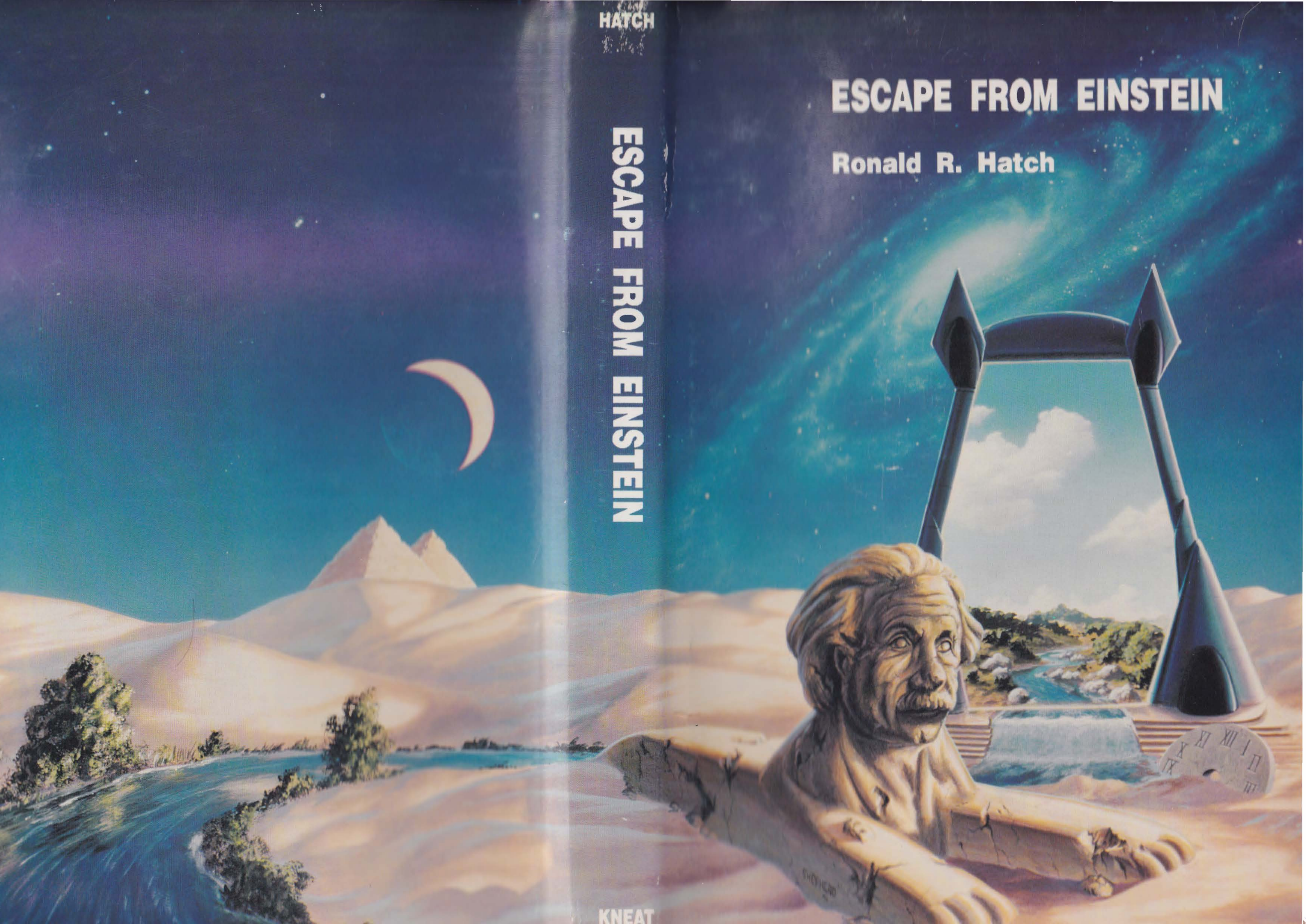
HATCH
ESCAPE FROM EINSTEIN
KNEAT
ESCAPE FROM EINSTEIN
Ronald R. Hatch

ESCAPE FROM EINSTEIN

Einstein's fame can, to some extent, be ascribed to the fact that he originated a theory which, though contrary to common sense, was in remarkable agreement with the experimental data.

Ron Hatch claims there is increasingly precise data which contradicts the theory. But he does not stop there. He offers an alternative—an ether gauge theory, which offers an unparalled, common-sense explanation of the experimental data. The new theory is distinguished by:

- a return to time simultaneity, even though clocks (mechanical and biological) can run at different rates
- the replacement of the Lorentz transformations with gauge transformations (scaled Galilean transformations)
- a unification of the electromagnetic and gravitational forces
- a clear explanation of the source of inertia
- a clear and consistent explanation of the physics underlying the equivalence principle

In addition to the above, a comprehensive review of the experimental record shows that the new ether gauge theory agrees with experiment better than the special theory. This releases everyone from the necessity of accepting a nonsensical theory which denies the common, ordinary sense of elapsed time.

Rather than curved space, the ether gauge theory postulates an elastic ether. This results in relatively minor modifications to the general theory mathematics—but with significant interpretational differences.

ESCAPE FROM EINSTEIN

Ronald R. Hatch

A KNEAT BOOK

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PREFACE

The person who tackles Einstein's theories appears to most others as one with an excess of gall and an insufficiency of intelligence. If this is your opinion, I beg your indulgence. Please consider the arguments presented.

I first began to question Einstein's special theory of relativity more than fifteen years ago, after being confronted with the twin paradox for the first time. The typical explanations seemed to me (then and now) more like poor excuses than reasoned logic. The twin paradox is reviewed in the first chapter.

Einstein moved from the special theory of relativity (a velocity theory) to the general theory of relativity (a gravitational theory) by calling upon the equivalence principle. Yet that same equivalence principle shows that the special theory and the general theory are incompatible. This incompatibility is explored in the second chapter, and an alternate theory is proposed.

The alternate theory employs a solid mechanical ether, a concept which was discarded at the turn of the century. A particular ether is proposed such that the presence of mass results in compaction of the ether which is the same as an apparent curvature of space. The bottom line is a gravity theory very similar to the general theory. But now the equivalence principle can be used in the opposite direction—to go from a gravity theory to a velocity theory. The resultant velocity theory explains the same phenomena as the special theory—but without any paradoxes.

The development of the new ether gauge theory with a gravity gauge and a velocity gauge was aided immensely by M.G. Bowler's book, *Gravitation*, (Pergamon Press, New York, 1976). I encountered his book when I was first struggling to describe the gauge effects of gravity. Bowler's description of the general theory in terms of gauge changes saved many hours of effort. While his book was a very big help in developing the new theory, there is no indication that Bowler would be sympathetic to this alternative to Einstein—in fact, quite the opposite is indicated by some of his comments regarding the twin paradox.

The unification of gravity with electromagnetism was a goal long sought by Einstein. This unification is accomplished in the third chapter. Of necessity, the development involves more mathematics than is desirable in a book aimed at a wide audience.

While the idea behind the unification is mine, the development was aided significantly by Beckmann's book, *Einstein Plus Two*, (Golem Press, Boulder, 1987). Beckmann's book encouraged me in two ways. First, it showed me that I was not alone in questioning Einstein's theories or in supposing that the speed of light was with respect to the gravity field. Second, it showed me that, if I wanted my ideas to be considered seriously, I needed to put them on a sound mathematical basis. It was in pursuing the mathematical development that the unification concept presented in chapter three was developed.

Various aspects of the new theory are developed in the next five chapters. The fourth chapter considers doppler and aberration effects. It is devoted to showing that there is no free choice of frame using the special theory. This limited choice of frame is critical to many later arguments. The fifth chapter addresses the question of electromagnetic forces in the presence of charge motion. The Edwards effect, discussed in the fifth chapter, was brought to my attention by an article in *Galilean Electrodynamics* by Howard Hayden. The Sagnac effect, considered in the sixth chapter, was stimulated by my own experience using satellites for high-precision navigation and survey applications. The seventh and eighth chapters are intended to show that the new theory offers promise of resolving some of the current problems in physics.

The next four chapters address the experimental status of Einstein's theories and of the new theory. The ninth and tenth chapters contrast the special theory with the new theory. The eleventh and twelfth contrast the general theory and the new theory.

The last chapter, Chapter 13, presents a concise summary of the preceding chapters, together with a set of conclusions and a call to action. No penalty will be imposed for reading the last chapter first.

It is appropriate to make a number of acknowledgments. A number of my co-workers at Magnavox have provided criticism which has improved the presentation. I thank them. Others have also provided helpful criticism and asked pertinent questions. Bill Wilkinson has done both. He asked about the g-factor of the electron before I had noticed that it was explained by the electron model presented in Chapter 7. David Allan asked how the new theory could explain the apparent gravitational radiation indicated by the binary pulsar data of Taylor's. This led to a portion of the material in Chapter 12. Howard Hayden's article on the Edwards effect has already been mentioned.

I am very much indebted to Howard Hayden for setting me straight on the meaning and significance of the Mossbauer experiments discussed in Chapter 10. My discussion of the Mossbauer experiments follow his lead. Henry Palka has provided a number of significant references. Petr Beckmann has provided encouragement and help in the process of preparing the text for publication.

Note that, by expressing thanks to the above individuals, I am not implying that they endorse the new theory or even the resolution of the particular questions they have asked.

I also wish to express my thanks to a number of family members who have provided assistance. Ed, my brother, has suggested several ways to improve the text. He constructed an animated computer model of the electron corresponding to the description in Chapter 7. He also drew the figures in Chapter 7. In addition, he has spent many hours of time on long-distance telephone conversations regarding the new theory. These conversations have kept me writing when it would have been easy to postpone the work. Dean, another brother, has provided some helpful criticism regarding the clear distinction between the ether and the space in which it is embedded. Above all, I thank my wife, Nancy. She has contributed more than any other. Not only has she allowed me to shirk some of the normal household maintenance tasks; but, in addition, she has spent many hours attempting to correct my grammar and punctuation. Except where my innate stubbornness has caused me to ignore her suggestions, the book is, without doubt, much more readable.

A portion of Chapter 5, regarding longitudinal magnetic forces has been submitted for publication in the periodical *Galilean Electrodynamics*. The review comments by Thomas Phipps and Peter Graneau have been used to improve the presentation. A portion of Chapter 10, regarding the Pioneer 10 experiment was also submitted, but was rejected. The reviewers appeared to be confused by the role of a mirror within Einstein's special theory. Because I believe that experiment is so significant, I have rewritten it extensively and illustrated it with a number of figures in an attempt to clarify the presentation. The review comments of that experiment by J.P. Claybourne stimulated some additional material in the second chapter regarding the equivalence principle.

I am indebted to John McAfee who commissioned the jacket painting.

Wilmington, CA, 11 December 1991 Ron Hatch

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THE PROBLEM

Arguing with Albert

> Modern physics resembles a three-legged stool. The legs are: (1) Einstein's special theory, (2) Einstein's general theory, and (3) the quantum theory. The stool is rather wobbly. It seems the cross-bracing between the legs is rather ill-fitting. The braces refuse to stay in place. Isham (1989) says that workers trying to find a theory of quantum gravity (a joining of legs two and three) have encountered such serious incompatibilities that they have coined a phrase which is the antithesis of the marriage vow:
>
> What God has put asunder, let no man join together!
>
> In this chapter the first leg, the special theory, is shown to be faulty. This leg needs to be completely removed (and replaced later) in order to restore the stool.

No, I am not a member of the Flat Earth Society. No, I do not believe that fire is caused by the escape of phlogiston. Yes, I do believe that Einstein's special theory of relativity is wrong.

Because so many of the special theory predictions have been checked and verified time after time, many scientists bestow a super status upon the special theory. This is illustrated by two quotations from Clifford Will:

> Experimentally, there is simply no doubt about its validity; it has been checked and rechecked and confirmed time and time again. (Will 1986, xii)

> Special relativity is so much a part not only of physics but of everyday life, that it is no longer appropriate to view it as the special "theory" of relativity. It is a fact, as basic to the world as the existence of atoms or the quantum theory of matter. (Will, 1986, 246)

David Jackson (1987, 34) has made a similar statement:

> Special relativity is a fact of life, part and parcel of the way nature is.

Obviously, these are overstatements. The same could have been said with more justification of Newton's theory of gravity prior to Einstein's general theory. Every object that fell was, in Will's sense of the word, a confirmation that the theory was correct. In truth, a theory can only be measured against its alternatives. If an alternate theory could be formulated which predicted and met all the same experimental evidence but was free of the anti-intuitive features of the special theory, it should clearly replace the special theory—that is, if it could receive a fair hearing.

Many of the giants of turn-of-the-century physics did not accept the special theory. These included Mach, Lorentz, Poincaré, Michelson, Lodge, and Lord Kelvin. The most commonly offered explanation for this is that it takes time for a new paradigm or thematic hypothesis to be accepted. Houlton (1986) makes the comment:

> ... during a stage of transformation, the significance and impact of themata is indicated by the fact that they force upon people notions that are usually regarded as paradoxical, ridiculous, or outrageous. I am thinking here of the "absurdities" of Copernicus's moving earth, Bruno's infinite worlds, Galileo's inertial motion of bodies on a horizontal plane, Newton's gravitational action without a palpable medium of communication, ... Einstein's twin paradox and maximum speed for signals, ... or Heisenberg's indeterminacy conception.

But, if this were the only reason for non-acceptance of the special theory, it would be expected that after 85 years it would be accepted by all—of course, with the normal number of cranks excepted. But such is not the case. There are a substantial number of scientists who, having studied the theory, find it indeed absurd. It is difficult to estimate how many. They are denied a hearing in the major scientific journals. Herbert Dingle is a prominent example. He was the author of a textbook explaining the special theory, yet later he argued forcefully against its acceptance. His attempts to alert the scientific establishment to the logical inconsistency of the special theory were completely rebuffed. He felt the reason his arguments were rejected was:

> that the only possible answer proves the theory to be wrong, and physicists have lost the power to believe that—the cardinal sin in science—and so remain silent. (Dingle 1977)

and:

> It is simply that physicists have, unawares, allowed their trust in special relativity to escape the control of reason and become a blind slavery to dogma, ... (Dingle 1976)

The statements of Will and Jackson certainly support Dingle's claims. Relativity theory was not written by God on tablets of stone.

In this chapter I intend to show that, in fact, the special theory fails the experimental test. The failure becomes apparent when the twin paradox, embodied within the special theory, is considered in detail. None of the "simple" solutions of the paradox found within the literature survive the experimental test. In fact, the experimental evidence contradicts the special theory. Before addressing the twin paradox, though, it is important to obtain a basic understanding of the special theory—and what it is that makes it difficult to believe.

The Special Theory of Relativity

Einstein's special theory of relativity is an extension of the Galilean principle of relativity. Galileo claimed that the laws of physics were unchanged by the velocity of an observer. Thus, for example, the physics of pouring water into a glass while in a moving ship's stateroom (assuming a perfectly calm sea) was claimed to be no different than pouring a glass of water while stationary. Galilean relativity claims that physics is invariant (does not change) under a Galilean transformation.

A Galilean transformation is a mathematical procedure for specifying how the coordinates (position description) of a point measured with respect to one coordinate system will change if it is measured instead with respect to a second coordinate system which is moving at a constant velocity with respect to the first.

This can be easily illustrated. Let Terrance and Stella be twins, and place each at the center of his own coordinate system. Furthermore, to keep the transformation simple, choose the axes of the coordinate systems such that they point in the same direction. In addition, for later comparison with the Lorentz transformation, treat time as a dimension. Finally, in the twins'

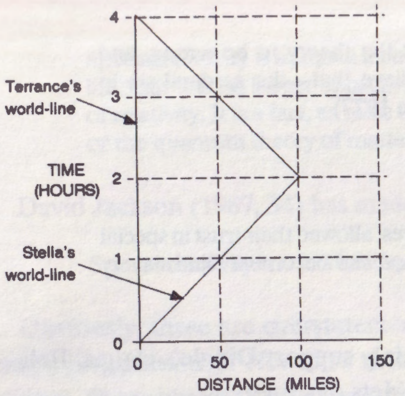


Figure 1.1 Space-time diagram from Terrance's point of view

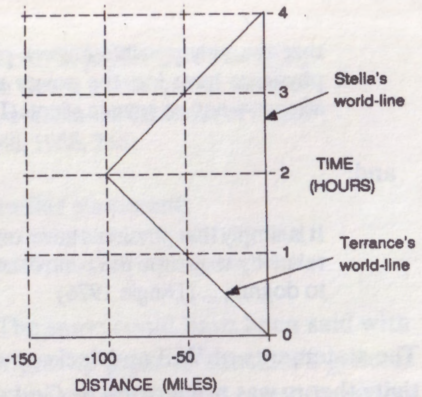


Figure 1.2 Space-time diagram from Stella's point of view

coordinate systems, assume the time axes to be parallel and their clocks synchronized (set to the same time) and running at the same rate.

Now, let's set the clocks to zero time and simultaneously send Stella away from Terrance on a train traveling at 50 miles per hour. She travels for two hours, then turns around and returns at the same speed. No loss of generality occurs if the X axis is chosen to lie in the direction of the train's velocity. This allows us to ignore the Y and Z directions and draw in Figure 1.1 a space-time diagram of the trip from Terrance's viewpoint. The path of an observer in space and time is referred to as that observer's world-line. The same trip from Stella's viewpoint is shown in Figure 1.2. Of course, it can be argued that the two figures are not truly symmetrical, since Stella would have encountered some acceleration effects as she turned around to make the return trip.

