by the charged body will be same with value measured by me. If the charged body does not move in the air medium, then the charged body will not produce magnetic field, I can not measure magnetic field, and detectors on reference A, B, C, D also cannot measure magnetic field.

If the charged body is in air, there is air magnetic conductivity μ, then charged body moves relative to air and produces magnetic field in air. Air is a partial reference system.

If the charged body is in water, there is water magnetic conductivity μ, then charged body moves relative to water and produces magnetic field in water. Water is a partial reference system.

If the charged body is in glass, there is glass magnetic conductivity μ, then charged body moves relative to glass and produces magnetic field in glass. Glass is a partial reference system.

If the charged body is in vacuum, there is vacuum magnetic conductivity μ, then what reference system does the charged body relative to and moves and then produces magnetic field?

Any speed must have a reference system; otherwise the definition of speed is meaningless. In my opinion, there only exists ether in vacuum, and ether is absolutely motionless. It a charged body moves in vacuum, that means the charged body moves relative to ether. Ether is a medium, and if magnetic conductivity of vacuum is μ_0, then magnetic conductivity of ether is μ_0. According to the Biot-Savart Law, the charged body moves in vacuum and produces magnetic field is just same to charged body moves relative to ether and produces magnetic field in ether. Even I do not have judging experiment to prove existence of ether.

Even though I do not have a decisive experiment to prove the existence of ether, the hypothesis is reasonable. Here is one argument: If a charged body is in a certain medium, then the medium is a partial reference system. The space of the Universe is full of ether, and ether is absolutely motionless. Therefore, there exists an absolutely motionless reference system in the Universe.

According to my hypothesis, I put forward several experiments, and hope that people who have the interest and the conditions to do these experiments to test the hypothesis.

If a charged body moves in medium, according to the Galilean principle of relatively, there exist the following two cases:
Case 1: The charged body moves, and medium stays motionless;
Case 2: The medium moves, and the charged body stays motionless.

Experiment 1: Prepare a hollow quartz glass pipe, install and fix a charged body in center of the pipe. When air or other medium in pipe flows quickly in pipe, in my opinion, charged body is able to produce magnetic field, the magnetic field spreads towards inside and outside of the pipe, magnetic field will be detected with a magnetic field detector both in and out of the pipe.

Experiment 2: Prepare a hollow quartz glass pipe, install and fix a charged body in wall of the pipe and make half the charged body in the pipe and half out of the pipe. When air or other medium in pipe flows quickly in pipe, in my opinion, charged body is able to produce magnetic field, the magnetic field spreads towards inside and outside of pipe, magnetic field will be detected with a magnetic field detector in and out of the pipe.

Experiment 3: Prepare a hollow quartz glass pipe, install and fix a charged body outside of the pipe. When air or other medium in pipe flows quickly in pipe, in my opinion, charged body does not produce magnetic field, magnetic field will not be detectable by magnetic field detector in or out of the pipe.

Experiment 4: Prepare a hollow quartz glass pipe, install and fix a charged body in center of the pipe. When pipe is vacuumized, in my opinion, charged body is able to produce magnetic field, the magnetic field spreads towards inside and outside of the pipe, magnetic field will be detected with a magnetic field detector in or out of the pipe.

Especially the Experiment 4 can prove, not only my hypothesis, but also testify to the existence of ether and absolutely static reference system. I have no condition to do these experiments and hope other people will do them.

2) Suppose a charged body is placed in closed space, as shown in Fig. 2.

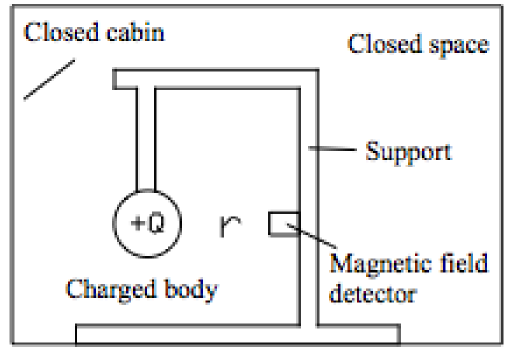

Figure 2. Charge in closed space.

When I take the device and move, the moving direction is vertical to paper surface, then, will the charged body produce a magnetic field?

I have thought about this problem for a long time.

When I am driving, I will think if I hang a charged body on my car head, when I park, drive, speed up and speed down, will the charged body produce magnetic field, whether I can measure magnetic field? If the charged body is fixed on roadside, when I drive and pass by it, can I measure magnetic field? If both I and the charged body move together in an open space, what will be the result? If the charged body is fixed in closed space, and I move with the closed space together, what will be the result?

Now, the result is very clear. According to my hypothesis: the prerequisite for the charged body to produce a magnetic field is that the charged body have mutual contact and relative motion with the medium. The fixed charged body in closed space has no relative motion with its surrounding medium, therefore, the charged body in closed space does not produce magnetic field in medium.

Therefore, for the fixed charged body in closed space, when I move with the closed space, no matter I am inside or outside the closed space, there is no relative motion between charged body and its surrounding medium, charged body does not produce magnetic field, I cannot measure magnetic field. Just like on the surface of Earth, even the Earth is in state of autorotation and revolution, motionless charged body will not produce magnetic field, I also cannot measure a magnetic field.