The relationship shown in the two figures, when expressed in equation form, is referred to as the Galilean transformation. Specifically:

$$X_t = X_s + vT_s \quad (1.1)$$
$$Y_t = Y_s \quad (1.2)$$
$$Z_t = Z_s \quad (1.3)$$
$$T_t = T_s \quad (1.4)$$

where: X, Y, Z, and T are the coordinates
v is the velocity
s is the subscript used to identify Stella's coordinate system
t is the subscript used to identify Terrance's coordinate system

This set of equations describes how to find the coordinates of any point located in Terrance's coordinate system in terms of the corresponding coordinates in Stella's coordinate system. The inverse transformation is very similar:

$$X_s = X_t - vT_t \quad (1.5)$$
$$Y_s = Y_t \quad (1.6)$$
$$Z_s = Z_t \quad (1.7)$$
$$T_s = T_t \quad (1.8)$$

The Galilean transformation worked very well with the laws of mechanics as formulated by Newton. However, with the development of electromagnetic theory in the nineteenth century, problems developed. In particular, measurements involving the speed of light seemed to be in disagreement with the Galilean transformation.

From the form of the equations above, it is easy to show that the Galilean transformation implies that velocities add as vectors. Let Terrance and Stella have a sister, Astra. Now suppose Astra is moving along the X axis at a speed of 50 miles per hour with respect to Terrance, and suppose Stella is moving in the same direction along the X axis at a speed of 50 miles per hour with respect to Astra. The Galilean transformation equations can be used to express the coordinates of Stella in terms of Astra's coordinate system and then, applying the transformation again, to express the result in terms of Terrance's coordinate system. The final result shows that the velocity of Stella with respect to Terrance is 100 miles per hour—the sum of the component velocities.

The above result is simple and seems obvious. However, when the speed of light was involved, the predicted results did not agree with the experimental evidence. The Michelson-Morley experiment (to be considered in detail in Chapter 9) could not be explained using the Galilean transformation. Instead, the experiment indicated that the speed of light was the same in the direction of the earth's orbital movement as it was in the perpendicular directions. Thus, the experiment seemed to demand that the speed of light plus any other velocity still must equal the same speed of light.

Einstein proposed the extension of the principle of Galilean relativity to cover electromagnetic phenomena as well as mechanical phenomena. He postulated that the speed of light is constant with respect to the observer, whether that observer is moving or not, and that the speed of light is, therefore, independent of the velocity of the source. This postulate leads to a number of counterintuitive concepts. However, some of the predictions, such as the equivalence of mass and energy, were quickly supported by experimental evidence.

If the speed of light is constant with respect to the observer, velocities cannot be simply additive and the Galilean transformation cannot be correct. This, in turn, implies that two different coordinate systems which move at a constant relative velocity do not necessarily have time axes which point in the same direction; and clocks in the two systems do not necessarily run at the same rate.

It is possible to simplify the terminology somewhat by referring to an inertial frame of reference (frame) rather than a coordinate system. All coordinate systems moving at the same velocity are equivalent, and no significance is attached to any particular choice of which way each spatial-dimension axis points or even whether the coordinates are Cartesian. The significance of different frames is that they are moving at constant velocities with respect to one another, which in the special theory defines the relative direction of the time axes.

How can an observer in one frame assign to events in another frame a specific time in terms of his own time scale? Einstein proposed the radar rule. Specifically, if an observer sends an electromagnetic signal which reaches an object in another frame and is reflected back to the observer, the time at which the signal was reflected back is assigned a time equal to one-half the sum of the time of transmission plus the time of reception. (It is important to remember that this assigned time is the time of the observer's clock and not necessarily the time an observer in the other frame would assign to the same event.) This radar rule can be justified by treating the observer as stationary in his own frame. Since the speed of light is constant and isotropic (the same in every direction) in his own frame, the one-way transit times on each leg of the journey should be equal.

The radar rule allows us to construct a time mapping from one frame to another. This is done by constructing lines of simultaneity in space-time. A line of simultaneity consists of the points in space-time where the radar rule assigns the same time. These lines of simultaneity are easier to picture if distances are expressed in terms of light travel time. (Alternatively, time can be expressed in terms of the distance which light would travel in the associated time.) Using light-years as distance measurements means that our space-time diagrams of time versus distance will show light signals at an angle of 45 degrees when the time is measured in years. Now, if Stella is sent off at one-half the speed of light relative to Terrance, it is possible to construct lines of simultaneity for both Terrance and Stella in Terrance's frame. This is done for Terrance in Figure 1.3 and for Stella in Figure 1.4. The lines with the finest

dots represent the radar signals, and a line of simultaneity can be drawn by connecting the point of reflection to the point on the observer's world-line halfway between the transmission and reception of the radar signal.

Notice from the figures that, when Stella's velocity is half the speed of light, her world-line in Terrance's frame has a slope of two (the inverse of her velocity ratio) and that her line of simultaneity has a slope of one-half (equal to her velocity ratio). This simple relationship between the velocity ratio, the world-line, and the line of simultaneity makes it particularly easy to construct space-time diagrams similar to Figures 1.3 and 1.4. The world-line of a light signal and its line of simultaneity are identical and have a slope of either one or minus one. In other words, at the speed of light, time stands still.

In Figure 1.3 it is seen that one of Terrance's lines of simultaneity intersects Stella's world-line where Terrance's clock reads four years. But, in Figure 1.4, Stella's line of simultaneity for the same point on her world-line intersects Terrance's world-line at three years. (This apparent inconsistency will concern

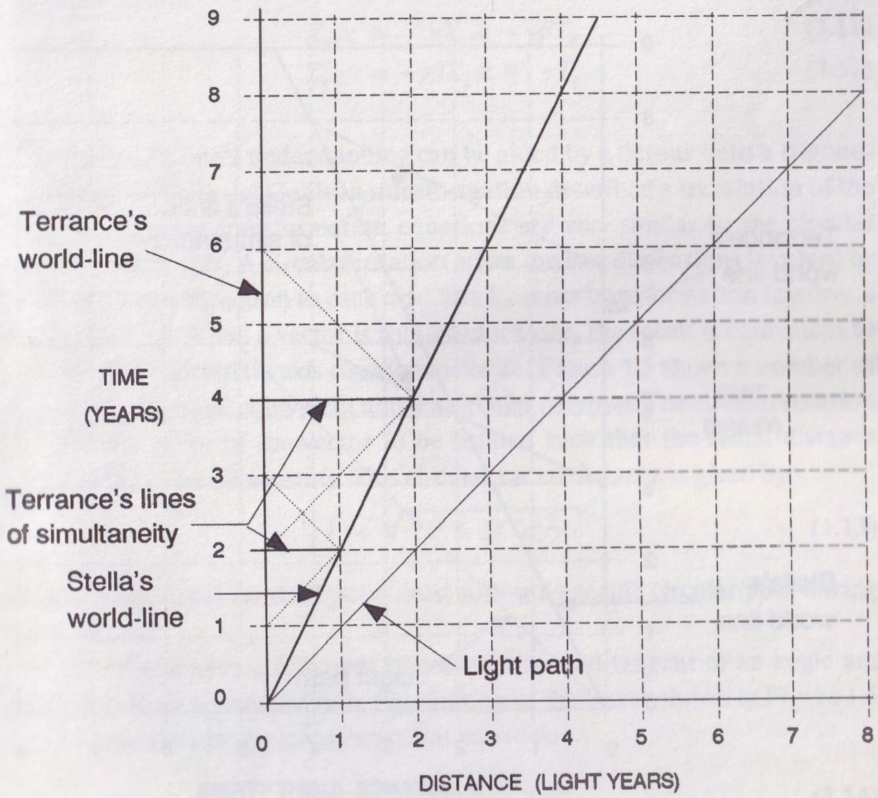


Figure 1.3 Space-time diagram showing Terrance's lines of simultaneity

us later.) But relativity says the relationship between Stella and Terrance must be symmetrical—one of the difficult-to-believe characteristics. This means that, if Stella sees Terrance's clock running slower than her own, Terrance must see Stella's clock running slower than his own. Thus, the three to four ratio of where the two lines of simultaneity cross Terrance's world-line must be apportioned equally between the two frames. Therefore, Terrance must see Stella's clock running slow by the square root of three-fourths of his time, and Stella in turn must see Terrance's clock running slow by the square root of three-fourths of her time. Or, stated another way, Terrance has to multiply Stella's time by a factor gamma, γ, to obtain his own time. In this instance γ is given by the square root of four-thirds.

Following this logical process to its conclusion, Einstein obtained the transformation relationship for the special relativity theory similar to the Galilean transformation equations given earlier for Galilean relativity. These transformation equations are called the Lorentz transformation, since Lorentz had proposed their use prior to Einstein. The Lorentz transformation, which maps Stella's coordinates into Terrance's when the relative velocity is along the X axis, is given by:

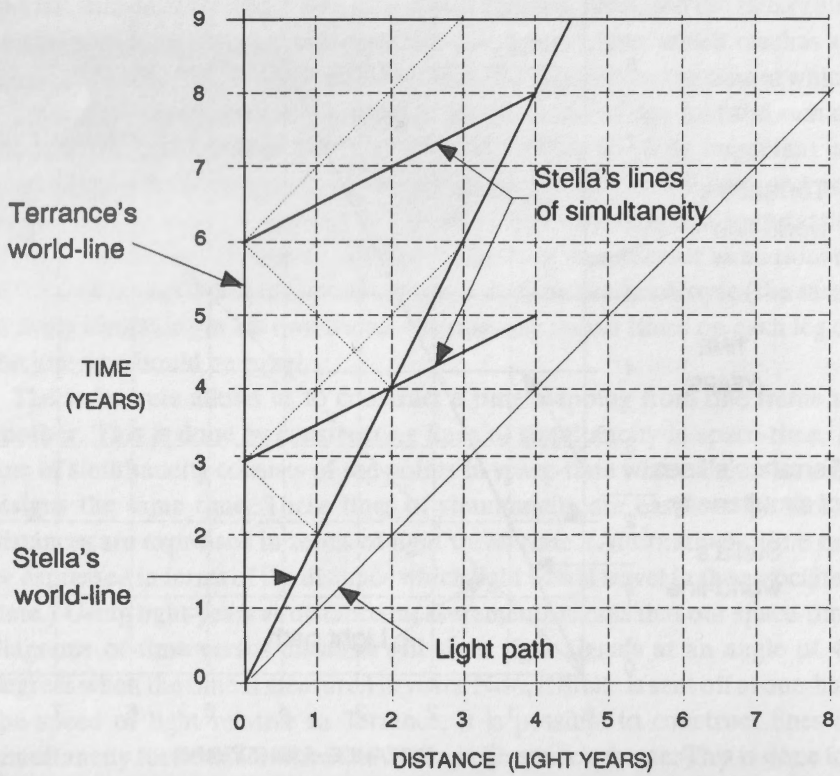


Figure 1.4 Space-time diagram showing Stella's lines of simultaneity

$$X_t/c = \gamma X_s/c + \gamma\beta T_s \quad (1.9)$$

$$T_t = \gamma\beta X_s/c + \gamma T_s \quad (1.10)$$

where: β is the ratio of the relative velocity to the speed of light
γ is the inverse of the square root of the quantity $(1-\beta^2)$
c is the speed of light and is used to scale the distance into elapsed light time (e.g. light years)

The Y and Z transformations are not included, since they are simple one-to-one transformations and are not affected when the velocity is in the X direction.

The inverse Lorentz transformation is symmetrical and is given by:

$$X_s/c = \gamma X_t/c - \gamma\beta T_t \quad (1.11)$$

$$T_s = -\gamma\beta X_t/c + \gamma T_t \quad (1.12)$$

At this point one's understanding can be aided by a detour onto a trigonometric path. While the Galilean transformation described a translation of the axes, the Lorentz transformation equations are very similar to the circular rotation of the axes. A circular rotation mixes the two dimensions involved by assigning a new direction to each axis. The Lorentz transformation involves a similar mixing. When a vector is rotated clockwise, the result is equivalent to rotating the coordinate axis counterclockwise. Figure 1.5 shows a number of vectors which are all equivalent under a circular rotation. The circular rotation causes each point of the vector to be rotated such that the radial distance remains the same (invariant). This circular radial distance is given by:

$$r = \sqrt{T^2 + (X/c)^2} \quad (1.13)$$

In this transformation each point must follow a specific circular path during the rotation.

If the trigonometric functions of cosine, sine and tangent of an angle are defined in their normal fashion, the rotation of the vector shown in Figure 1.5 can be described by the transformation equation:

$$X'/c = C\,X/c - S\,T \quad (1.14)$$

$$T' = S\,X/c + C\,T \quad (1.15)$$

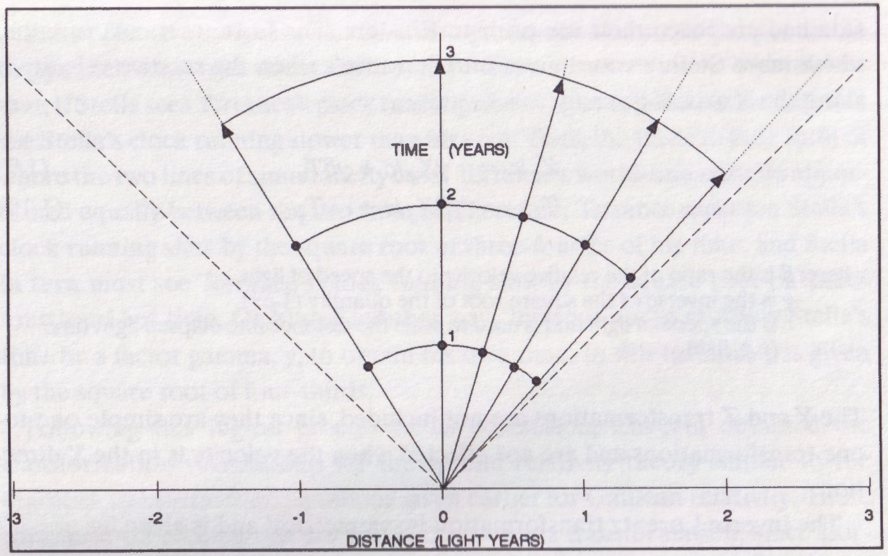


Figure 1.5 Illustration of circular rotation

where: C is used to designate the cosine of the angle of rotation
S is used to designate the sine of the angle of rotation

For comparison to the Lorentz equations, it is more useful to use the tangent function. Since the sine is given by the cosine times the tangent, this gives:

$$X'/c = C\,X/c - CB\,T \qquad (1.16)$$
$$T' = CB\,X/c + C\,T \qquad (1.17)$$

where: B is used to designate the tangent to avoid confusion with the time axis T

In these equations the X axis has been divided by the speed of light to put it in the same units as the time axis. Now, if C is associated with γ and B is associated with β, the rotation equations are identical with the Lorentz transformation equations (1.9) and (1.10) except for the presence of the minus sign in equation (1.16).

The minus sign is symptomatic of the need to associate the Lorentz transformation with a hyperbolic rotation rather than a circular rotation. A circular rotation causes all points of a vector to be modified subject to the circular constraint that their radial distance, r, does not change. The hyperbolic rotation causes all points of a vector to be modified subject to the hyperbolic constraint that their hyperbolic distance, τ, does not change. This is shown in

Figure 1.6. In this transformation each point must follow a specific hyperbolic path during the rotation.

The hyperbolic distance, τ, which defines each hyperbolic path, is associated with the invariant parameter called proper time. The proper time defines the time which each observer would see on his own clock and, thus, is frame independent or invariant. It is given by:

$$\tau = \sqrt{T^2 - (X/c)^2} \qquad (1.18)$$

Note that this proper time constraint is the same as the circular constraint given in equation (1.13) except for the minus sign. In Figure 1.6, dots have been placed on each vector to mark the elapsed proper time corresponding to one year and two years. The total length of each vector is a proper time of three years.

There are several other relationships between the circular and hyperbolic rotations which differ only by the change of a sign. The circular cosine can be computed from the circular tangent by the formula:

$$C = 1/\sqrt{1 + B^2} \qquad (1.19)$$

The hyperbolic cosine, γ, can be computed from the hyperbolic tangent, β, using the similar equation:

$$\gamma = 1/\sqrt{1 - \beta^2} \qquad (1.20)$$

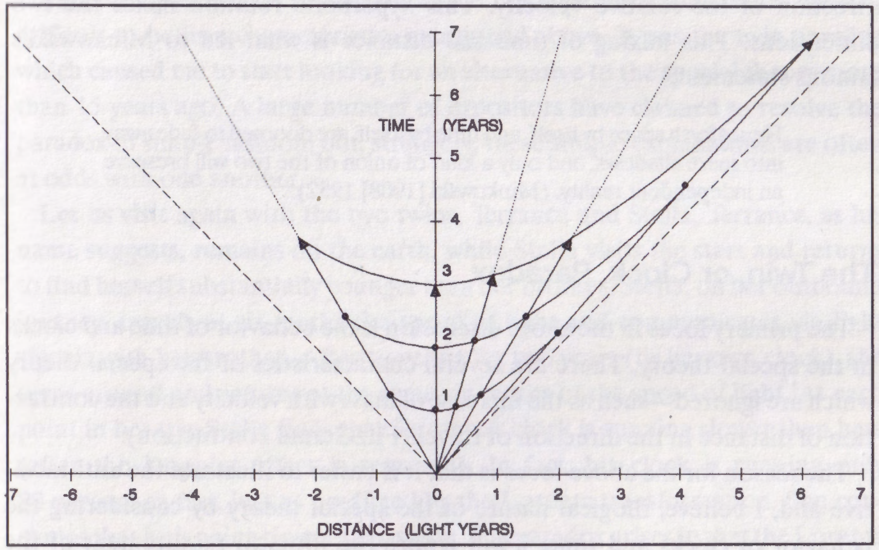


Figure 1.6 Illustration of hyperbolic rotation

The factor, γ, in the special theory is familiar to many as the ratio of a stationary clock's speed (time rate of change or frequency) compared to a moving clock.

The tangent of the sum of two circular rotation angles can be computed from the tangents of the individual component angles by the equation:

$$B_3 = (B_1 + B_2) / (1 - B_1 B_2) \tag{1.21}$$

The hyperbolic tangent of the sum of two hyperbolic rotations can also be computed from the hyperbolic tangents of the component angles by a similar equation:

$$\beta_3 = (\beta_1 + \beta_2) / (1 + \beta_1 \beta_2) \tag{1.22}$$

Since the hyperbolic tangent is identified with the ratio of the velocity relative to the speed of light, this last equation gives us the new rule for adding velocities using the Lorentz transformation. Furthermore, it meets Einstein's requirement that the speed of light with respect to any moving observer be the same constant speed of light. If β_1 is equal to one (i.e. the velocity is equal to the speed of light), β_3 will be equal to one no matter what velocity ratio is used for β_2.

At this point, I have shown that the Lorentz transformation corresponds to a hyperbolic rotation involving the time axis and the spatial axis in the direction of the relative velocity. This hyperbolic rotation mixes the two dimensions. This mixing of time and distance is what led to Minkowski's famous statement:

> Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality. (Minkowski [1908] 1952)

The Twin, or Clock, Paradox

The primary focus in the above discussion is the behavior of time and clocks in the special theory. There are several characteristics of the special theory which are ignored—such as the increase of mass with velocity and the contraction of distance in the direction of travel (FitzGerald contraction).

The reason for the above focus is that it is easier to illustrate the anti-intuitive and, I believe, illogical nature of the special theory by considering the behavior of clocks and time. I will ignore the illogical requirement of the special theory that two observers moving apart must each see the other's mass increase and must each see the other's length measurements become smaller than their own. These requirements are paradoxical, if true. I want to concentrate instead on two difficult-to-believe characteristics of the special theory which involve time and its measurement using clocks.

Both of these difficult-to-believe characteristics are contained in the Lorentz transformation. These two characteristics are: (1) the symmetrical nature of the Lorentz transformation; and (2) the non-simultaneity of time. There is, in fact, no direct experimental evidence to support either of the two characteristics. The symmetrical nature of the Lorentz transformation arises from the apparent relativity of velocity. It appears to be just as valid to describe two frames of reference in relative motion as: (1) frame one moving at a velocity with respect to frame two; or (2) frame two moving at an opposite velocity with respect to frame one. The non-simultaneity of time has already been illustrated above. A line of simultaneity from Terrance's point of view is not parallel to a line of simultaneity from Stella's point of view. Thus, a set of clocks synchronized and keeping common time in Terrance's frame of reference will appear to read different times compared to a similar set of clocks in Stella's frame. The amount of difference in the time will be a function of the clock-separation distance in the direction of the relative velocity of the two systems. If Terrance and Stella are approaching each other, then (at least to the mid-point observer) the local time of each is in the future time of the other. If they are moving apart, the local time of each is in the past time of the other.

The twin paradox or its variation, the clock paradox, illustrates the two difficult-to-believe characteristics mentioned above. It was the twin paradox which caused me to start looking for an alternative to the special theory more than 15 years ago. A large number of expositors have claimed to resolve the paradox in simple fashion; but, strangely, these simple explanations are often at odds with one another.

Let us visit again with the two twins, Terrance and Stella. Terrance, as his name suggests, remains on the earth, while Stella visits the stars and returns to find herself substantially younger than her brother. Stella, on her outbound journey, travels at six-tenths the speed of light and communicates via light signals with her brother. After traveling for two years (by her own clock), she turns around and returns at the same six-tenths of the speed of light. At each point in her trip Stella finds that Terrance's clock is running slower than hers (after the Doppler effect is removed). In fact, his clock is running only 80 percent as fast, just as predicted by the Lorentz transformation. She concludes that he is aging slower than she is. The paradox arises in that the Lorentz transformation is symmetrical and her brother sees her clock running only

80 percent as fast as his own. He, therefore, concludes that she is aging slower than he is. But can each be aging slower than the other? Can each clock be running slower than the other? What is the solution to this paradox?

In Figure 1.7 the space-time diagram of Terrance and Stella is shown in Terrance's frame. I can and will use this figure to show the heart of the paradox. However, before doing so, it is worth showing that the choice of another frame of reference does not change the nature of the paradox. The choice of another frame simply causes a hyperbolic rotation of the entire figure. For example, in Figure 1.8, a frame of reference moving at a speed halfway between Terrance's velocity and Stella's initial velocity is chosen. Equation (1.22) is used to compute the velocities in different frames. In the frame halfway between Terrance and Stella, both move away at one-third the speed of light (1⁄3 plus 1⁄3 equals 6⁄10 using equation 1.22) on the outbound portions of their journeys, and Stella's return velocity is 7⁄9 the speed of light (1⁄3 plus 6⁄10). As a second example, Figure 1.9 shows the same trip from the point of view of Stella's initial frame. In this frame Terrance moves away at 6⁄10 the speed of light; and, after two years of her time, Stella moves away at a velocity of 15⁄17 of the speed of light to catch him.

In each of the above figures, the lines of simultaneity have been drawn whenever a one-year time point was reached by either twin. Each sees the other's clock running at only 80% of his own. But a discontinuity occurs when

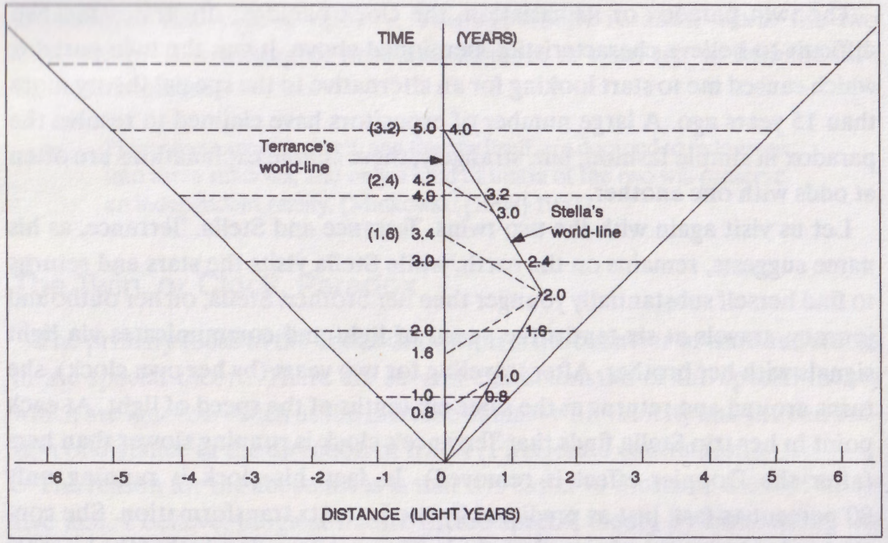


Figure 1.7 Twin trip as seen from Terrance's frame

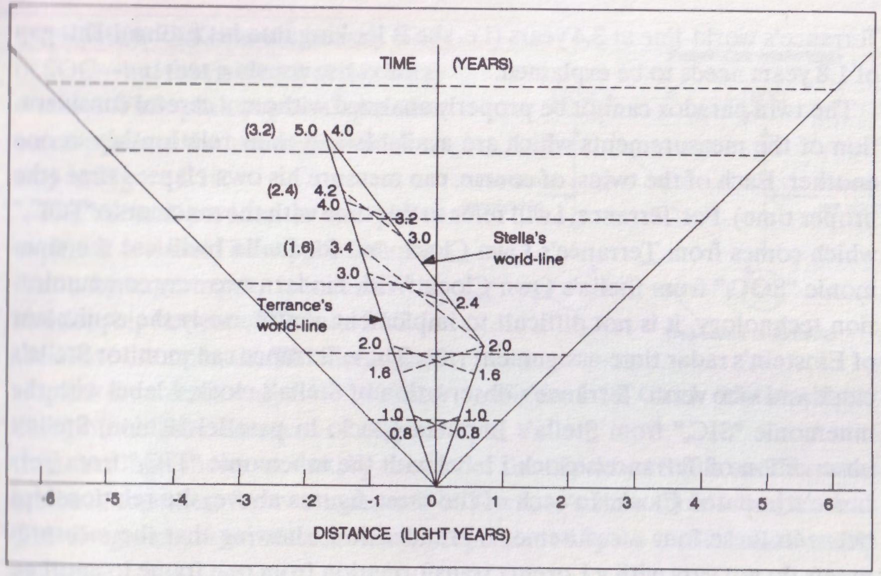


Figure 1.8 Twin trip as seen from the mid-velocity frame

Stella's world-line changes direction at her two-year time point (Terrance's 2.5-year time point). Before changing direction her two-year line of simultaneity intersects Terrance's world-line at 1.6 years (i.e. she was looking into his past). After changing direction her two-year line of simultaneity intersects

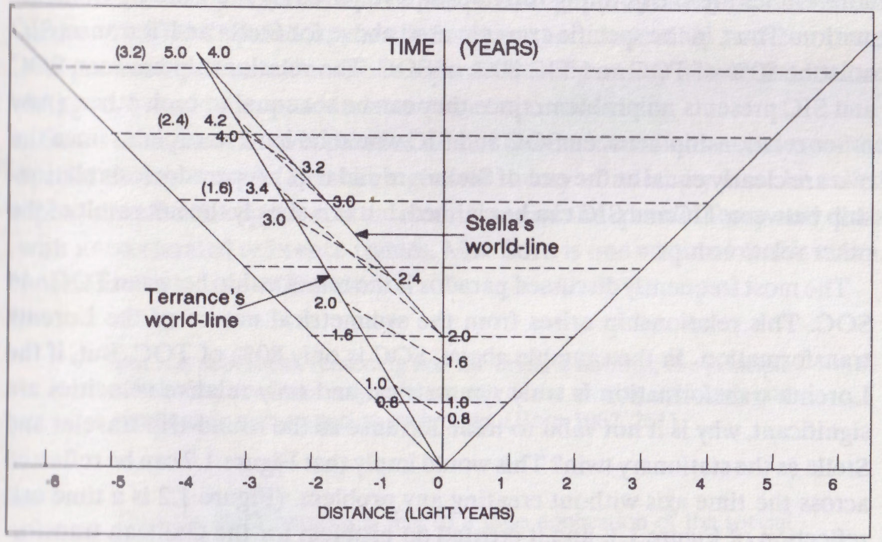


Figure 1.9 Twin trip as seen from Stella's initial frame

Terrance's world-line at 3.4 years (i.e. she is looking into his future). This gap of 1.8 years needs to be explained.

The twin paradox cannot be properly analyzed without a careful consideration of the measurements which are available and their relationship to one another. Each of the twins, of course, can measure his own elapsed time (the proper time). For Terrance, I will refer to this time with the mnemonic "TOC," which comes from Terrance's Own Clock; and for Stella I will use the mnemonic "SOC," from Stella's Own Clock. With modern two-way communication technology, it is not difficult to implement continuously the equivalent of Einstein's radar time-assignment rule. Thus, Terrance can monitor Stella's clock and vice versa. Terrance's observation of Stella's clock, I label with the mnemonic "SIC," from Stella's Imputed Clock. In parallel fashion, Stella's observation of Terrance's clock I label with the mnemonic "TIC," from Terrance's Imputed Clock. In each of the three figures above, the relationships between these four measurements are identical, showing that the measurements do not vary with a Lorentz transformation from one frame to another.

However, there are two different relationships between these measurements which are considered to be paradoxical. The failure to distinguish between the two different paradoxical relationships has created part of the confusion between claims and counterclaims regarding the twin paradox. In Figure 1.10, I show the four time measurements as small circles on a plane. The relationships between them are shown as lines with arrows on each end. The diagonal dotted lines are the defining relationships required by the Lorentz transformation. Thus, in the specific example used above for Stella and Terrance, SIC must be 80% of TOC and TIC 80% of SOC. The relationship between SOC and SIC presents no problem, since they can be set equal to each other. (Any other relationship between SOC and SIC would be hard to explain, since the two are clearly equal at the end of Stella's round trip.) A paradoxical relationship between TIC and SIC can be claimed, but it is simply the net result of the other relationships.

The most frequently discussed paradox is the relationship between TOC and SOC. This relationship arises from the symmetrical nature of the Lorentz transformation. In the example above, SOC is only 80% of TOC. But, if the Lorentz transformation is truly symmetrical and only relative velocities are significant, why is it not valid to treat Terrance as the round-trip traveler and Stella as the stationary twin? This would imply that Figure 1.7 can be reflected across the time axis without creating any problem. (Figure 1.2 is a time axis reflection of Figure 1.1, and it created no problem for the Galilean transformation.) But, if Stella can be considered the stationary twin, it should be just

as valid that TOC should be only 80% of SOC—but that is clearly self-contradictory. This philosophical paradox corresponds to the horizontal relationship in Figure 1.10.

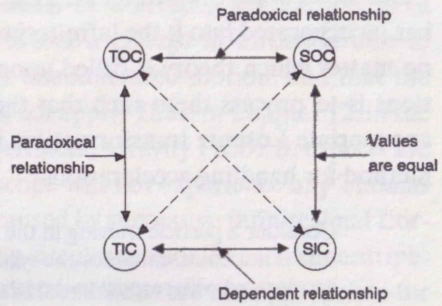


Figure 1.10 Clock relationships

The second paradox is not philosophical. It should be capable of resolution by experiment. It involves the relationship between TOC and TIC. In the above example, the TIC measure of elapsed time reads only 64% (80% of 80%) of the TOC measure of elapsed time. Yet logic indicates that, by the end of the trip when Stella and Terrance are back together, the two measures of Terrance's time should be identical. This disagreement in measured time is represented by the vertical relationship in Figure 1.10.

In order to present a vivid reminder of the distinction between the two paradoxical relationships, I would like to refer to each by a name which is easier to remember. For the horizontal paradox, in order to emphasize its philosophical nature, I would like to grant to each twin a degree of Doctor of Philosophy (in physics , of course!). This allows us to refer to the horizontal relationship as the "Pair-of-Docs" paradox. The more practical paradox, which can be resolved by experimental techniques, can appropriately be referred to as the "TIC-TOC" paradox, since it involves the relationship between these two parameters. I consider the two paradoxes separately below; but, before doing so, I would like to address another important claim.

Some claim that the twin paradox cannot be considered in the context of the special theory but that Einstein's general theory of relativity must be called upon, since Stella experiences accelerations and the special theory only deals with unaccelerated reference frames. Max Born is one who makes this claim. I present two quotes of Born's:

> But it is superficial reasoning and the error is obvious; the principle of relativity concerns only such systems as are moving uniformly and rectilinearly with respect to each other. (Born 1962, 261)

> Thus the clock paradox is due to a false application of the special theory of relativity, namely, to a case in which the methods of the general theory should be applied. (Born 1962, 356)

But Born is clearly wrong. As Friedman (1983) shows, the general theory has incorporated into it the infinitesimal structure of the special theory. Thus, no matter which theory is called upon, the procedure for handling accelerations is to process them such that the instantaneous velocity is used in the appropriate Lorentz transformation. Goldstein (1980) clearly spells out the method for handling accelerations:

> Consider a particle moving in the laboratory system with a velocity v that is not constant. Since the system in which the particle is at rest is accelerated with respect to the laboratory, the two systems should not be connected by a Lorentz transformation. We can circumvent this difficulty by a frequently used stratagem (elevated by some to the status of an additional postulate of relativity). We imagine an infinity of inertial systems moving uniformly relative to the laboratory system, one of which instantaneously matches the velocity of the particle. The particle is thus instantaneously at rest in an inertial system that can be connected to the laboratory system by a Lorentz transformation. It is assumed that this Lorentz transformation will also describe the properties of the particle and its true rest system as seen from the laboratory system.

Though, in fact, it may be an additional assumption, procedures are well defined for handling accelerations in the special theory. The Thomas precession, which will be encountered again, depends on the above process for handling accelerations in the special theory.

With this extraneous argument disposed of, it is time to turn to a consideration of the two paradoxical relationships between the twins' measures of time.

(1) "Pair-of-Docs" Paradox

This philosophical paradox has created a lot of heat but very little light. The claim is usually made that it is invalid to switch reference frames when Stella turns around. This claim is usually phrased along the lines that the acceleration which Stella undergoes clearly makes the situation non-symmetrical. Typical of the language used to argue this point is Herman Bondi's statement:

> Of course, it was always ridiculous to call this a paradox; no paradox of any form is involved, for Brian [Stella] has undergone several periods of acceleration in his life, whereas Alfred [Terrance] has been inertial all the time. (Bondi 1962, 151)

But these claims are very close to saying that velocities are not really relative.

The situation becomes even more muddled when one asks whether it is the change in the velocity (a kinematic effect) or the acceleration itself (a dynamic effect) which causes the Lorentz transformation to change the direction of the time axis. The consensus among specialists in Einstein's general theory of relativity is that a gravitational field causes a change in direction due to curvature of space, that this represents unaccelerated motion, and that the Lorentz transformation, therefore, does not apply. Thus, in Chapter 12, in the discussion of the new gravitational experiment, Gravity Probe B, experts are cited who claim that the orbiting gyroscope will not experience any Thomas precession. The Thomas precession is caused by successive infinitesimal Lorentz transformations, which occur during circular motion due to the centripetal acceleration. Thus, since Lorentz transformations are not appropriate for gravitational (non-accelerated) motion, it would appear that one should be able to use a gravity field to send Stella back to Terrance without rotating the direction of her time axis.