However, if the charged body is placed in open space, only if charged body has mutual contact relative motion with air medium, the charged body will produce magnetic field in air medium, then I can measure magnetic field produced by charged body. In reverse, if I measure magnetic field produced by charged body, then I can calculate moving speed of charged body relative to air. As air often is motionless relative to Earth surface, therefore, it can be say that I can know my moving state and moving speed relative to earth surface. Because magnetic field produced by charged body is not produced due to my existence, therefore, even I am in a closed space, only if I measure magnetic field through outside magnetic field detector, I also can know my moving state and moving speed relative to Earth's surface.

By conducting similar extension, place charged body outside of car, train, airplane, steamship *etc.*, by measuring strength of magnetic field produced by motion of charged body relative to air, and then moving state and moving speed of them relative to Earth's surface can be calculated.

If a charged body is placed in vacuum on the surface of Earth, because vacuum is just ether medium, ether is absolutely motionless. From point of view of cosmic space, the charged body will move in ether under driving of Earth surface, therefore, the charged body will produce a magnetic field in ether of vacuum, by measuring the value of magnetic field, the moving speed of the charged body relative to ether will be calculated, and by adjusting the position of magnetic field detector, moving direction and speed of Earth's surface relative to ether will be calculated.

This is a hypothesis worth testing by experiment.

Case 3: Use string to hang two charged bodies which respectively carry +Q electric quantity on support, the charged bodies bear function of string tension T, electrostatic repulsion F1, gravity G, and reach force balance in final, and stay still state, make distance of the two charged bodies be r. The support is placed in open space. See Fig. 3.

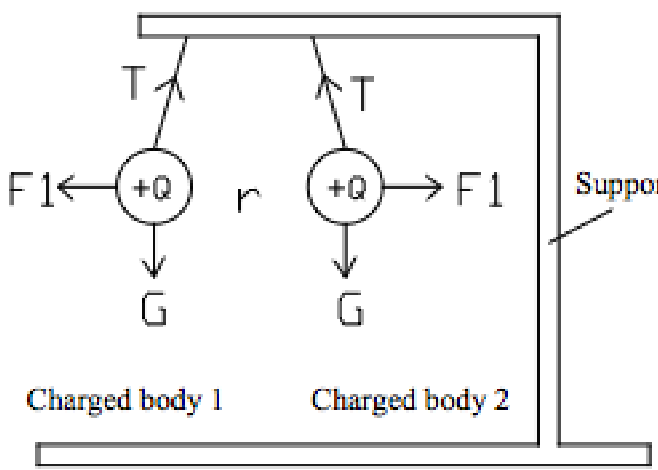

Figure 3. Two charged bodies in open space.

When I take the device and move with speed V, the moving direction is vertical to paper surface. Charged Body 1 will produce magnetic field in air medium in theory. Because charged Body 2 moves in magnetic field by cutting magnetic line of force, so the charged Body 2 will produce inward electromagnetic force. Electromagnetic force will resists electrostatic repulsion and makes charged Body 2 moves inward, and *vice versa*. The result is that the distance r between the two charged bodies shortens.

Textbooks also describe the phenomenon in that way. However, it is only established in theory; nobody ever did experiments to verify it. I do not mean to deny the conclusion; I only want people to do experiments to verify it. In fact, if experiments do not support my conclusion, that will be a direct disproof to my hypothesis.

There are three methods to make a magnetic field detector to measure magnetic field produced by charged body. The first is to use small magnetic needle to measure, Rowland's experiment is just do so; the second is to use Hall Effect to measure, the method has been discussed in my paper "Report and Theoretical Analysis on Luminous Spot Excursion Experiment on Earth Surface by Myself"; the third is to use charged body produces electromagnetic force by cutting magnetic line of force to measure.

By measuring the distance r between two charged bodies, strength of magnetic field produced by charged body and moving speed of charged body will be calculated. See Fig. 4.

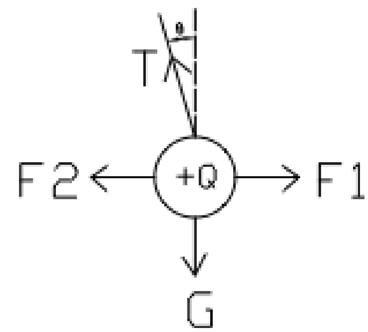

Figure 4. Force analysis of charged body.

According to field angle θ and gravity of charged body G, resultant force F of the tensile force T of string, electromagnetic force F_2 and electrostatic repulsion F1 can be obtained:

$$T\cos\theta = G \quad , \quad T = G/\cos\theta$$

$$T\sin\theta = F \quad , \quad F = G\sin\theta/\cos\theta$$

Electrostatic repulsion magnitude F_1 of charged Body 2 is:

$$F_1 = Q^2/4\pi\varepsilon r^2$$

The magnetic strength B produced by charged Body 1 at distance r is:

$$B = \mu Qv/4\pi r^2$$

The electromagnetic force magnitude F_2 produced by charged body 2 at position radius r is

$$F_2 = QvB = Qv \times \mu Qv/4\pi r^2 = \mu Q^2 v^2/4\pi r^2$$

The resultant force F of charged body 2 is:

$$F = F_1 - F_2 = Q^2/4\pi\varepsilon r^2 - \mu Q^2 v^2/4\pi r^2 = G\sin\theta/\cos\theta$$

The final result is:

$$v = \pm\sqrt{(Q^2/4\pi\varepsilon r^2 - G\sin\theta/\cos\theta)(4\pi\ r^2/\mu Q^2)}$$

The meaning of the plus-minus sign on the speed v is that, whether v moves forward or backward, the produced electromagnetic force is inward.

When I am driving, I also often ask: if I hang two charged bodies on my car hood, when I park, drive, speed up and speed down, can I observe motion of charged bodies? If the charged bodies are fixed on the roadside, when I drive and pass by them, can I observe motion of charged bodies? What will be the result if the charged bodies are fixed in closed space?

If the principle of relative motion is used to explain the phenomenon, the result is very confusing. Because no matter whether the two charged bodies are in open space or in closed space, only with a reference substance for relative motion, do the two charged bodies produce electromagnetic force, which will shorten their distance r. Different moving substance has different speed, so the calculated result will be different, the true problem is not lie in here, the true problem is in whether the experiment supports the conclusion.

According to my Hypothesis, the problem is easy to be explained. The prerequisite for a charged body to produce a magnetic field is that there be mutual contact and relative motion between charged body and the surrounding medium. Therefore, if the two charged bodies move in the medium, then charged Body 1 will produce magnetic field in medium, charged Body 2 will move in the magnetic field by cutting magnetic line of force, so charged Body 2 will produce electromagnetic force, and *vice versa*.

If a charged body moves together with the medium, because the charged body does not produce a magnetic field, as well as not cut magnetic line of force, the charged body does not produce electromagnetic force. Therefore, when the two charged bodies move relative to air, the inward electromagnetic force produced by charged bodies will shorten distance r between the two charged bodies. Electromagnetic force produced by charged body is not produced due to my existence, if I am in closed space, I still can see the effect. Therefore, install the device outside the object, when the object moves, by observing the effect and measuring distance r between the two charged bodies, even I am in closed space, and I still can sense my moving state and speed.

If the two charged bodies are placed on roadside, and stay motionless relative to air, when I drive by and pass them, I can find that the charged bodies do not produce magnetic field, and do not produce inward electromagnetic force; the two charged bodies do not move and their distance r is changeless.

When a charged body is placed in closed space, and if it changes state following closed space, as long as there is no relative motion between the charged body and medium in closed space, then it does not matter if there is, or is not, motion in the closed space, and no matter what the moving state of any reference substance outside, the charged body will not produce magnetic field or electromagnetic force.

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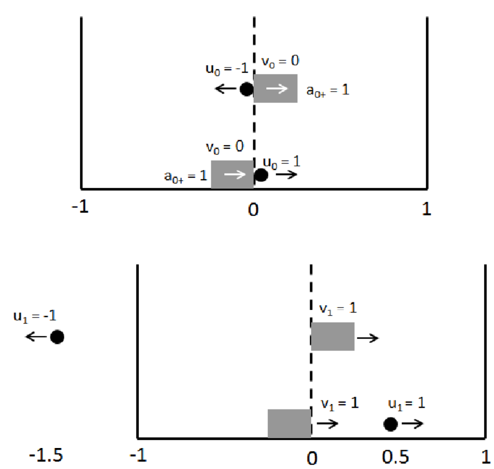
Accelerating Clocks Run Both Faster <u>and</u> Slower

Continued from p. 30

Case 1. Acceleration in Speed, not Direction

In Fig. 1, a boxcar of length two (arbitrary units) has a pair of guns (grey) mounted to fire in opposite directions at its midpoint (shown here as 'upper' and 'lower'). At time 0, when the boxcar is stationary, both guns fire projectiles at equal speeds of u0 = 1/sec (s). At an infinitesimal time later (0+), the boxcar, and therefore the two fixed guns, is accelerated to the right at a0+ = 1/s2 (white arrows). Since both projectiles have already left their guns, neither 'feels' this acceleration, so each continues on its path at the original, constant speed. After 1 s, the boxcar has traveled x = (1/s2)(1 s)2/2 = 0.5 to the right, now also the positions of the two guns (now with speeds of v1 = [1/s2][1 s] = 1/s to the right). Relative to their starting points in the boxcar, the projectiles have now reached the following positions: lower at +0.5, upper at –1.5 (having passed through the left wall of the box car).



Accelerated clock runs faster or slower.

Figure 1. Case 1. Boxcar Accelerating in Speed Only, not Direction.

Continued on page 39

Matter & Electromagnetic Radiation: Conflicting Concepts

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This article points out and discusses some present-day conflicts among commonly-used concepts in Physics, and shows how conflicts might be resolved, and further progress might be made, particularly in our understanding of matter, starting with atoms.

1. Introduction

The motion of matter and electromagnetic radiation (EMR) are presently considered to be interdependent, with the motion of the former being involved in the generation of the latter [1,2]. The particles of matter involved in the generation of EMR are considered to possess mass, and are arranged into atoms. The atom is proposed as consisting of one or more particles of one type (electrons) orbiting a central group (nucleus) of different types of particles (protons, neutrons, maybe more). A change in orbit of the circulating particle gives rise to gain or loss of energy emitted as electromagnetic radiation. The latter phenomenon is perceived in the form of 'photons' with a particular energy or waves of a particular wavelength [1].