Yes, the response comes back, but then Stella's clock will have been changed due to the gravitational potential encountered compared to that which Terrance encounters. In fact, from the equivalence of acceleration and gravity, the integrated acceleration (velocity change) can be directly equated with the integrated gravitational acceleration (potential change). This means that the gravitational potential experienced by Stella causes her clock to run slower, so that the expected difference in the clocks remains. This gravitational equivalent solution was suggested by Born and provided the context for the above quotes. Aharoni (1965) also claims that this gravitational solution solves the paradox. But neither Born nor Aharoni addresses the more fundamental "TIC-TOC" paradox. The "Pair-of-Docs" paradox is clearly distinguished from the "TIC-TOC" paradox in that it involves the proper times, TOC and SOC, and the clocks are compared only when they are again co-located.

Others have claimed to resolve the "Pair-of-Docs" paradox experimentally. Two such claims are considered below. They are representative of proofs given as solutions to the twin paradox.

The first is cited by Bowler. He refers to a CERN experiment where high-speed muons were constrained by a magnetic field to orbit in a five-meter diameter. In the experiment, the velocity of the muons was such that, by the special theory (ignoring the acceleration), the muons should have a lifetime about 12 times longer than their normal lifetime before they decay. After noting that the measured lifetimes were almost identical with that predicted, Bowler (1976, 16) says:

> This work thus provided the experimental coup de grace to the interminable twin paradox (which is dead but won't lie down).

Similar claims are made by Hafale and Keating in a twin set of articles in *Science*. At the start of the first article, they state:

> One of the most enduring scientific debates of this century is the relativistic clock "paradox" or problem which stemmed originally from an alleged logical inconsistency in predicted time differences between traveling and reference clocks after a round trip. This seemingly endless theoretical debate, which flared up recently with renewed vigor, begs for a convincing empirical resolution with macroscopic clocks. (Hafale and Keating 1972a)

At the end of the second article they state:

> At any event, there seems to be little basis for further arguments about whether clocks will indicate the same time after a round trip, for we find that they do not. (Hafale and Keating 1972b)

These two experiments fail to prove what the authors claim. The arguments are flawed in the same manner. First, each author assumes that it is the result of the experiment which is contested. It is not. It is a philosophical question. The opponents of the special theory contend that the proper time between two systems in relative motion cannot both be less than the other. This to them represents a logical inconsistency in the theory. Logical inconsistencies are not subject to experimental verification.

Second, these experiments come very close to proving just the opposite of what is claimed. The heart of the twin paradox is the question as to whether the symmetrical Lorentz transformation can be correct, i.e. whether each clock can run slower than the other. The special theory advocates claim that they can and that the acceleration of the one twin removes the symmetry. However, in the experiments cited above, the acceleration is perpendicular to the velocity vector. Thus, there is no separation of the two frames in the direction of the velocity, and there can then be no mixing of the time dimension with the space dimension. Thus, a strict application of the Lorentz transformation to circular motion requires that either the clocks must run at the same rate (contrary to the experimental results) or that they must each run slower than the other (contrary to any possible experimental results).

The only reason that this is not the coup de grace of the argument is that the special theory advocates can rightly claim that circular motion has historically been shown to exhibit some absolute space characteristics. Thus, for circular motion, the experimental effects described above fall under the category of the Sagnac effect. Post (1967), in the classic description and derivation of the Sagnac effect, shows in an appendix that, in order to obtain the non-symmetrical Sagnac effect from the symmetrical Lorentz transformation, one has to arbitrarily assume that the transformation is non-symmetrical and that the accelerated clock is the slower clock.

Now, in as circular an argument as I have ever encountered (logically circular and physically circular), the Sagnac effect, which arbitrarily assumed a non-symmetrical transformation, is used to prove that the symmetrical Lorentz transformation presents no problem in the form of the twin paradox. Whom are we kidding?

Often special theory advocates will claim that any acceleration breaks the symmetrical ambiguity of the Lorentz transformation, so the unaccelerated observer becomes the primary observer. No particular mechanism is cited. The example of muons (mu mesons) proves that this is not valid.

The muons produced in the earth's upper atmosphere are often cited as proof of the time dilation predicted by the special theory (Frisch and Smith 1963). The muons are produced at 10 to 20 kilometers above the earth's surface. At rest their expected lifetime before spontaneous decay is 2.2 microseconds. Based on this lifetime, they would only travel 0.66 kilometers on the average if they traveled at the speed of light. Yet a large percentage of them travel more than 10 kilometers to reach the earth's surface. Clearly, their very high velocity causes them to decay at a much slower rate.

But the muons once produced are in gravitational free-fall and, according to the general theory, unaccelerated. By contrast, the earth-based observer is acted on by the gravity field of the earth and by the centrifugal acceleration of the earth's rotation. If it were the unaccelerated observer whose clock runs correctly, the unaccelerated muons ought to see the earth-based laboratory clocks running slower, i.e. the earth would rotate through a smaller angle before the decay occurred. This is opposite to what actually happens. The laboratory-based observer always seems to win, whether the other observer is accelerated or not.

The advocates of the special theory have attempted to solve the philosophical paradox by recourse to experiment. This must, of necessity, fail.

In summary, as far as the "Pair-of-Docs" paradox is concerned, the arguments are non-ending, as is typical of philosophical questions not subject to experimental verification.

(2) The "TIC-TOC" Paradox

There are only two possible resolutions of the "TIC-TOC" paradox consistent with the Lorentz transformation. Each of the two alternatives has been proposed as a solution to the "TIC-TOC" paradox. I present first the solution proposed by Ohanian (1988).

Ohanian draws a space-time diagram similar to that of Figure 1.7 and asserts that Stella sees Terrance's clock make up for lost time as she decelerates at the end of the outbound portion of her journey and accelerates back up to her return velocity. In fact, during the acceleration phase, she sees her brother's clock exactly make up for the time lost during the outward-bound journey and also exactly compensate for the time that will be lost during the inward-bound portion of the journey. In the specific example of Stella and Terrance given above, this means that Stella would see an extra 1.8 years (which occur between 1.6 years and 3.4 years on Terrance's own clock) gained as a result of the deceleration and reacceleration phase at the midpoint of her journey. In this way she can see him aging slower during her inward-bound and outward-bound journeys and yet find him the expected age when she returns. This solution does not disagree with the Lorentz transformation. But it does call upon a supplementary effect which it is claimed is caused by acceleration. It makes use of the non-simultaneity of time, which is a function of the separation of the twins and their relative velocity. Thus, when Stella slows down, she is looking less and less into Terrance's past; and, when her velocity has turned around toward him, she is looking into his future. Ohanian is claiming that, as the acceleration is applied, the time axis rotates and all of the signals Terrance emitted during the 1.8 year interval are received by Stella. Ohanian calls upon the non-simultaneity of time to save the symmetry feature from contradiction.

The solution proposed has a certain logic which is attractive. The Lorentz transformation, as was shown above, is equivalent to a hyperbolic rotation in the plane formed by the direction of the relative velocity and the time dimension. Thus, the twins can see each other's clocks running slower because their time axes do not point in the same direction. The position of each twin can be expressed via the Lorentz transformation (hyperbolic rotation) in either of the two coordinate systems. Acceleration by changing the velocity is equivalent to a hyperbolic rotation of the coordinate system. Thus, it is appropriate that, if Stella accelerates, the coordinates of both she and her brother in her coordinate system be rotated. Since she is at the center of her coordinate system, this rotation has no effect upon her coordinates; but it has a dramatic effect upon her brother's coordinates as expressed in her coordinate system. Since Terrance does not himself accelerate, his coordinate system is not rotated; and neither his nor Stella's coordinates change as expressed in his system. (At the start or end of the journey, the acceleration has no effect on each other's specific coordinates, because each is located at the center of the other's coordinates, as well as his own.)

In the specific trip described above, Stella's perception of Terrance's clock, TIC, would experience a sudden 1.8 year jump in its reading. Ohanian states:

> Of course, such a discontinuity is unphysical, but the blame for this must be placed on the unphysical world-line of Stella—we have assumed an instantaneous change in velocity ... If we make a more reasonable assumption, with a gradual change in Stella's velocity, then we find that Terra's [Terrance's] clock does not jump but simply speeds up during the time that Stella accelerates. It is this speeding up of Terra's [Terrance's] clock which more than compensates for the time dilation along the other parts of the world-line...and makes Terra [Terrance] older, no matter what reference frame is used to calculate the aging.

Yes, the solution offered has an attractive logic. But does the solution check? Can the effect be compared with reality?

In fact, there are two tests that can be applied to the solution. Each of the tests indicates that the proposed solution is invalid. First, the size of the time step can be made arbitrarily large. It is a function of the distance of the object in Stella's coordinate system. If Stella is granted a very long life and travels for a very long time, Terrance's position coordinates in Stella's coordinate system become very large. However, the amount of time it takes Stella to decelerate is not a function of the total length of the journey. Thus, the amount and rate at which Stella perceives Terrance's clock gaining time as she accelerates can be made arbitrarily large. The longer the trip, the faster Terrance's clock must appear to run to make up for the time lost on the trip. Clearly, this does not correspond to any observed physical phenomenon.

A second test is also easily made. The hyperbolic rotation effect described above is a general effect. It does not depend upon how Terrance and Stella became separated—only upon their separation distance. Thus, the same effect should be observed by measuring the amount of time a distant pulsar loses or gains when an acceleration toward it is executed. The huge distances of some pulsars should lead to huge effects from very small accelerations. No such effects have ever been observed. If the effect were real, it would be easy to see. All earth-based observers are accelerated along with the earth by the sun's gravitational field, but no acceleration effects are induced in the pulsar data.

Ohanian's solution to the "TIC-TOC" paradox does not work and cannot be made to work. He failed to follow the implications of the solution to its logical conclusion.

Another solution to the "TIC-TOC" paradox has been proposed by Lucas and Hodgeson (1990). The Lucas-Hodgeson solution is that Stella does not see the whole picture. She is, in fact, deceived. She loses all knowledge of what happened to Terrance during the "gap" interval of 1.8 years in the above example. Lucas and Hodgeson present an example where the gap represents a longer interval of time. In their example the traveling twin turns around just after he sees his apparently younger brother getting married. But, once he turns around, he sees his brother retiring and all knowledge regarding the twin from marriage to retirement is lost. Lucas and Hodgeson conclude their argument in the following words:

> The essence of this solution is kinematical rather than dynamical. It is the conceptual shift in the lines of simultaneity, not any effect of the force required to bring about the needed accelerations and decelerations, that accounts for the mistaken reckoning of the traveling twin. He changes his time-reckoning in mid-course, not by moving the hands of his clock, but by changing the rules for dating events on earth, and so naturally gets his calculations awry. The earth-bound twin has an uninterrupted view of what is happening to his traveling brother, and so his view of the matter is undistorted, while the view of the traveling twin is disrupted, and only seems to show, without actually doing so, that his brother must be younger than he is himself.

Stephenson and Kilmister (1958) come to this same conclusion by considering three observers instead of two—triplets instead of twins. Let Astra be far removed from Stella and Terrance but moving toward them at high velocity. Let Stella be moving toward Astra at an equal velocity. Let Stella synchronize her clock as she passes Terrance (who is not moving in his reference frame). When Stella and Astra meet, let Astra set her clock to Stella's time. When Astra arrives at Terrance's location, they compare their clocks and Astra's reads a much lower elapsed time. This triplet maneuver allows Stephenson and Kilmister to obtain the same net effect as the twins without the use of accelerations. The gap in time occurs because, at the time of synchronization, the triplet moving away from the stationary triplet has not yet seen the time which occurs in the gap and the triplet moving toward the stationary triplet has already seen the gap. Stephenson and Kilmister state:

> In this example, the distant synchronization avoids the need for considering accelerated observers and introduces the characteristic lack of symmetry in another way, so that the paradox is impossible to formulate.

So Lucas and Hodgeson have solved the "TIC-TOC" paradox. Or have they? Again experimental evidence can be called upon to contest the solution. If Terrance is continuously broadcasting his clock readings to Stella and the Lucas-Hodgeson solution is correct, 1.8 years of signal energy has been lost in space-time. Such a solution is in violent disagreement with the law of the conservation of energy. The fundamental laws of physics disagree with the proffered solution. Some relativists might prefer to see conservation of energy contradicted rather than the special theory. Therefore, direct evidence against the Lucas-Hodgeson solution will be presented in Chapter 10 using data from a Pioneer 10 experiment.

The Lucas-Hodgeson solution to the "TIC-TOC" paradox does not work and cannot be made to work. Energy does not get lost in space-time.

The "TIC-TOC" paradox is subject to experimental test. And all the evidence is in disagreement with any solution compatible with the Lorentz transformation. The Ohanian solution allows Stella's observation of Terrance's clock to run slow but requires an unphysical clock rate increase in the received clock signal when the observer is accelerated. The Lucas-Hodgeson solution allows Stella's observation of Terrance's clock to run slow but requires an unphysical loss of Terrance's transmitted signal energy.

Direct experimental evidence exists for a non-symmetrical transformation which allows one clock to run faster than the other and one clock to run slower than the other. The logical basis for such a transformation will be presented in Chapter 2.

In Figures 1.7 to 1.9 it was shown that the ratio of the proper time of a traveling twin to the proper time of a stationary twin was independent of the inertial frame. But that is only true at the end of the trip, after the traveling twin has rejoined the stationary twin. If the traveling twin does not turn around, the proper time ratio appears to be a function of the inertial frame chosen. But modern technology allows us to measure time and frequency over vast distances. Thus, an interplanetary probe (which does not turn around) can easily be used to check whether the Lorentz transformation correctly characterizes the time and frequency relationships between the probe and the ground communication stations. After adjusting for the gravitational and Doppler effects, the frequency which the ground receives from the probe should be lower according to the Lorentz transformation. It is. In addition, the frequency which the probe receives from the ground should be lower according to the Lorentz transformation. It is not! It is actually higher by the same amount that the signal from the probe is lower. Thus, the actual frequencies are reciprocal, not symmetrical; and simultaneity of time must hold. This also means that there is only one frame which is a valid frame for use in computing the proper time. (See Chapter 10, Pioneer 10 experiment.)

The Lorentz transformation fails the test. It must fall—and with it the special theory of relativity.

The Symmetry of the Lorentz Transformation

The scientist, like other people, is wonderfully adept at rationalization. The Lorentz transformation actually used is normally a mixture of the two symmetrical coordinate system transformations. See, for example, Mansouri and Sexl (1977).

The time equation, equation (1.12), which maps Terrance's time to Stella's, is solved for Terrance's time and gives:

$$T_t = (1/\gamma)T_s + \beta X_t/c \qquad (1.23)$$

But this equation is paired with equation (1.9), which maps Stella's X coordinate into Terrance's:

$$X_t/c = \gamma X_s/c + \gamma\beta T_s \qquad (1.24)$$

The equations in this form allow one to speak of the time dilation when referring to equation (1.23), where γ is in the denominator, and to speak of the FitzGerald length contraction when referring to equation (1.24), where γ is in the numerator.

The actual experimental results are more indicative of the non-symmetrical transformation required by nature. The laboratory, as stated above, always seems to win out in the time-dilation sense (i.e. the clock moving with respect to the laboratory is the slower clock). But, wonder of wonders, the length contraction is rarely called upon in the laboratory frame. Length contraction is virtually always called upon only when the moving system looks back at the laboratory. Thus, as far as length is concerned, the laboratory usually loses.

The symmetry of the Lorentz transformation allows one to pick the direction of the transformation to match the experimental results. If expansion is needed, solve the inverse transformation for the original parameter; if contraction is needed, use the transformation directly. This makes it hard for anyone to refute the theory. Any result is covered.

Non-Simultaneity of Time

The non-simultaneity of time is confused by some as a statement that clocks will run at different rates as a function of their velocity. But clocks which run at different rates can still exhibit simultaneity. Clocks which run at different

rates exhibit non-syntonicity, i.e. they simply run at different frequencies. The relationship between clocks which run at different rates can easily be explained by non-symmetrical one-to-one transformations, which simply map the relative clock rates from one system to the other. Non-simultaneity, on the other hand, means that one inertial system looks into the past of another in the physical direction opposite their relative motion and into the future in the physical direction of their relative motion. Such behavior is highly non-intuitive and illogical and is the only physical phenomenon ever claimed which violates the normal understanding of the flow of time.

Not only is non-simultaneity not required by any direct experimental evidence—it creates problems in interpreting some experiments. The experiments designed to test the Bell inequality (Shimony 1988) are a prime example. In quantum mechanics the predictions of the behavior of particles or photons in an entangled state are in opposition to predictions based on a classical particle understanding. The quantum predictions have been proved correct. Furthermore, measurements performed on one of an entangled pair of particles seem to instantaneously affect the other particle, even though a substantial distance separates the two particles. But, if such non-local behavior can occur instantaneously and if non-simultaneity were true, a mixing of cause and effect could occur. Another observer traveling at high velocity with respect to the experiment might easily see the effect on the second particle occur before the measurement on the first particle which caused it. It is the famous time-travel problem of fiction. Non-simultaneity of time becomes equivalent to time travel. Non-simultaneity of time is a clear defect in the special theory.

Foundations of the Special Theory

The above arguments lead to the conclusion that the special theory is wrong. But the special theory is founded upon only two postulates. Which of the two is in error? Or are both in error? Where did Einstein go wrong? Before attempting to answer these questions, a review of the state of physics at the end of the nineteenth century is in order.

The discovery that light was polarized and consisted of transverse vibrations led to the concept of a solid ether. Only solids are capable of sustaining transverse vibrations. This led to the natural question of how the earth and other solid bodies could move through such a solid ether—a question addressed in Chapter 2. The speed of light would, of course, be with respect to a coordinate system in which the ether is at rest. The velocity of light with respect to the ether then provides a method of determining the motion of physical bodies with respect to the ether.

The earliest evidence seemed to indicate that the earth moved through the ether with no apparent resistance. The specific evidence was the aberration of starlight, which was first discovered by Bradley in 1725. The light coming from stars in directions perpendicular to the earth's orbital velocity around the sun appears to be deflected in the direction of the motion of the earth. The effect is very small but clearly observable by measuring the relative deflection of stars in directions tangent to and perpendicular to the earth's velocity at different times of the year. The most common analogy is made to rain drops falling vertically. They appear to someone running to be falling at an angle. The tangent of the angle is proportional to the relative velocity of the falling rain and the person running. Thus, the amount of aberration can and was used to compute the apparent velocity of light, given the velocity of the earth around the sun.

The argument that the aberration of light means that the ether cannot be moving with the earth has almost always been given more weight than it deserves. Surely no one believes or believed that the entire ether in the universe moved along with the earth. If the ether is identified with the gravity field, as Beckmann (1987, 27) proposes, clearly aberration can still occur at the transition regions of gravity fields or where a differential movement in the ether is taking place.

The next significant evidence regarding motion relative to the ether was obtained by Fizeau in his famous experiments of 1851. He measured the velocity of light in pipes filled with moving transparent liquids. He was able to detect the difference in light velocity moving with the flow of the medium and against the flow of the medium. As a result, he found that the amount by which light was "dragged" along by the medium was determined by its index of refraction—a result predicted by Fresnel many years earlier on the basis of a partial dragging of the ether. The result played a significant role in discussions regarding the ether at that time. Because the index of refraction of air is essentially one, the result was widely interpreted as ruling out the possibility that the ether moved with the earth. This was supported by experiments performed by Lodge, which showed that the speed of light was not affected in the vicinity of spinning disks.

But this conclusion was contradicted by the result of the Airy 1871 experiment, which was also predicted by Fresnel. Airy showed that filling a telescope with water did not affect the measured angle of stellar aberration. This result is compatible with either partial ether drag or total ether drag but not compatible with the absence of ether drag. Of course, it is also compatible with the special theory.

The crucial experiment regarding the ether was first performed by Michelson in 1881. The precision, however, was insufficient to be conclusive. Therefore, Michelson collaborated with Morley and repeated the experiment in 1886 with enough precision to be significant. It showed that the velocity of light relative to the earth was no different in the direction of the earth's orbital velocity than it was perpendicular to the earth's orbital velocity. This result destroyed the common understanding (based primarily on the aberration of starlight) that the ether did not move along with the earth.

Some, Michelson among them, interpreted the experiment to mean that, in fact, the earth did carry the ether along with it. Furthermore, it is clear that Michelson understood that the aberration of starlight did not disagree with that hypothesis. In 1897 Michelson unsuccessfully attempted to measure the difference in the amount by which the speed of light was carried along with the earth as a function of altitude above sea level. That attempt clearly shows he understood that the aberration phenomenon could be occurring at some distance above the earth's surface. It is not widely known that Michelson and Gale in 1925 did show that the earth's rotational velocity does not carry the ether along with it. (I know this is not the normal interpretation.) In other words, there is an apparent difference in the velocity of light, depending on whether it is moving east (with the earth's rotational velocity) or west (against the earth's rotational velocity). Beckmann and Hayden (Pool 1990) each have offered a $1000 reward to the first person who can prove that, to an earth-fixed observer, the speed of light is the same eastward as it is westward.

Because physicists had become convinced that the ether was not carried along by the earth, the result of the Michelson-Morley experiment was very unsettling; and a number of attempts were made to reconcile the experiment with theory. The most famous adjustment was that of FitzGerald, who postulated that material things would contract just enough in the direction of motion to counteract the difference in the speed of light. Lorentz came to the same conclusion and developed his famous transformation on the basis of length compaction. He also showed that it was consistent with the Maxwell equations.

Strangely, the Michelson-Morley experiment seems to have played a minor or non-existent role with Einstein. No one has been able to pinpoint just when Einstein became aware of the experiment. But it was apparently quite near the same time the special theory was published. Perhaps this is best explained by Einstein's comment some years later (Shankland 1963) that he expected the result. This would explain why, when he did become aware of it, no significant impression was made.

Einstein pursued a reconciliation of theory and experiment from first principles. He was remarkably successful in the special theory. From two fundamental principles, he was able to construct the theory and to predict many unusual effects, which have been verified. These two principles or postulates are considered next.

First, consider what was actually his second postulate:

THE CONSTANCY OF THE SPEED OF LIGHT

> The velocity of light is independent of the motion of the source.

This postulate has much to commend it. Even if one is a believer in an ether, he can accept this postulate. It could mean that the velocity of light is determined by the medium (ether) it is passing through. Or it could mean, as it does in the special theory (to be compatible with the other postulate), that it is determined by the velocity of the observer. I believe that the speed of light is constant with respect to the local medium it is passing through. Therefore, even though I disagree with the special theory interpretation of this postulate, I have no quarrel with the postulate itself.

Einstein's first postulate is the postulate of relativity:

POSTULATE OF RELATIVITY

> The laws of nature and the results of all experiments performed in a given frame of reference are independent of the translational motion of the system as a whole.

This postulate had much to commend it. Historically, with the hypothesis of an ether, the reference frame in which the ether was at rest was endowed with special characteristics as far as electromagnetic effects were concerned. And the speed of light was relative to this fixed ether frame. Thus, relativity of constant translational motion did not exist in electromagnetism. Yet all the historical evidence in all other fields of physics indicated that the principle of relativity applied. Specifically, the laws of mechanics were clearly unchanged by constant relative motion (i.e. they were invariant under Galilean transformations). Einstein was astute enough (although wrong, I believe) to propose that the same held true of electromagnetism.

From these two hypotheses all of the special theory flows—and it results in the Lorentz transformation—and I showed above that the Lorentz transformation cannot survive the twin paradox. One of the two postulates must, therefore, be wrong. I believe it is the postulate of relativity that is wrong.

After Einstein proposed his solution, it became absurd to believe anything else. Witness Bondi (1962, 53):

> The concept of the ether, therefore, involves the absurd consequence that by optical means one should be able to distinguish between being in a state of uniform motion and being at rest, although it is impossible to do so by dynamical means.

Yet the discovery of the background radiation from the creation big bang can be used to ascribe a unique velocity to any mass (Conklin 1969).

Do all mechanical experiments indicate that the laws of physics are unchanged by relative velocity? Which of the two following statements is easier to believe: (1) The change in the rate at which a clock runs is caused by the abstract concept of the relative velocity of the one observing it? (2) The change in the rate at which a mechanical clock ticks can be induced by real physical phenomena related to mass moving through an ether?

When a bucket of water is spun, the parabolic shape assumed by the water surface shows that rotational velocity with respect to the distant stars can be detected by mechanical means. But at what radius of curvature does the rotational velocity become pure translational velocity, which cannot even in principle be detected by mechanical means? At what level of precision are you willing to say that there is no curvature in the path followed by a moving object?

Einstein (1951), in his memoirs, related that he was led to the principle of relativity by considering what would happen if he pursued a beam of light with the velocity of light itself. To one moving with the speed of light, it would appear as an electromagnetic field constant in time but periodic in space. But the Maxwell equations do not allow such a solution. Therefore, Einstein postulated the relativity of electromagnetic phenomena, so that, no matter how fast he moved, the Maxwell equations could still apply. But the special theory itself does not allow mass to move with the velocity of light. Thus, the problem Einstein considered was a purely hypothetical problem. Furthermore, the concept of a mass dragging the ether with it could also clearly account for the absence of such a solution to the Maxwell equations.

The General Theory and Quantum Mechanics

The structure of modern physics is still fragmented into several disjoint theories. Each of the component theories is adequate over a limited domain. However, there are problems that arise at the boundaries between the theories.

The Bell inequality was cited above as an example of the special theory (non-simultaneity of time) creating a problem with quantum theory. There are other problems.

A second example of the conflict of the special theory with quantum theory is the renormalization problem. The renormalization problem arises because certain integrals become infinite when the limits of the integration approach zero or infinity. Dirac (1973) says regarding this problem:

> One can put the calculations of the Lamb shift and of the anomalous magnetic moment of an electron into a sensible form by introducing a cutoff, by taking the upper integration limit in our integrals to be not infinite but some finite value. ... One still gets effectively the same Lamb shifts and the same anomalous magnetic moment when one works with this cutoff, to the first order of accuracy. One then has a theory where the infinities are gone, a theory that is sensible mathematically.

> An unfortunate result is that, of course, the relativistic invariance of the theory is spoiled. ... One can thus make quantum electrodynamics into a sensible mathematical theory, but only at the expense of spoiling its relativistic invariance. I think, however, that that is a lesser evil than departing from standard rules of mathematics and neglecting infinite quantities.

Dirac did go on to state, however, that something must be wrong with the quantum mechanics, not with the special theory. I, of course, think the special theory is the culprit.

A similar problem between the general theory (the way it incorporates the special theory) and quantum theory is described by Smolin (1987):

> While it appears that the basic principles of quantum mechanics can be applied meaningfully to certain special situations in which gravitational interactions are relevant, ... all of these successful applications depend on recourse to a preferred time coordinate ... In more general circumstances, ... the standard quantization procedures become ambiguous. ... This is a serious problem which goes to the foundations of quantum field theory and which rests ultimately, on the conflict between the very different roles time plays in quantum mechanics and general relativity.

Quantum theory, as represented by the "standard model," has predicted the magnetic moment of the electron to ten digits. Yet its boundary with classical physics remains undefined, and it conflicts with Einstein's special theory at several points. It also conflicts with the general theory. The conflict is not just with the role time plays, as described above. The quantum theory endows the vacuum with so much energy in its "vacuum fluctuations" that space should exhibit, according to Abbott (1983), a curvature at least 46 orders of magnitude greater than that observed. Abbott goes on to state:

> If the vacuum energy density, or equivalently the cosmological constant, were as large as theories of elementary particles suggest, the universe in which we live would be dramatically different, with properties we would find both bizarre and unsettling. What has gone wrong with our theories? We do not know the answer to this question at present. Indeed, a comparison of our theoretical and experimental understanding of the cosmological constant leads to one of the most intriguing and frustrating mysteries in particle physics and relativity today.

In a more recent article (Schwarzschild 1990), it is claimed that the cosmological constant is 120 orders of magnitude too small. Guth and Steinhardt (1989) state:

> Our inability to explain the extreme smallness of the vacuum energy density, or equivalently the cosmological constant, is regarded by many particle theorists as one of the most important problems in physics. This "cosmological constant problem" seems to indicate that even a state as simple as the vacuum has properties that we do not yet understand.

But, though there is conflict, there are borrowed concepts and synergism between the theories. The general theory has incorporated the special theory into its local (infinitesimal) structure. The quantum theory has been constructed to maintain Lorentz covariance. If the Lorentz transformation of the special theory is wrong, it must impact these other theories as well.

It is appropriate to quote McCausland (1988) at this point:

> The abandoning of special relativity would involve a scientific revolution; like other scientific revolutions, it might cause chaos for a time, but it might also lead to an enormously stimulating period of scientific research. Scientists should not shrink from grasping such an opportunity.

A quote from Joseph Ford (admittedly, in a different context) also seems appropriate:

> But to accept the future, we must renounce much of the past, a formidable challenge indeed. For as Leo Tolstoy poignantly recognized, even brilliant scientists can seldom accept the simplest and most obvious truths if they be such as to contradict principles learned as children, taught as professors, and revered throughout life as sacred ancestral treasures. (Ford 1989)

Conclusion

What is the conclusion? Even the strongest advocate of the special theory will admit to its non-intuitive character. I am convinced, and I hope I have begun to convince the reader, from the mathematical and empirical evidence that the special theory is not only non-intuitive, it is also non-sense.

But Kuhn (1970) has argued, and Dingle's experience tends to corroborate him, that the classical refutation of a theory does not occur. He states:

> ...a scientific theory is declared invalid only if an alternative candidate is available to take its place. No process yet disclosed by the historical study of scientific development at all resembles the methodological stereotype of falsification by direct comparison with nature ...

Thus, I cannot expect the criticism of the special theory to be accepted without an alternative. An alternative which is both rational and intuitive is presented in the next chapter.

2

AN ALTERNATIVE

Either Ether or Aether

> One leg of the three-legged stool used to represent modern physics was removed in Chapter 1. That leg was Einstein's special theory of relativity. In this chapter a new leg, an ether gauge theory, is inserted as a replacement. In addition, some significant reshaping is performed on another leg—Einstein's general theory of relativity.

Physics, in the last century, has suffered an increasing process of abstraction. This is, I believe, a severe problem. The elimination of the ether illustrates the abstraction process.

In the nineteenth century the ether was the substance through which electromagnetic waves propagated. This ether, or electromagnetic medium, had to be a solid, since only solids are capable of sustaining transverse waves. The polarization of light proved that it consisted of transverse waves. However, solids also sustain longitudinal pressure waves (e.g. sound waves in material solids), as well as the shear waves. The complete absence of any pressure waves within the ether constituted a severe problem to all the proposed ether theories.

The problem was solved by an abstraction process. Eliminate the ether and define in its place an electromagnetic vector field which does not require a physical medium to propagate. This abstraction process is equivalent to saying that the mathematics is the reality—the physical process involved is unknown and so ignored. This abstraction process is very dangerous. The same mathematical equation may be used to describe many different physical processes. Tyndall (1966) has stated:

> Ask your imagination if it will accept a vibrating multiple proportion—a numerical ratio in a state of oscillation.

While the ether was eliminated as the carrier of electromagnetic energy, it has been impossible to retain the vacuum as a featureless absence of matter. In effect, the "vacuum" has become the new ether. Whittaker (1951, preface) has said:

> As everyone knows, the aether played a great part in the physics of the nineteenth century; but in the first decade of the twentieth, chiefly as a result of the failure of attempts to observe the earth's motion relative to the aether, and the acceptance of the principle that such attempts must always fail, the word "aether" fell out of favour, and it became customary to refer to the interplanetary spaces as "vacuous"; the vacuum being conceived as mere emptiness, having no properties except that of propagating electromagnetic waves. But with the development of quantum electrodynamics, the vacuum has come to be regarded as the seat of the "zero-point" oscillations of the electromagnetic field, of the "zero-point" fluctuations of electric charge and current, and of a "polarization" corresponding to a dielectric constant different from unity. It seems absurd to retain the name "vacuum" for an entity so rich in physical properties, and the historical word "aether" may fitly be retained.

Since Whittaker wrote these words, the vacuum has continued to acquire additional characteristics and fields. The Higgs field (the source of mass, according to quantum theory) constitutes a prime example.

Pauli's (1958, vi) view of the ether also illustrates the move to abstract mathematical properties:

> ... the theory of special relativity was the first step away from naive visualization. The concept of the state of motion of the "luminiferous aether", as the hypothetical medium was called earlier, had to be given up, not only because it turned out to be unobservable, but because it became superfluous as an element of mathematical formalism, the group theoretical properties of which would only be disturbed by it.

In this chapter I return to the solid ether concept of the nineteenth century—an ether with mechanical characteristics analogous to the mechanical characteristics of ordinary material objects. This "naive visualization" of the ether has a number of arguments in its favor.

In the first chapter Holton was quoted as saying that, during a transformation stage from one paradigm to another, people are forced to accept notions which are usually regarded as paradoxical, ridiculous, or outrageous. The notion of a mechanical solid ether may qualify as a ridiculous and outrageous concept to some people. It is a concept which has been scoffed at and regarded as naive ever since Einstein developed the special theory. Two arguments which show that a solid ether is not as ridiculous as we have been led to believe are presented next.

The two arguments are followed by a basic outline of a new ether gauge theory of physics. The gauge, or scale, of physics is determined in this theory by the ether density. The ether density is, in turn, a function of both the gravitational potential and velocity through the ether. The gravitational force arises from the gravitational gradient of ether density and the acceleration force from the velocity gradient of ether density.

Because the ether and its characteristics are fundamental to the theory, it is presented in detail in this chapter. The fundamental gauge concepts are also presented in this chapter. This is sufficient for a basic understanding of the new theory. There are, of course, a number of interrelated concepts to be developed. Several of the peripheral concepts are simply stated in this chapter. They are reconsidered, together with supporting arguments, in subsequent chapters. The chapter ends by showing that the velocity gauge results directly from the general theory and the equivalence principle.

Inertia

A first argument in favor of a naive ether concept involves the characterization of inertia. Some have espoused the Machian concept that inertia is caused by the effect of the distant stars. But, if causal effects are limited to the speed of light, this cannot be the case—inertia has to be a local phenomenon, since accelerations are instantaneously resisted. (Only if the distant stars affect the local environment, whether called vacuum or ether, can they affect the inertia.) No time delay occurs in the action or reaction of inertia. It is instantaneous and, therefore, a local phenomenon.

Yet the special theory also suffers the same instant-action-at-a-distance problem, compounded by the fact that the local environment must simultaneously act differently for two different observers in relative motion. Overcoming inertia involves the transfer of energy (or mass). If an increase in velocity causes an increase in mass, the increased mass energy represents the energy transferred to the particle by accelerating it. But the special theory treats the velocity as relative; and, therefore, the energy must be relative.

The problem can be illustrated by another visit with the twins, Stella and Terrance, and their sister Astra. Let Stella and Terrance move away from Astra in opposite directions at one-half the speed of light. After some time, let Astra be accelerated to the same speed and in the same direction as Stella. This means that Astra's local environment must cause her mass to decrease for Stella (the relative velocity between Astra and Stella is decreased), while at the same time causing her mass to increase for Terrance (the relative velocity between Astra and Terrance is increased). Furthermore, this simultaneous increase and decrease in Astra's mass must occur instantaneously for each observer, no matter how far away they are.