A photon is proposed as being a discrete particle having zero mass, no electric charge and an indefinite lifetime. It is further proposed that the electromagnetic radiation is both released and gained in discrete amounts named quanta on the grounds that continuous energy release would the result of the orbiting particles leaving obit and becoming components of the central mass thereby ending radiation emission. Since radiation is generated by the motion of matter and is transmitted by and through matter it follows that radiation cannot move through a vacuum. Therefore the concept that the limiting velocity of light is the velocity in a vacuum is not valid [2]

The above concepts have given rise to the following values for particular parameters for the neutron particle, a particle involved in the structure of atoms

1) Neutron mass = 1.67×10^{-24} gm

2) Neutron radius = 2.3×10^{-13} cm

From these, the following parameters can be estimated:

3) Neutron volume = 5.097×10^{-38} cc

4) Neutron density = 3.27×10^{13} gm/cc

The value of neutron density implies that the density of matter progressively increases as the dimensions diminish, that a state of matter exists in which the density value approaches infinity, and that the zero existence of matter defines the nature of infinity. In order for the density of a neutron to have a value in accordance with measured values for other elements and compounds, the radius is required to have a value of the order of 10^{-9} cm. Such a value precludes the inclusion of neutrons into the central nucleus arrangement, given the present measured dimensions associated with atoms, such as chemical bond length.

Considerations of the relative motion of bodies of matter and electromagnetic radiation gave rise to the concepts of 'rest mass', defined as a quantity of matter without motion, and 'increase in the mass' of a body of matter with increasing speed [2]. A state of rest would result in the cessation of the proposed particle motion and collapse of the atom structure described, unless it is considered that a mass of matter can be at rest while the components of matter continue in motion. This is impossible when particles of matter are considered to have mass.

It follows from the second concept that the particle involved in the above-described orbit change undergoes a change of mass; that is, the quantity of matter changes. This requires the existence of a means of increasing and decreasing mass as velocity varies, for example, by the conversion of electromagnetic radiation to mass. Such a conversion is also made impossible by the proposed atom structure described that involves change in velocity only [1]. EMR has been described mathematically as two vibrations moving through space at right angles to one another, one vibration represents electric motion, and a second represents a magnetic motion. The present structure of the atom does not represent this description. Entropy is defined as the degree of disorder or randomness in the system that is gradual decline into disorder. There is no relationship of entropy to the structure of matter as presently envisaged.

As a consequence, the present concepts of the organization and properties of the ultimate components of matter, the generation and motion of electromagnetic radiation, and the relative motion of each, are in conflict.

2. Atom Structure and Properties

It is perfectly possible to devise an atomic structure in which motion of electrons induce vibrations in three directions passing through matter. A structure of atoms has been described based on the concept that at all temperatures above Absolute Zero neutrons are rotating [3]. The neutrons are further postulated to progressively disintegrate with increasing rotational energy giving rise to a variety of particles of matter. The fraction of neutron mass lost dictates the type of particle emitted and the type of rotating particle remaining after release. The latter also undergoes disintegration and particle release under conditions where rotation continues and the rotational energy continues to increase.

This means that protons, for example, also undergo rotation disintegration. The initial particle emitted by neutron is identified as an electron. This assumption is supported by the observation that free neutrons disintegrate into an electron and a proton. The released electron carries a fraction of the energy possessed or acquired by the neutron at the time of release. The above conditions allow structures to be formed comprising two or more spinning neutrons arranged in a circular planar rings and linked by emission and capture of electrons. The Coulomb force of attraction between proton and electron, which appears simultaneously with ejected electrons, results in the electron traveling in a trajectory to capture by the neighboring proton formed in the ring. These transfers produce an intermittent circulation of electrons in trajectories around the planar ring. The trajectories are orientated in the plane of the ring and the direction of circulation is decided by electron repulsion. The neutron positioning around the ring has a minimum value such that proton repulsion does not destabilize the structure. Three such ring circulations arranged at right angles enclose a sphere of empty space with the ring centers coinciding with the sphere centre. Such a structure is designated an atom cage. Complex atoms are advanced as being formed by many such cages, one inside the other. The radius length of the cages decreases as the centre of the atom is approached, giving the impression of atoms having a core where none exists [3].

An increase in neutron rotational energy arises by application a tangential force through a non-capture encounter with a neutral, positively or negatively charged particle of matter, or by collision capture of a particle. The first instance increases the rotation rate and the second increases the mass. The characteristics of electron trajectories from emission to capture are dependent on the kinetic and rotational energy imparted to the electron at the time of release. The smaller the trajectory radius is, the higher the electron kinetic energy is and the shorter the transit time is. Reduction of the electron trajectory radius while in orbit increases the electron energy. Trajectory electrons undergo repulsion on approaching each other in the neighboring circulations of internal cages of an atom and external cages of closely positioned atoms.