Instantaneous action at enormous distances seems to be required if no ether exists. If this is the alternative to a naive belief in a mechanical ether, I prefer to be considered naive.

The Equivalence Principle

The second argument for an ether involves the equivalence principle. Einstein's development of the general theory was motivated in part by a desire to take advantage of the indistinguishability of the force of acceleration and the force of gravity (at least in small enough regions of space). This equivalence principle has no fundamental physical basis in Einstein's theories. In fact, the relationship has fundamental incompatibilities.

C.W.F. Everitt (1991) has stated regarding the equivalence principle:

> The more you think about it, the stranger it is.

In the context of Einstein's relativity theories, Everitt is correct. The equivalence principle equates an apple to an orange.

Gravitational Time Dilation

The general theory describes the gravitational effect upon a clock. It allows us to define for every point in space a unique value of the time dilation, or rate at which a clock would run compared to the rate of an identical clock outside the gravitational potential. The scalar value of time dilation by which a clock in a gravity field runs slow can be computed directly from the value of the gravitational potential at the same point. The one-to-one relationship between the clock rates is given by:

$$t_o = \gamma_g t_g \qquad (2.1)$$

where: t_o is the time of the clock outside the gravity field
t_g is the time of the clock in the gravity field
γ_g is the time dilation factor for a gravity field

The gravitational time dilation factor is given by:

$$\gamma_g = 1/\sqrt{1 + \frac{2\varphi}{c^2}} = 1/\sqrt{1 - \frac{2GM}{rc^2}} \qquad (2.2)$$

where: φ is the gravitational potential
c is the speed of light
G is Newton's gravitational constant
M is the mass which is the source of the gravity field
r is the distance from the center of the gravitational mass

Let's call equation (2.2) the apple equation. There are two important characteristics of this apple equation. First, it is an absolute equation, i.e. there is one and only one value of time dilation, γ_g, applicable to each point in space. Second, there is no reason to interpret this as anything other than the rate at which a clock runs in a gravity field. In other words, non-simultaneity of time is neither needed nor implied.

There is a lot of fuzzy thinking and several misconceptions regarding the equivalence principle. In order to clarify the equivalence principle, it is desirable to explore the relationship between time dilation and acceleration. The gravitational acceleration per unit mass is:

$$g = \frac{GM}{r^2} \qquad (2.3)$$

But,

$$\int_R^\infty (g)\, dr = \int_R^\infty \left(\frac{GM}{r^2}\right) dr = \frac{GM}{R} = -\varphi \qquad (2.4)$$

From the above, it is clear that the gravitational time dilation, γ_g, is a function of the spatial integral of the gravitational acceleration, i.e. the potential per unit mass.

More light on the role which acceleration plays can be obtained with a little review. The acceleration can be expressed as the force per unit mass:

$$F/m = a \qquad (2.5)$$

Energy is the force times distance:

$$E/m = ad \qquad (2.6)$$

Taking the derivative of equation (2.6) shows that the acceleration can be defined as the spatial derivative of the energy per unit mass. The gravitational time dilation is a function of the spatial integral of the acceleration or, in other words, a function of the gravitational potential energy per unit mass.

A common misconception is that the gravitational time dilation is caused by the gravitational acceleration. It is not. The misconception is fostered by the fact that, in any given gravity field, there is a one-to-one mapping between the acceleration and the potential, i.e.

$$\varphi = -rg \tag{2.7}$$

But this equation defines a different one-to-one mapping for different gravity fields, because the acceleration at a specific distance, r, is different. *In other words, it is not the acceleration which defines the time dilation, but the gravitational potential energy.*

Consider briefly the general theory. According to Einstein's general theory, the acceleration is caused by space curvature. If, instead, mass compacts the ether in its vicinity, it will cause a gravity field. (Elastic equations are almost identical to space-curvature equations.) The rest-mass energy in a more compacted ether is decreased (this is clearly compatible with the decreased speed of light in a gravity field), and the released rest-mass energy is the source of the potential energy. Thus, the gravitational acceleration would be due to the spatial gradient of ether compaction or spatial gradient of rest-mass energy. Thus, no instant action at a distance is required, nor is a retarded force required. The time dilation is a linear function of the ether density.

Velocity Time Dilation

Now let's consider non-gravitational acceleration. It turns out that a spatial integral of acceleration equivalent to the gravitational situation is easier to compute for centripetal acceleration than it is for linear acceleration. Compare a clock on the edge of a spinning disk to a clock at the center of the disk. The clock at the edge of a spinning disk experiences a centripetal acceleration:

$$a = \frac{v^2}{r} \tag{2.8}$$

where: v is the velocity at the edge of the disk
r is the radius of the edge of the disk

The spatial integral of the acceleration is then given by:

$$\int_0^R \left(\frac{v^2}{r}\right) dr = \int_0^R (r\omega^2)\, dr = \frac{R^2\omega^2}{2} = \frac{v^2}{2} \tag{2.9}$$

where: ω is the angular rotation rate

The spatial integral of the acceleration is the kinetic energy per unit mass. If the integrated centripetal acceleration or kinetic energy per unit mass is substituted into equation (2.2) in place of the integrated gravitational acceleration or gravitational potential, φ, one obtains:

$$\gamma_v = 1/\sqrt{1 - \left(\frac{v}{c}\right)^2} \tag{2.10}$$

Like the gravitational equation for time dilation, this time dilation is a function of energy, not acceleration. While, for a specific disk spinning at a specific rate, there is a one-to-one mapping between the acceleration and the kinetic energy, the relationship will change when the disk is spun at a different rate. *It is the kinetic energy which determines the time dilation, not the acceleration.*

The equation for time dilation due to velocity (kinetic energy) is quite familiar. The special theory interprets equation (2.10) as an orange. The velocity is treated as relative, and the formula is used to describe the intrinsic nature of time rather than the rate at which a clock runs. In other words, while there is no problem uniquely defining the gravitational reference for equation (2.2), there is a problem defining the velocity reference for equation (2.10).

This velocity-reference problem can be illustrated quite easily. If the spinning disk described above is given a translational velocity, v, equal to the rotational velocity of the edge, the velocity of a point on the edge will vary from zero to twice v as it traces out a cycloid pattern. The result is an oscillating time-dilation factor from the viewpoint of an observer in the original frame of reference. But an observer moving with the center of the disk would not see an oscillating time-dilation factor. Which of the two time-dilation patterns will be equivalent to the gravitational time dilation? Clearly, both time-dilation patterns cannot be equivalent to the same gravitational time-dilation pattern. An apple is not equivalent to an orange.

Claybourne (1990) identified the equivalent time-dilation factor with the kinetic energy, and he is correct. But, if velocity is relative, kinetic energy is relative. In which inertial frame is the kinetic energy to be defined?

Equivalence Impact on the Special Theory

The simple fact is that, in order for the equivalence principle to hold, equation (2.10) must be transformed from an orange into an apple. In other words, a single unique reference frame must be found where equation (2.10) holds and where the velocity time-dilation factor can be put in one-to-one equivalence with the gravitational time-dilation factor. And, in addition, the time dilation due to velocity must be interpreted as a clock effect, not as an intrinsic time effect.

There are several physical indications that the reference frame required by the equivalence principle is the reference frame stationary with respect to the gravity field. For example, if the gravitational acceleration is used to accelerate a clock, an automatic equivalence must hold. If a clock is allowed to fall from infinity to a point in the gravity field, its integrated acceleration or velocity is precisely equal to the integrated gravitational acceleration or gravitational potential. In other words, the kinetic energy is equal to the decreased potential energy. The particular velocity which the clock will attain at each point under such a free-fall is equal to its escape velocity at that point. The escape velocity is clearly a velocity with respect to the gravity field. Furthermore, the escape velocity is actually the escape speed, a scalar, since the direction of the velocity does not affect its escape from the gravity field (as long as it does not collide with the gravitating body). Thus, the square of the escape speed is equal to twice the gravitational potential at each point in space. This single example clearly shows that the equivalence principle demands that the velocity reference frame must be identified with the gravity field. Not only must the reference frame be the gravity field, the velocity of light must also be with respect to the gravity field. Beckmann (1987, 27) has previously proposed that the velocity of light is with respect to the gravity field.

Another benefit arises when the velocity reference frame is defined with respect to the gravity field. Specifically, it becomes apparent that such a definition establishes an absolute energy frame of reference. The fact that each point in space has a gravitational potential associated with it and also a kinetic energy, which is required in order to escape the local gravity field, clearly implies the existence of an absolute energy scale.

The existence of an absolute energy scale associated with the gravity field is illustrated by the launching of spacecraft. Most space scientists know that it takes more energy to launch a spacecraft westward than it does to launch one eastward. The reason is that to launch a spacecraft westward one has to counteract and overcome the spin velocity of the earth. But, when launching eastward, one can take advantage of the earth's rotational velocity, which the spacecraft already possesses. This is another way of saying that the velocity which is important is the velocity with respect to the gravity field. This dependence on the local gravity field is underlined by the observation that the

launch energy required is not affected by the earth's orbital velocity around the sun. In other words, the amount of energy required to launch a spacecraft eastward at noon is the same as the amount of energy required to launch the same spacecraft eastward at midnight. Thus, the velocity with respect to the solar gravity field is of no local importance. With an absolute energy frame of reference, the conservation of energy is easy to ensure.

Equivalence Impact on the General Theory

The above example of equivalence also reveals another significant difference between the two mechanisms of time dilation. Specifically, the time dilation induced by energy changes is of opposite sign for the two mechanisms. A decrease in the gravitational potential energy causes a time dilation. Exactly the same time dilation is caused by an equal increase in the kinetic energy.

In the prior example of a clock falling from infinity, the clock will run slower due to the decrease in gravitational potential and will run yet slower by the same factor due to the velocity (increase in kinetic energy) which it acquires. This is illustrated in inverse fashion by clocks located at sea-level on the surface of the earth. A clock at the equator will run slow compared to a clock at the north pole because of its velocity. But the velocity effect is exactly counteracted by the equatorial bulge caused by the centrifugal force. The increased radial distance from the center causes an increase in the gravitational potential, and this potential increase results in a clock which runs just enough faster to counteract the velocity-induced time dilation.

A spinning disk induces a radial outward force and a slower clock. A gravitational field induces a radial inward force and also a slower clock.

Although the principle of equivalence played a major role in Einstein's development of the general theory, it is not difficult to show an incompatibility between the general theory and the equivalence principle.

According to the general theory, gravity can be aliased into the geometry. In other words, according to the general theory, the curvature of Minkowski space is eliminated for a particle in free-fall. The particle then is supposed to behave as if it were unaccelerated in a flat Minkowski space. But an unaccelerated clock in a flat Minkowski space should run at a constant rate. This contradicts experiment. Clocks in free-fall in an elliptic orbit do not run at a constant rate. While the curvature of the three spatial dimensions may cancel to yield an effective flat space, the clock effects do not cancel—they add. The GPS (Global Positioning System) system demonstrates that a clock in an elliptic orbit near perigee, where the kinetic energy is higher and the potential energy is lower, will run slow by the sum of the two effects.

The fix of the general theory is to allow curvature in three-dimensional space or, better yet, a gradient of ether compaction. If kinetic energy causes an ether-density expansion (have you noticed that the special theory uses length contraction only when the moving particle looks back at the lab?), acceleration will induce a gradient of ether compaction or space curvature opposite to that of the gravity field. Thus, in free-fall the particle will travel in flat space. But the flat space is Euclidean, not Minkowski. The change in the general theory is required anyway to rid it of its false reliance upon a special theory which does not work.

In conclusion, the equivalence principle tells us several things. First, the special theory cannot be correct with its relativity of velocity and non-simultaneity of time. The replacement theory must be much closer to the general theory, and the corresponding phenomena must have a common physical basis. Second, the general theory must be modified to remove the corrupting influence of the special theory which it incorporated.

A replacement theory based upon gauge or scale effects due to the compaction of an elastic ether is a rational solution. It is now time to describe the basic characteristics of that solution.

The New Ether Gauge Theory

Defining the Ether

The polarization of light shows that light involves transverse vibrations, i.e. vibrations of shear strain. Shear waves can only occur in solids; therefore, the ether must be a solid. But normal solids have two kinds of wave-propagation phenomena. The first is a transverse wave, corresponding to a moving shear pattern of strain. Light is an example of such a transverse wave. The second kind of wave which can exist in a solid is a longitudinal compressive wave, corresponding to a moving pattern of volume strain. Compressive strain waves can occur in both solids and gases. Sound waves are compressive volume strain waves in ordinary matter.

The thorniest problem with which any proposed ether has to deal is the absence of any compressional (longitudinal) ether waves in nature. Green and Cauchy approached this problem head on. Green's model of the ether (Whittaker, 1951, 139-142) eliminated the longitudinal wave by assuming a very large resistance of the ether to volume distortion as compared to its resistance to shape distortion (similar to Jell-O). Thus, the velocity of the longitudinal wave approached infinity, and little energy was lost to longitudinal vibrations.

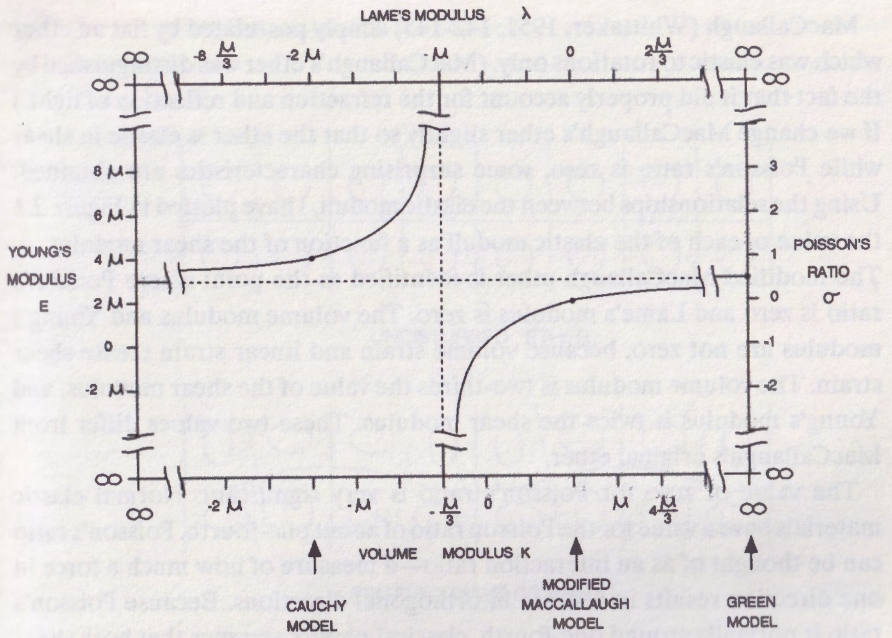


Figure 2.1 Elastic Modulus Relationships

Cauchy's contractile or labile ether (Whittaker, 1951, 145-148) was an ether with a negative compressibility such that the velocity of the longitudinal wave was zero. Hence, no energy was lost to longitudinal vibrations. Both of these models had problems conforming to the known characteristics for reflection and refraction of light.

In my first attempt at an ether model, I used a coefficient of volume elasticity (minus one-third the shear modulus) which caused the velocity of the compressive wave to be the same as the transverse wave. I hoped to show that they degenerated into one and the same wave. To avoid the instability of the compression which Cauchy encountered with his negative compressibility, I set the shear modulus negative rather than the volume modulus. Having an ether which was stable in compression was important, because I was also looking for an ether which would account for gravitational phenomena, as well as for light phenomena. Unfortunately, the negative shear modulus rather than negative volume modulus simply made the ether unstable in shear instead of volume. It was only after the discovery of how electromagnetic and gravitational phenomena fit together that I found a compatible set of ether elasticity characteristics. This ether is probably best described as a modified MacCallaugh ether.

MacCallaugh (Whittaker, 1951, 142-145) simply postulated by fiat an ether which was elastic to rotations only. (MacCallaugh's ether was distinguished by the fact that it did properly account for the refraction and reflection of light.) If we change MacCallaugh's ether slightly so that the ether is elastic in shear while Poisson's ratio is zero, some surprising characteristics are obtained. Using the relationships between the elastic moduli, I have plotted in Figure 2.1 the value of each of the elastic moduli as a function of the shear modulus, μ. The modified MacCallaugh ether is identified as the point where Poisson's ratio is zero and Lame's modulus is zero. The volume modulus and Young's modulus are not zero, because volume strain and linear strain create shear strain. The volume modulus is two-thirds the value of the shear modulus, and Young's modulus is twice the shear modulus. These two values differ from MacCallaugh's original ether.

The value of zero for Poisson's ratio is very significant. Normal elastic materials have a value for the Poisson ratio of about one-fourth. Poisson's ratio can be thought of as an interaction ratio—a measure of how much a force in one direction results in a strain in orthogonal directions. Because Poisson's ratio is normally around one-fourth, classical physics assumes that both shear strains and volume strains lead to wave-energy radiation. But such energy radiation depends on the orthogonal interaction of stress and strain. Pure shear strains or pure volume strains do not cause wave-energy radiation if Poisson's ratio is zero.

The Physics of the Ether

The ether can be thought of as a kind of superelastic solid material. Like superconductivity, it has no resistive or dissipative force. In addition, forces maintain their dimensional nature—Poisson's ratio is zero. This means that rotational (shear) oscillations of the ether would not propagate. They would simply remain in place and oscillate. In similar fashion, compressive oscillations of the ether would not propagate. They also would remain in place and oscillate. In fact, a combined shear and compressive oscillation would also stay in place and oscillate, if the two oscillations are out of phase. These oscillating patterns in the ether are illustrated in Figure 2.2. The combined out-of-phase standing-wave pattern of shear and volume oscillations is labeled as a "B" (for beginning) particle.

(1) Electromagnetic Radiation

Propagation of wave motion in an ether where Poisson's ratio is zero can only occur when the shear and compressive oscillations are in phase. This is shown in Figure 2.3. This pattern is, of course, identified with electromagnetic

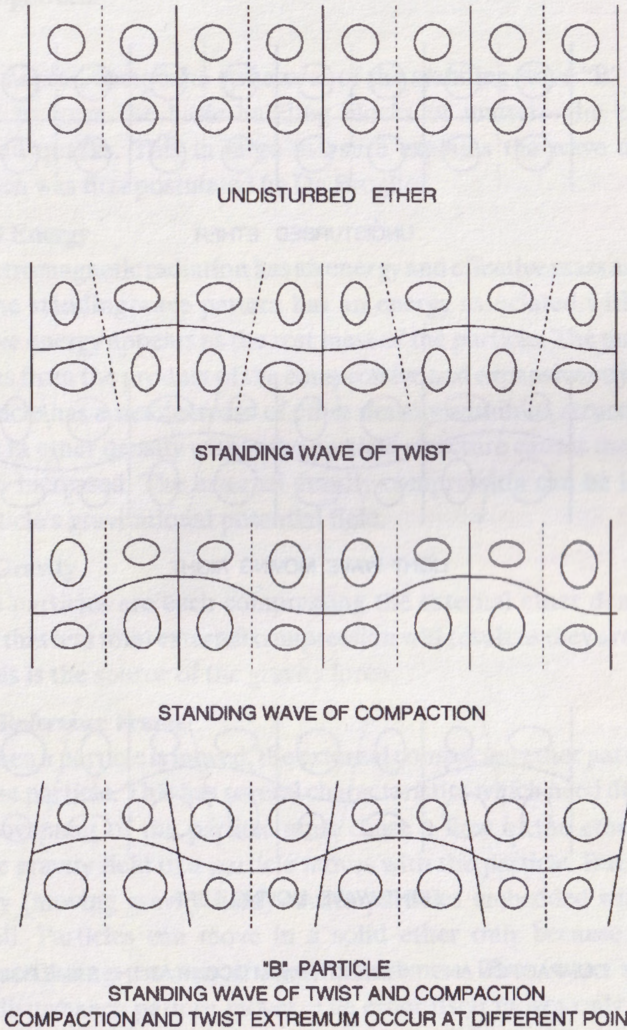


Figure 2.2 Standing Waves in the Ether

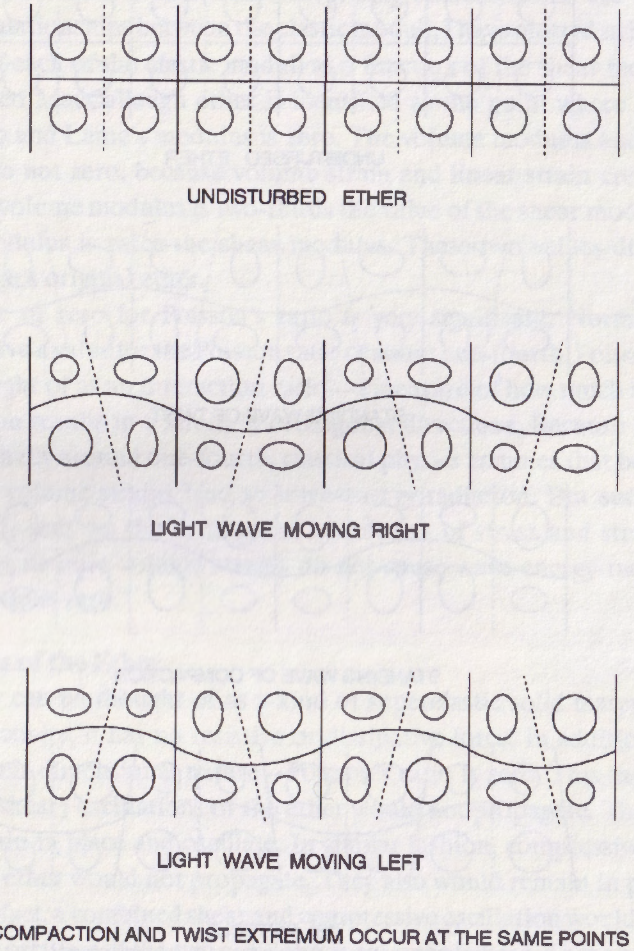


Figure 2.3 Light Waves in the Ether

radiation or, assuming the appropriate frequency, light. Because the twist (shear) is in phase with the compression and expansion, each time a compression-expansion cycle occurs there is a resultant net movement of the entire strain energy pattern.

(2) Matter

In a later chapter, composite structures of the standing-wave "B" particles will be used to form the basic building blocks of matter—the electrons, neutrinos, and quarks. This in large measure explains the wave nature of particles which was first postulated by De Broglie.

(3) Mass and Energy

Just as electromagnetic radiation has an energy and effective mass associated with it, so the standing-wave pattern has an energy associated with it. This standing-wave energy appears as the rest mass of the particle. The mass of the particle arises from the product of the compressive and expansive strains, such that the particle has a net decrease of ether density within its structure. This net decrease in ether density within the particle structure causes the external density to be increased. The external density compression can be identified with the particle's gravitational potential field.

(4) Force of Gravity

When two particles are each compressing the external ether density, it is easy to show that less total external compression will result as they are brought together. This is the source of the gravity force.

(5) Primary Reference Frame

Clearly, when a particle is moved, the external compacted ether pattern must move with the particle. This has several characteristics which need discussion. First, the movement of the particle must cause a flow of the ether-density pattern—the gravity field of a particle moves with the particle. But a flow of ether density (moving gravity field) causes particles embedded within it to move as well. Particles can move in a solid ether only because they are themselves oscillating patterns of ether disturbance. Thus, when a particle moves, the disturbance pattern moves. The ether itself moves only a limited amount as the density pattern moves. Furthermore, just as the disturbance pattern associated with particles is carried along by a gravity field (moving density pattern), so also the oscillating density pattern associated with light is carried along so that the effective speed of light is relative to the ether-density flow. In other words, the primary reference frame is always associated with the gravity field. As stated earlier, I am not the first to suggest this. Beckmann has previously published this concept. However, here it is developed as an inherent characteristic of the modified MacCallaugh ether.

(6) Increase of Mass with Velocity

Another result of movement of a particle through a gravity field is an apparent additional decrease in the internal ether density of the particle and an associated increase in the external density. This decreased internal density increases its mass and its own gravity field by causing an increase in the external density of the ether. Since the reaction time of the ether is related to the speed of light, one would expect that this change in internal ether density would be a function of the ratio of the velocity to the speed of light. This is precisely what is found.

(7) Radiation

Before pursuing the effects of motion further, another potential misunderstanding must be addressed. The moving pattern of oscillating volume and rotational stress and strain, pictured in Figure 2.3, was identified above as electromagnetic radiation—or, assuming the proper frequencies, light waves. Yet I have identified a volume compression of the ether field with gravitation. Does Figure 2.3 show electromagnetic radiation or gravitational radiation? Clearly, volume strain cannot be identified with the electric potential, since it can only result in attractive forces—a characteristic of a gravity field. Electric and magnetic phenomena exhibit both attractive and repulsive forces. I claim (the detailed arguments must be postponed until the next chapter) that what is normally identified as electromagnetic radiation is gravitokinetic or gravitational radiation.

(8) The Nature of Fields

An electric field is actually an oscillating gravity field. A magnetic field is actually an oscillating twist or rotational field. Since twist is caused by motion, I label the twist field as a kinetic field. Thus, a magnetic field is an oscillating kinetic field. The polarity and the attractive or repulsive characteristics of the electric and magnetic fields are related to the direction of the phase movement of the oscillations. The electric field is identified with a standing wave of oscillating compressive strain. The magnetic field is identified with a standing wave of oscillating twist. The phase of the oscillations is caused by an underlying rotation of the standing-wave structure, e.g. the electron. The force results from the fact that the net ether compression is changed when the separation distance is changed. In other words, the ether distortion from the combined fields is reduced with the appropriate movement.

(9) Measuring Time and Distance

With an elastic ether, a return to the concept of an absolute Euclidean space with an independent universal time dimension is practical. It is this absolute space-time continuum in which the ether is embedded. However, because of gravitational and velocity compaction of the ether, measurements of time and distance will be a function of location and velocity. Compaction of the ether causes measuring sticks to be compacted and causes the velocity of light to change. Our time measurements are, when reduced to their underlying basics, a measure of how long light takes to travel a specified distance. Because distance and light speed vary with ether density, so also time measurements will vary with local ether density. Thus, although time itself is universal in its flow, the perceived physical flow of time is a function of ether density. This picture of space and time represents a return to reality (cause always precedes effect), and a departure from the abstraction process which has created so many problems over the last century.

The Gauge of Gravity

As stated at the start of this chapter, the scale, or gauge, of physics is assumed to be proportional to the ether density. Since, as was argued above from the ether characteristics, the gravitational potential is proportional to the ether density, the gravitational potential must affect the scale of physics. In the development that follows, the similarity between the general theory and the ether gauge theory will be exploited to determine the specific gauge changes which occur as a function of gravitational potential.

There are three fundamental parameters in physics—length, mass, and time. If the local gauge, or scale, of these three fundamental parameters changes for any reason, within that local region no observable effects can be expected. In other words, since our measurement standards are based upon physical phenomena, as the physical phenomena change, the measurement standards will change as well. Thus, all of the local physics will appear to be unchanged.

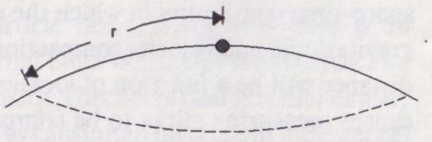
Einstein obtained the general theory by moving from a flat Euclidean geometry to a curved Riemannian geometry. The similarity between an elastic ether with a variable scale (a function of the ether density) and the general theory with its space curvature is not particularly obvious; in fact, they are very similar.

An observer in three-dimensional space generally has no trouble seeing the curvature of a two-dimensional surface which is embedded within that three-dimensional space. The observer has the advantage of an external view. There are methods, though, by which observers can determine the curvature of a space (surface) even when they are confined within that space. Three methods of determining the curvature of a spherical two-dimensional surface, using only internal measurements, are described below.

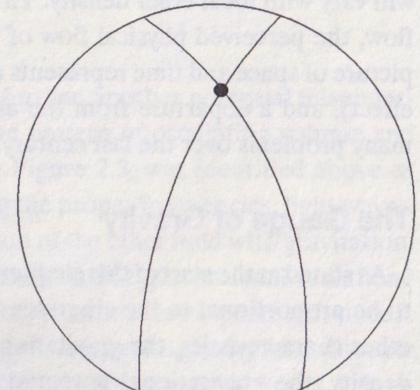
The first method is to measure how much the circumference of a circle deviates from the value it would have in flat space. Figure 2.4 shows that, on a spherical surface, the circumference will be smaller than it would be on a flat surface. This is because the true radius in the higher-order space (in which the curved space is embedded) is shorter than the value measured in the curved space.

A second method involves the measurement of the separation distance between two straight lines (geodesics) as a function of distance from where they cross. On a flat space the separation distance varies as a constant ratio of the distance along the lines. Figure 2.5 shows that the lines of longitude on a spherical surface first separate and then reconverge.

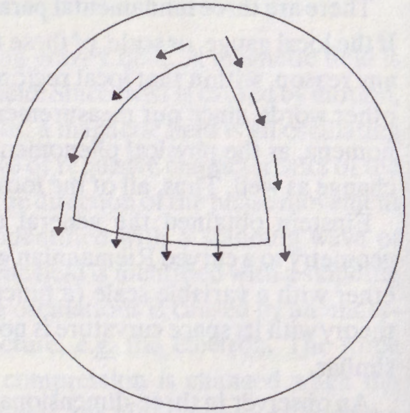
A third method is to measure the amount by which the direction of a vector will rotate as it is carried along a closed path in a "parallel transport" fashion. On a flat space the vector will always point in the same direction as it is carried without rotation. Parallel transport means to carry the vector such that no rotation occurs relative to the flat plane which is instantaneously



Radius to Circumference Ratio
Figure 2.4



Distance between Crossing Lines
Figure 2.5



Parallel Transport
Figure 2.6

tangent to the surface. Figure 2.6 shows that on a spherical surface the vector orientation after a round trip will depend upon the path followed.

These internal methods for determining the curvature of a two-dimensional surface via measurements on that surface can be extended to higher dimensional spaces. But are these methods reliable? Is it always clear that real curvature is involved?

Let us inflate a spherical rubber balloon and inscribe it with a spherical coordinate system of latitude and longitude. Now, at one of the poles let's make a pinhole and stretch the circular edge of the pinhole to a larger and larger radius until the rubber becomes a flat plane with the pole opposite where the pinhole was made at the same scale it had when the balloon was inflated. If the inscribed coordinate system is used for the measurement metric, every test described above will indicate that the surface is curved—even though it is now flat. Thus, an elastic gauge or scale is equivalent, as far as internal measurements are concerned, with a curved space. (This is illustrated by all the flat maps that have been made of the earth's surface.)

But you might argue that the metric in the above example is rather arbitrary. Not necessarily. On the rubber balloon stretched out as a sheet in the above example, an internal observer might use the wavelengths of internal sound waves or the transverse vibrations of the surface as his length measurement. In like manner, the frequency of the vibrations could be used as his time source. But these parameters are local functions of the amount of stretch of the balloon membrane and will largely reflect the metric previously inscribed on the balloon surface.

Let's distinguish this elastic curvature from true curvature. There are differences between true curvature of space and elastic curvature. True curvature can exist only if it is embedded within a higher dimensional space, while elastic curvature can exist within an elastic medium embedded within a space of the same dimensions. In other words, the general theory requires five dimensions in order to allow space curvature of the four-dimensional Minkowski space-time. By contrast, the ether gauge theory requires only three-dimensional Euclidean space in which to embed the three-dimensional elastic medium with its elastic curvature. With true curvature one can follow a straight line (geodesic) and, without turning around, arrive back at one's starting point (a hyperspherical surface). But in elastically curved space such a trip is impossible. Of more significance, the integral of true curvature simply gives the net change in direction, while the integral of elastic curvature gives the change in density of the medium.

It is worth mentioning briefly that, although the general theory is essentially compatible with the ether gauge theory, there are some significant differences. For example, the general theory associates mass and energy with space curvature. The new gauge theory makes a subtle but significant distinction. Mass or localized energy causes a decrease of ether density within the local particle structure and an associated increase in the external density. The relaxation of the external density with distance from the particle or energy concentration causes the ether density gradient, which is the equivalent of space curvature. The distinction above has very significant implications. In the general theory, any form of energy must cause space curvature. Thus, the tremendous energy which quantum theory embeds within the vacuum should cause a space curvature many tens-of-orders of magnitude greater than that actually observed. The new ether gauge theory has no such problem. Since the quantum vacuum energy is not localized but homogenous, it may create a change in the ether density; but a uniform change in ether density creates no gradient of ether density and, hence, no true curvature or elastic curvature of space.

Because of the near equivalence between true curvature and elastic curvature, it is not difficult to transfer some of the general theory results directly into their ether gauge equivalent effects. The space curvature caused by a spherically symmetric mass was obtained by Schwarzschild in 1916. The equivalent elastic scale or gauge of time and distance can be obtained directly from the metric coefficients which Schwarzschild obtained. To complete the gravity gauge description, the mass scale change must be determined as well. The mass scale change can be obtained heuristically by the requirement that the rest-mass energy decrease sufficiently to cause gravitational attraction. As far as I am aware, Bowler (1976, 67-69) was the first to show that the general theory was essentially equivalent to a gauge transformation. He obtained the same gauge transformation given below.

From the Schwarzschild metric, the length scale is decreased as the gravitational potential is decreased. From elasticity considerations, length must be proportional to the ether density. Thus, in terms of local lengths, the ether density is constant. The time-scale change is also obtained directly from the Schwarzschild metric. It increases (is dilated) as the gravitational potential is decreased. The time dilation can be related to an increase in the reaction time of a denser ether. The mass increases as the third power of the ether density. Since the mass is proportional to the amount of ether excluded from the internal structure of the particle, this also seems intuitive.

A table of gauge changes can now be presented. In the table, a superscript plus indicates that the parameter is increased by the scale factor. In the case

of gravity gauge change, the scale factor is "the inverse of the square root of one plus the quantity two times the (negative) gravitational potential divided by the speed of light squared." Or, in equation form:

$$\gamma_g = 1/\sqrt{1 + 2\varphi/c^2} \tag{2.11}$$

where: γ is the scale factor—the subscript g is used to denote a gravity-induced effect
φ is the gravitational potential (a negative quantity)
c is the speed of light

A superscript plus is used to designate that the parameter is modified by the scale factor. A superscript minus indicates that the parameter is modified by the inverse of the scale factor. Multiple plus or minus signs indicate multiple powers of the scale factor. Two abbreviations in the table need to be defined: "svisu" means that the physical constant under consideration has the "same value in smaller units"; "svilu" means that the physical constant under consideration has the "same value in larger units."