The repulsion has maximum value at the point of closest approach in the trajectories, which is normally at the center point of the latter. The repulsion therefore reduces the value of trajectory radii increasing the energy of the transferring electron and the neutron formed on capture. The latter again emits the electron sustaining continuous circulation. This interaction represents the conversion of potential energy to kinetic energy. The ring diameter oscillates between the states of electron transfer and no transfer. This change occurring simultaneously in all three rings produces a pulsing effect of the cages. The effect is transmitted in all directions within an atom and to neighboring atom structures by repulsion and represents the electric component of electromagnetic radiation. The repulsion effect of trajectory electrons is also directed at right angles to the plane of a ring, giving rise to repulsion in this direction. This produces a twisting effect of the ring planes occurring simultaneously with the above pulsation and represents the magnetic component of electromagnetic radiation.

The above structure defines the value of wavelength (λ) as trajectory length, the value of frequency (ν) as the reciprocal of the time in orbit, that is, the transit time. From this the multiple of wavelength and frequency results in the velocity of radiation being constant. The spectral lines identifying an element are generated by oscillations in cages specific to the element. This includes hydrogen, deuterium and tritium where the neutrons are arranged into single planer rings [3]. The intensity of electromagnetic radiation is a function of the number of electrons in transit at any one period of time in a given mass of matter. The electron trajectory radii at surface between two states of matter are held in balance by repulsion. Reduction of the trajectory radius of one state results in a balancing increase in the electron trajectory radius of the second state. This mechanism is the origin of the photoelectric effect. The trajectory reduction in the gaseous transmitting medium in contact with the non-transmitting metal surface, by passage of the illuminating electromagnetic radiation, results in electrons appearing above the metal surface as the trajectory radius in this state increases.

This phenomenon occurs provided the trajectory radius in the transmitting medium is sufficiently reduced by interaction with the impinging electromagnetic radiation. This requires a particular value of the trajectory radius in the latter, that is, a particular frequency, as observed. Induced movement of electrons between cage rings by electron injection from a source linked to the body of matter involved represents electric current flow. When the electron emission energy creates a direct transfer trajectory, *i.e.*, when the value of the trajectory radius approaches zero, the result is the highest frequency of electromagnetic radiation.

Higher electron release energies result in failure of capture by the proton, producing the ionized state. Simultaneous avoidance of capture by a majority of electrons in a given mass of matter leads to disintegration of the atom structures. The repulsion force between trajectory electrons is inversely proportional to the separation distance. The latter is proportional to the trajectory radii. For equal radii the force is inversely proportional to the square of the radii. This represents Coulomb's inverse square law, which originates from the trajectory interactions described. Decrease in the conversion of potential energy to kinetic energy, originating with random change of trajectory characteristics, causes cessation of the radiation in regions distant from the point of initiation of electromagnetic radiation. This structure of atoms and motions within an atom has been applied to explain the Doppler effect and the description of natural phenomena given support the atom structure outlined [4].

3. Effects Linked to Generation of EMR

A proposed explanation of the Michelson-Morley Experiment results was that the major length of the principle component of the equipment used in the experiments had contracted. The extent of contraction is given by $1\big/\sqrt{1-v^2/c^2}$, and is known as the 'Lorentz contraction'. The v is the value of the speed of Earth in orbit and c is the speed of electromagnetic radiation [5,6,7]. The velocity of Earth in orbit is 30 km per sec. At this speed, the factor v^2/c^2 has the value 1.0×10^{-8}, and represents the proposed length contraction of the major component of the equipment under these conditions. A Hydrogen molecule comprises two neutrons exchanging electrons in a ring circulation.

The Hydrogen-Hydrogen bond has a value of 7.4×10^{-9} cm, and this is identified as the trajectory length. This trajectory length is the longest stable trajectory, and is representative the trajectory length in the rings of the outermost cages of the majority of atoms [3]. The value of the Lorentz contraction above is identified as the trajectory length and indicates that the Michelson-Morley experiment measured the oscillating change in component length associated with electron transfer.

Planck's constant h has the unit erg × second, which converts to dyne × centimeter × second, and then to gram × centimeter per second per second centimetre second. The latter reduces to mass (m) × speed (v), × distance (d), or momentum (mv), times distance (d). Identifying m as the neutron mass, v as the peripheral speed, d as the neutron radius r, the angular momentum of the neutron is mvr. Planck's constant is a unit of angular momentum related to the angular momentum of the rotating neutrons. This establishes that the condition of rotation is associated with the fundamental nature of matter. The established value of the constant is also indicative of being associated with a minute mass of matter.

The value of E in the relationship $E = h\nu$ is identified as the energy of a photon of electromagnetic radiation, where h is a constant and ν is the frequency of radiation [8]. The frequency of electromagnetic radiation from the atom model above is given by $\nu = 1/t$, where t is period time and time $t = nt_1$, and n is a whole number. From this we find $E = h\nu = h/t$. Inserting the relationship above for h yields $E = mvdn/t = nmv^2$. If the value of n in the above relationship is identified as $1/2$, giving $E = mv^2/2$. From this, the energy of a photon represents the energy of the electron in a trajectory [3].

As the peripheral velocity of the neutron (v) attains the value of the velocity of electromagnetic radiation (c), the angular momentum (mcr) is proposed as having the value of the Planck constant (h). The angular momentum involved is the classical angular momentum of a rotating body and not electron "momentum" ($h/2\pi$) used in quantum mechanics. Identifying v as the peripheral velocity of a neutron, ω as the angular speed, and the neutron radius as r, then $v = \omega r$, $\mathrm{KE} = I\omega^2/2 = mv^2/2r^2$ and $m = 2\mathrm{KE}r/v^2$. From this, $mv^2 = 2r\mathrm{KE}$. As v^2 approaches c^2, $2r$ approaches zero and KE approaches mc^2. When $r \to 0$, the neutron mass is entirely converted to energy, giving $E = mc^2$.

The energy value of an electron on an ejection from a neutron is 1.5 x 10^{18} ev [3]. From the above, the limiting value of the angular momentum of a neutron is 1.069 10^{-27} gm cm^2 sec^{-1}, or 2.2×10^{18} ev, corresponding to the condition where the peripheral velocity equals the value of of electromagnetic radiation. No particles with energies equal to or greater than this value are known (9,10). The Solar system the flux of particles with an energy value of 10^{18} ev is of the order of 1.0 particle/km^{2}yr, equivalent to 1.0 particle/cm^2 10^{-5} years. This observation supports the proposal that a neutron is completely converted to energy when the peripheral velocity equals that of electromagnetic radiation.

Assuming the trajectories in hydrogen molecules as a semicircles and each equal to the measured molecule bond length, then the circumference of the circle formed is $2\pi r = 2 \times 7.9 \times 10^{-9}$ cm and $r = 2.5 \times 10^{-9}$ cm. The closest approach of the neutrons is contact. Taking the circumference of the trajectory circle as passing through the neutron centers the radius of a neutron is of the order of 1.25×10^{-9} cm, and the neutron density calculated from this value is 8.2 gm / cc. As the angular momentum of the neutron approaches the limiting value of $mcr = h$ the value of the neutron radius has decreased by loss of matter to a value of 2.12×10^{-14} cm [3]. The value of neutron radius of 2.3×10^{-13} cm above gives the peripheral velocity of the neutron as approximately 90% of the velocity of light under the conditions of measurement.

It is observed that a difference exists between the measured atom mass and the expected atom mass obtained by summation of the particle masses present in the atom being considered. Since atoms have mass and occupy volume these units have density. From this as mass changes either volume changes making atom density constant or the volume remains unchanged causing a change in atom density. In the atom model described the particles involved are neutrons. As the atom cages are formed the repulsion between the formed protons in a given cage and between rings of different cages decides the stable volume of a cage [3]. As the number of cages one inside the other increases the repulsion between protons leads to compression of the structure directed towards the centre and decreases the total volume. As the density remains constant, the observed mass decreases in sympathy.

4. Additional Consequences

1. As the velocity of motion of a body of matter is increased towards that of light at least one of the electron trajectories in the ring circulations is directed a right angles to the direction of motion. The motion therefore displaces the receiving proton while the electron is in a trajectory. This proton displacement results in avoidance of electron capture as increase of the velocity of the body of matter progresses. The result is collapse of atom structure. From this progressive increase of the mass of a body with increasing velocity does not therefore occur [2].

2. Avoidance of the electron capture can be induced by extreme compression of matter. This moves the relative proton positions while the electrons are in orbit and induces collapse of the atom structure. Collapse involving a kilogram of uranium-235 atoms has been shown capable of generating equivalent to 14.9 kilotons of TNT at 100% efficiency [3]. This is to be compared with 13 kilotons generated from 7.5 kilograms of uranium-235 involved in the atom device used at Hiroshima.

3. As a body is progressively cooled the neutron rotational energy decreases and the released electron energy diminishes. Finally electron emission ceases and matter progresses towards a group of neutrons in space without motion. This condition is proposed as occurring at Absolute Zero and is identified with Absolute Rest envisaged by Newton [13]. The condition is also represents maximum entropy since the neutrons are positioned in total disorder

5. Conclusions

1. The presented concept of atomic structure is in agreement with observations, which implied that the atom structure comprised largely empty space [11].
2. The particles involved in the structure are not required to have dimensions allowing confinement in a close central mass, as is presently envisaged.
3. Electromagnetic radiation is a disturbance passing through matter in the form of vibrations generated by the motion of particles in trajectories, and hence involves the characteristics of waves and particles.
4. Matter is identified as the aether, which is postulated as being required for the motion of electromagnetic radiation as described by the electrodynamics equations of Maxwell [12].
5. The atom structure described resolves the conflicts detailed.

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Accelerating Clocks Run Both Faster *<u>and</u>* *Slower*

Continued from p. 35

Case 2. Acceleration in Direction, not Speed

For the next two cases, it is convenient to examine circular motion, as that inherently involves directional acceleration and, if rotational speed is changed, acceleration in speed as well. First, we consider the case of acceleration due only to directional change, as shown in Figures 2.1 and 2.2. In Fig. 2.1, a carousel (torus) rotates at a constant speed of 2π radians/s, such that the tangential speeds vt of the inner and outer rims are 2/s and 6/s, respectively, given the radii shown (in arbitrary length units). A grey gun fixed to the inner rim, with its end rotating at vt = 2/s, shoots a projectile from Point 0 at radial speed vr = (100/π)/s such that it travels at speed v = ([2/s]2 + [{100/π}/s]2)0.5 = 31.89/s at angle α = arctan (2/[100/π]) = 0.06275 radian (3.595o). It follows Path 0-B to hit the outer rim at Point B after traveling a length of {2cos(π-α) + ([2cos(π-α)]2 + 32)0.5}/2π = 0.6370, using the law of cosines. The elapsed time is (0.6370)/(31.89/s) = 0.01997 s. Point A, on the outer rim, immediately above the gun, rotates to Point A′ = (0.01997 s)(2π radians/s) = 0.1255 radian (7.191o) from the original Point A. Point B corresponds to rotation by arccos {(π2/6) (10/π2 -0.63702)} = 0.04185 radian (2.398o).

Define a new time unit, the 'zek' (z), as the time for the projectile to hit the outer rim. When stationary, one z = (3/π - 1/π)/([100/π]/s) = 0.02 s. When rotating as shown, one z = 0.01997 s, i.e., 'time' appears to have sped up by (0.02 – 0.01997)/0.02 = 0.001313 (~0.13%). But really time has not varied; only the directional acceleration has caused an apparent speeding up by ~0.13%. If we use the projectile hitting the outer rim as a clock and standardize it when the carousel is stationary (one z), we conclude that, when accelerated, the clock runs faster (1 + 0.001313 = 1.001313 z by the standard clock).

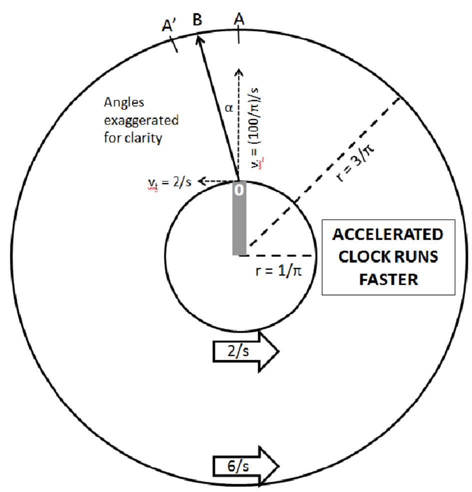

Figure 2.1. Carousel Rotating at Constant Speed with Gun Mounted on Inner Rim – Directional Acceleration Only

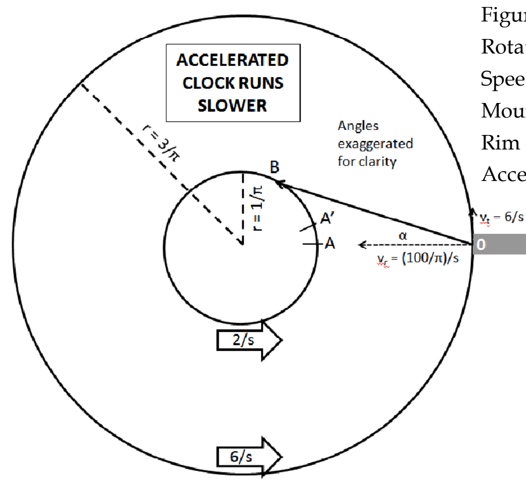

Figure 2.2. Carousel Rotating at Constant Speed with Gun Mounted on Outer Rim – Directional Acceleration Only.

Fig. 2.2 is the same as Figure 2.1, but with the gun mounted on the outer rim. With its end rotating at v_t = 6/s, it shoots a projectile from Point 0 at radial speed v_r = (100/π)/s such that it travels at speed $v = ([6/s]^2 + [\{100/\pi\}/s]^2)^{0.5}$ = 31.93/s at angle α = arctan (6/[100/π]) = 0.1863 radian (10.67°). It follows Path 0-B to hit the inner rim at Point B after traveling a length of {6 cos α -

$([6 \cos \alpha]^2 - 32)^{0.5}\}/2\pi = 0.6738$, again using the law of cosines. The elapsed time is (0.6738)/(31.93/s) = 0.02111 s. Point A, on the inner rim, immediately below the gun, rotates to Point A′ = (0.02111 s)(2π radians/s) = 0.1326 radian (7.598°) from original Point A. Point B corresponds to rotation by arccos $\{(\pi^2/6)\ ([10/\pi^2 - 0.6738^2)\}$ = 0.4029 radian (23.08°).

Now define the zek (z) as the time for the projectile to hit the inner rim. When stationary, one z again = 0.02 s. When rotating as shown, one z = 0.02111 s, *i.e.*, 'time' appears to have slowed by (0.02111 – 0.02)/0.2 = 0.05523 (~5.5%), an opposite effect. But really time has not varied; only the directional acceleration has caused an apparent slowing by ~5.5%. If we again use the projectile hitting the inner rim as a clock and standardize it when the carousel is stationary (one z), we conclude that, when accelerated, the clock runs slower (1 - 0.05523 = 0.94477 z by the standard clock). As with Case 1, direction matters.

Case 3. Acceleration in Both Speed and Direction

For the final two cases, we continue with our rotating carousel, but now with the addition of acceleration in rotational speed. In Fig. 4 3.1, the carousel rotates as before, with the grey gun mounted on the inner rim shooting a projectile as before. However, now at an infinitesimal time later (0+), the carousel is accelerated at 2π radians/s², such that the tangential accelerations a_t of the inner and outer rims are 2/s² and 6/s², respectively (grey arrows). The projectile does NOT experience this acceleration and, as before (Fig. 2.1), reaches the outer rim in 0.01997 s. Because the carousel now speeds up, it will rotate by [4π radians/s + (2π radians/s²)(0.01997 s)](0.01997 s)/2 = 0.1268 radian (7.262°), such that the projectile strikes the outer rim at Point B′, with a perceived trajectory 0-B′ now of length $[(10 - 6 \cos[0.1268])/\pi^2]^{0.5}$ = 0.6404.

When the carousel was not speeding up, the trajectory 0-B length was 0.6370 and required 0.01997 s (1.001313 z) to reach the outer rim. Now the length (trajectory 0-B′) is longer (0.6404) and requires 0.6404/([100/π]/s) = 0.02012 s, or ([1.001313 z][0.02012 s]/[0.01997 s]) = 1.008644 z, to reach the outer rim. That is, more time has elapsed, which means the additionally accelerated clock (speed plus direction) now runs faster by (1.0086443 – 1.001313)/(1.001313) = 0.007321 (~0.73%).

Figure 3.2 is the same as Figure 3.2, but now with the grey gun mounted on the outer rim with its end rotating at v_t = 6/s. Again, at an infinitesimal time later (0+), the carousel is accelerated at 2π radians/s², such that the tangential accelerations a_t of the inner and outer rims are 2/s² and 6/s², respectively (grey arrows). The projectile does NOT experience this acceleration and, as in Fig. 3, again reaches the inner rim in 0.02111 s. Because the carousel now speeds up, it will rotate by [4π radians/s + (2π radians/s2)(0.02111 s)](0.02111 s)/2 = 0.1340 radian (7.677°), such that the projectile strikes the inner rim at Point B′, with a perceived trajectory 0-B′ now of length $[(10 - 6 \cos[0.1340])/\pi^2]^{0.5}$ = 0.6409.

When the carousel was not speeding up, the trajectory 0-B length was 0.6738 and required 0.02111 s (0.94477 z) to reach the inner rim (remember the zek has different durations based on direction). Now the length (trajectory 0-B′) is shorter (0.6409) and requires 0.6409/([100/π]/s) = 0.02013 s, or ([0.94477 z][0.02013 s]/[0.02111 s]) = 0.90132 z, to reach the inner rim. That is, less time has elapsed, which means the additionally accelerated clock (speed plus direction) now runs slower by (0.94477 – 0.90132)/(0.94477) = 0.04599 (~4.6%). Again, as with Cases 1 and 2, direction matters.

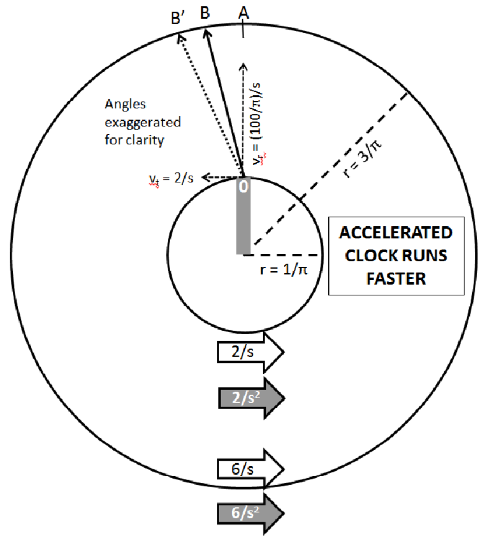

Figure 3.1. Carousel Rotating at Increasing Speed with Gun Mounted on Inner Rim – Both Speed and Directional

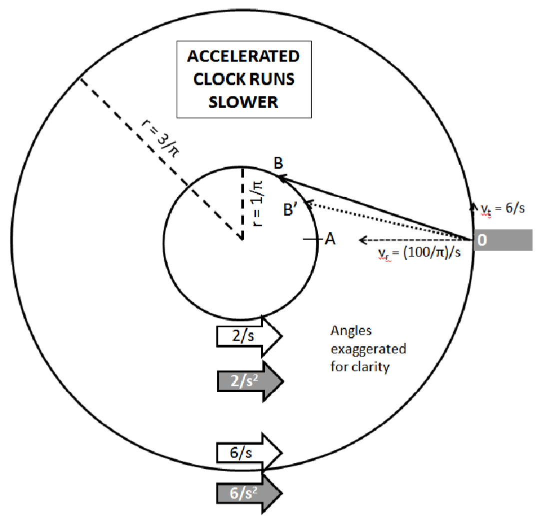

Figure 3.2. Carousel Rotating at Increasing Speed with Gun Mounted on Outer Rim – Both Speed and Directional Acceleration.

4. Conclusion

Can accelerating clocks run both faster and slower? Sprague believes so, and provides his arguments on his website. I endeavored to examine this possibility using three cases considering both speed and directional changes as part of acceleration. As a result, I come to the same conclusion. This does not imply any belief in the variation of time itself, whether under constant or accelerating velocities, but merely a physical effect on an <u>accelerating</u> 'clock.' It also does not imply any belief that a clock moving at a <u>constant</u> velocity, even near the speed of light, will show any variation. The key is acceleration. And direction matters.

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