When the gravitational potential energy is decreased (deeper in the gravity field—increased ether density):

Gravity Gauge

length units shrink	l^-
mass units increase	m^{+++}
time units dilate	t^+

As a result other physical units change proportionately:

velocity units are smaller	v^{--}
speed of light slows (svisu)	c^{--}
emitted radiation frequency units are smaller	f^-
emitted radiation frequencies are smaller (svisu)	f^-
emitted radiation wavelength units are shorter	w^-
emitted radiation wavelengths are shorter (svisu)	w^-
emitted radiation energy units are smaller	E^-
emitted radiation energies are smaller (svisu)	E^-
rest-mass energy units are smaller	E^-
electrostatic charge (esu) has smaller units	q^-
charge of the electron (esu) is smaller (svisu)	q^-
electromagnetic charge (emu) has larger units	q^+
charge of the electron (emu) is greater (svilu)	q^+
force units are unchanged	f
Planck's constant is unchanged	h

These changes are completely self-consistent. That is, since the standard units of length, mass, and time are redefined, the changes which occur as a result of being moved to a lower gravitational potential are completely unobservable (within the local region). Note also that the scale changes are changes in the size of the units of measurement. But, if the standards change such that the local physics remain unchanged (e.g. the electron mass has the same measured value), specific physical changes must also occur of the same sign and magnitude so that the same value is measured in these modified units.

Measurements of non-local phenomena are affected, however. For example, the units of frequency in an increased gravitational potential are increased or become higher. This means that measured frequencies in an invariant external gauge would be higher. It is for this reason that clocks in an orbiting satellite appear to observers on the earth's surface to run faster in orbit than they did on the ground (excluding velocity effects). The increased gravitational potential means that the clock time units are shortened and the frequency units are higher (opposite the decreased gravitational potential effect in the above table). A standard clock oscillates at the same rate in these shorter time units and higher frequency units, which is measured as a higher rate in the unchanged time and frequency scale at the earth's surface.

The rest-mass energy is simply the static distortion energy of the ether compaction resulting from the presence of mass. It is computed as $E=mc^2$. The rest-mass energy decrease resulting from the change of scale is the source of the gravitational potential energy. Its gradient is the source of the gravitational force. The rest-mass energy is actually resident in the compressive energy of the ether external to the particle (i.e. its gravity field). The energy derived from the conversion of mass is actually obtained from the relaxation of the strain within the ether.

The Gauge of Velocity

There are two distinct situations which must be considered in assessing the effects of mass velocity on gauge. One is the situation in which the mass is so large that it dominates the gravity field surrounding it. Consideration of this situation is postponed until later. The second situation is that in which the gravity field of the particle does not dominate the surrounding space. It is this second situation which is considered first.

One might think that the simplest method for obtaining the gauge of velocity would be to use the equivalence principle and require that the gravitational

force affect the ether in exactly the opposite way that an acceleration force does. However, gravity affects the speed of light, and it is clear that the velocity of a small particle cannot affect the speed of light except in a very minute region. Later it is shown that the velocity of light is relative to the gravity field. Thus, motion of a small particle, since it has a negligible region where its gravity field dominates, cannot affect the speed of light. At first blush, it seems that the gravity gauge and velocity gauge cannot cancel and no equivalence principle is possible. But it is still possible that an equivalence principle obtains in Euclidean space rather than Minkowski space-time. After the velocity gauge is developed below, I will return to this question and show that there is considerable experimental evidence that the general theory, the special theory (with its Minkowski space-time), and the equivalence principle cannot all be true. In fact, the general theory and the equivalence principle will be used to directly obtain the velocity gauge.

Before deriving the velocity gauge, I want to consider the relationship between the ether, the gravitational effects of mass, and the velocity effects of mass. These are concisely stated in the table below. Einstein required that the gravitational force result from the curvature of space. By the equivalence principle, he essentially required that acceleration cancel this curvature and create a flat space when an object was in free-fall. By using an ether density gradient rather than space curvature, the new ether gauge theory can meaningfully relate the effects of the integral of the gravity force and the integral of the acceleration force. Thus, the gauge effects of gravitational potential energy and kinetic energy (velocity) can be compared.

Gravity Effect	Ether Effect	Velocity Effect
Gravity Potential	Ether Density Ether Compression Energy Gauge–Scale–Metric	Kinetic Potential
Gravity Force	Ether Density Gradient Gauge or Metric Gradient Curvature of Space	Acceleration Force
Gravity Force opposite to Acceleration Force	Equivalence Principle Free-Fall Constant Ether Density Constant Energy Constant Gauge Flat Space	Acceleration Force opposite to Gravity Force

Table 2.1 The equivalence between gravity and velocity effects on the ether

Historically, Lorentz and others argued that the electron must be distorted by velocity such that it suffers a contraction in the direction of motion. It was this which led Lorentz to develop the Lorentz transformation. Einstein's special theory claims that all objects suffer a contraction in the direction of motion, and he also obtained the Lorentz transformation. Several have argued against the special theory and yet accepted the flattening of the electron with velocity. To me, that is an untenable position. It is the symmetrical nature of the Lorentz transformation which creates the twin paradox.

The new ether gauge theory proposes a spatial three-dimensional reciprocal transformation. The Lorentz transformation is, by contrast, a transformation involving a single space dimension and the time dimension. In addition, it is symmetrical rather than reciprocal. I believe that the new gauge transformation applies to the electron and to all other matter. The velocity gauge using a general electron model is derived below.

In a later chapter, the electron will be modeled as a standing wave. For the moment, if that is assumed, it is possible to determine an expected change in its gauge as a function of velocity. Young's double-slit experiment demonstrated the interference effects of light waves. After De Broglie postulated that matter waves could exist, a number of experiments were conducted which demonstrated that they did indeed exist. Of particular interest are the experiments which have shown that moving electrons exhibit interference effects when they are allowed to pass through two small openings which are close together. But, strangest of all, the interference pattern is generated even when the electrons are sent toward the two holes one at a time. I believe these interference experiments strongly support the electron model as a standing wave which maintains a stable structure by acting back upon itself. The amplitude of the standing wave is inversely proportional to the distance from the center (given by the speed of light times the elapsed time). When one charged particle acts on another and (the crucial claim here) if part of a standing wave acts on itself, the force exerted is proportional to the product of the amplitudes.

Using the above characterization, the amplitude of the standing wave at a distance, d, from its center should be proportional to the speed of light divided by the square root of the outward-bound elapsed time of light propagation multiplied by the inward-bound elapsed time of light propagation. If the electron is not moving, this gives:

$$A \;\propto\; c/\sqrt{\tau_o \tau_i} \;=\; c/\tau \;=\; d \qquad (2.12)$$

where: A is the envelope amplitude
d is the distance
τ is the elapsed time (with appropriate subscript)

When the electron is moving, the outward- and inward-bound elapsed times will differ. By defining appropriate distances and times, the elapsed times can be computed:

$$r = \tau_o c \qquad (2.13)$$

$$b = \tau_o v \qquad (2.14)$$

$$d = \tau_o c_o \qquad (2.15)$$

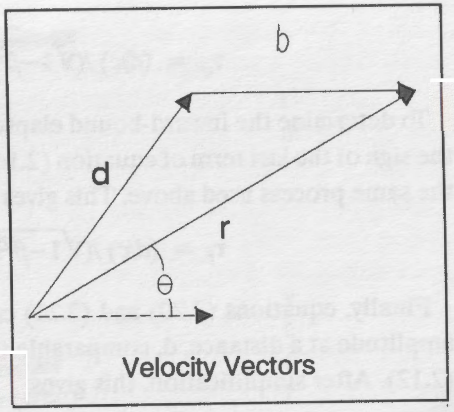


Figure 2.7

where: r is the radial distance moved at the speed of light
b is the distance the electron moves (change in origin)
d is the total distance
c is the true speed of light
v is the velocity of the electron
c_o is the effective apparent velocity of light
τ_o is the outward elapsed time

Now the cosine law can be used to give:

$$r^2 = b^2 + d^2 + 2bd\cos(\theta) \qquad (2.16)$$

where: θ is the angle with respect to the velocity vector.

Substituting equations (2.13) through (2.15) into (2.16) and eliminating the elapsed time gives:

$$c^2 = v^2 + c_o^2 + 2vc_o\cos(\theta) \qquad (2.17)$$

rearranging and completing the square:

$$c^2 - v^2 = (c_o + v\cos(\theta))^2 - v^2\cos^2(\theta) \qquad (2.18)$$

solving for the effective outward light velocity:

$$c_o = c\,(\sqrt{1-\beta^2\sin^2\theta} + \beta\cos\theta) \qquad (2.19)$$

where: β is the ratio of the electron velocity to the speed of light.

Now equation (2.15) can be used to give the outward-bound elapsed time:

$$\tau_o = (d/c)\,/(\sqrt{1-\beta^2\sin^2\theta} + \beta\cos\theta) \qquad (2.20)$$

To determine the inward-bound elapsed time, it is only necessary to change the sign of the last term of equation (2.16) and propagate that change through the same process used above. This gives for the inward-bound elapsed time:

$$\tau_i = (d/c)\,/(\sqrt{1-\beta^2\sin^2\theta} - \beta\cos\theta) \qquad (2.21)$$

Finally, equations (2.20) and (2.21) can be used to compute the envelope amplitude at a distance, d, comparable to the stationary electron of equation (2.12). After simplification, this gives:

$$A \propto c/\sqrt{\tau_o\tau_i} = d/\sqrt{1-\beta^2} \qquad (2.22)$$

It is obvious from equation (2.22) that, if the electron amplitude envelope is to remain unchanged, the distance gauge must be changed. Specifically,

$$d' = d/\sqrt{1-\beta^2} \qquad (2.23)$$

The velocity of light is not changed; and, therefore, a time dilation must also occur. If it is assumed that Planck's constant does not change, the time dilation implies that the energy emitted from state changes of atoms is decreased. Therefore, rest-mass energies must be decreased; and, if rest-mass energies are decreased, mass must be decreased.

Sufficient information is now available to generate a table of velocity gauge changes. The entire gauge change is a simple function of the velocity with respect to the local gravity field.

The positive scale factor of the gauge change is given by "the inverse of the square root of the quantity one minus the square of the ratio of the velocity to the speed of light." Or, in equation form:

$$\gamma_v = 1/\sqrt{1-\beta^2} \qquad (2.24)$$

where: γ is the scale factor—the subscript v is used to denote a velocity-induced effect
β is the ratio of the velocity to the speed of light

As before, a superscript plus indicates that the parameter is modified by the scale factor and a superscript minus indicates the parameter is modified by the inverse of the scale factor. Multiple plus or minus signs indicate multiple powers of the scale factor. The same value in smaller units is abbreviated "svisu" and the same value in larger units is abbreviated "svilu."

Velocity Gauge

length units expand	l^+
mass units decrease (increase)	$m^{-(+)}$
time units dilate	t^+

As a result, other parameters change.

velocity units are unchanged	v
speed of light is unchanged	c
emitted radiation frequency units are smaller	f^-
emitted radiation frequencies are lower (svisu)	f
emitted radiation wavelength units are longer	w^+
emitted radiation wavelengths are longer (svilu)	w^+
emitted radiation energy units are smaller	E^-
emitted radiation energies are smaller (svisu)	E^-
rest-mass energy units are smaller	E^-
electrostatic charge (esu) units are unchanged	q
electromagnetic charge (emu) units are unchanged	q
force units are smaller	F^{--}
Planck's constant is unchanged	h

It is not difficult to show that this gauge change is self-consistent. However, a sensitive Michelson-Morley experiment moving with respect to the local gravity center should be able to detect the movement. For example, the classical Michelson-Morley experiment was just sensitive enough to determine that there was no effect due to the earth's orbital velocity—not surprising because the speed of light is with respect to the gravity field. But the gravity field does not rotate with the earth, so the earth's rotation ought to be detectable. Since the earth's rotational velocity at nominal latitudes is almost 100 times smaller than the earth's orbital velocity, an experimental sensitivity 10,000 times greater is needed to detect the rotational velocity—but it is detectable with modern instruments.

In the velocity gauge above, the mass is shown to decrease by the scale factor. This might seem strangely at odds with Einstein's special relativity prediction of an effective mass increase with velocity. However, it is the rest-mass energy before formation of the kinetic field which decreases. Furthermore, the energy within the kinetic field is actually twice the amount normally ascribed to kinetic energy. When the energy of the kinetic field is included as mass, the gauge-change table above should have a mass increase. This is shown in parentheses in the gauge-change table above. The extra energy (in excess of the classical amount) is supplied by the gauge change itself. Thus, the energy input required is only half of the total energy within the field. The total kinetic energy is given by mv^2 and is analogous to the magnetic field energy, which is given by the charge times the velocity squared. To be more precise, the total energy, both kinetic and rest-mass, is given by:

$$E_t = m_o c_o^2 / \sqrt{1-\beta^2} \approx m_o c_o^2 + \tfrac{1}{2} m_o v_o^2 \qquad (2.25)$$

when written in terms of the rest mass expressed in the gauge which existed prior to being accelerated. But, written in terms of the rest mass expressed in the gauge which exists after acceleration, this becomes:

$$E_t = m_1 c_o^2 / (1-\beta^2) \approx m_1 c_o^2 + m_1 v_o^2 \qquad (2.26)$$

This new gauge theory ascribes the mass increase to the presence of a kinetic force field. The kinetic potential arises from the induced twist in the ether caused by the moving mass. Like the magnetic field around a moving charge, it forms circular lines of force in a plane perpendicular to the direction of movement. It is not seen by the co-moving observer, if that co-moving observer is within the region of space dominated by the gravitational and kinetic field of the moving mass.

There is some specific evidence that the kinetic field does indeed have energy twice that normally ascribed to it. A satellite in an elliptic orbit around the earth experiences a continual exchange of energy between the gravitational potential and the kinetic potential. The gauge change of velocity always supplies or absorbs half of the kinetic field energy, and half is supplied or absorbed by the gravitational potential. But, at a given specific gravitational potential, a circular orbit can be obtained by providing the orbiting satellite with just enough kinetic (velocity) energy to counteract the gravitational potential. But a circular orbit at a second gravitational potential can be maintained by supplying a classical kinetic energy which differs by only half the differing potential energies. In other words, the difference in gauge energy at two different gravitational potentials can be counteracted by only half as much classical kinetic energy—or by an exactly equal amount of the revised kinetic energy.

A general increase in size from the velocity gauge is the only other phenomenon substantially different from the special theory. But, in the experimental application of the special theory, it is no different. When the special theory is used to transform from a laboratory coordinate system to a moving coordinate system, the FitzGerald-Lorentz contraction is called upon to cause the laboratory objects to become shorter, when seen from the moving coordinate system. Except that it applies to all dimensions (and is reciprocal rather than symmetrical), the same effect is obtained by the gauge change above. Because the length gauge is increased in the moving frame, the dimensions of the non-moving (or slower moving) frame appear to be shorter.

The velocity gauge effects derived above assume small masses whose gravity fields do not dominate the macroscopic region around them. Therefore, even a co-moving observer (outside the gravity and kinetic fields of the moving mass) will see a mass increase in the moving particle. If the mass is large enough to dominate its region of space (for example, the moon), within that region the gauge seen will be a gravity gauge only. The mass and, hence, gravity field of the moon is, of course, affected by its velocity within the earth's gravity field.

The same phenomenon occurs with the small particles as with the large mass accumulations. However, with the small particles the gravitational region over which the gravity gauge applies is extremely minute. But the question is the same for both large and small particles: specifically, how does the gauge change at the boundary of the gravitational region where the speed of light changes as it transitions from one gravitational region to another?

The Gauge of the Speed of Light

It is time to address the question as to what happens at the boundary between gravitational regions. In the transition regions where gravity fields merge, the gauge changes as the speed of light changes. Except for the energy used in the formation of the kinetic field, the only difference between the velocity gauge of small particles and the gravity gauge is that the former does not affect the speed of light and the latter does. This means that the difference in gauges can be ascribed to the speed of light.

The change in gauge with speed of light is described below, assuming that the speed of light decreases. All of the changes are reversed if the speed of light increases.

These changes are completely self-consistent and would be unobservable from within the system. Since both time and energy remain unchanged during the transition, it is also generally unobservable from without the system.

Speed-of-Light Gauge

Assume the speed of light decreases (svisu)	c^{--}
As a result, the fundamental units change	
length units contract	l^{--}
mass units increase	m^{++++}
time does not change	t
Other units also change	
velocity units are smaller	v^{--}
emitted radiation frequencies do not change	f
emitted radiation wavelength units are smaller	w^{--}
emitted radiation wavelengths are smaller (svisu)	w^{--}
emitted radiation energy is unchanged	E
rest-mass energy is unchanged	E
electrostatic charge (esu) units are smaller	q^{-}
charge of the electron (esu) is smaller (svisu)	q^{-}
electromagnetic charge (emu) units are larger	q^{+}
charge of the electron (emu) is larger (svilu)	q^{+}
forces units are larger	F^{++}
Planck's constant is unchanged	h

Note the significance of the above. A homogenous change in the speed of light causes physical changes in length and mass such that the change becomes unobservable. In other words, the constancy of the speed of light becomes a tautology—change it and it changes the physics so that it remains unchanged.

At the start of the derivation of the velocity gauge, the moving particle was limited to a size such that its gravity field did not dominate the gravity field in its vicinity. If the particle does dominate its immediate gravitational environment, the velocity gauge obtained above is still correct for regions of space (ether) outside its gravitational domination. Thus, for the moon its velocity through the earth's gravity field causes gauge effects to be observed on the earth identical (as far as velocity effects are concerned) with those of a small artificial satellite in the same orbit.

However, the gauge effects within the moon's gravity field must be different because, as shown later, the speed of light there is with respect to the local gravity field. The net result is a gauge change which is the sum of the velocity

gauge change and the speed-of-light gauge change. But these two gauge changes combine to give the equivalent of a gravity gauge change. The scale of this "gravity" gauge change, though, is the scale defined by the moon's velocity through the gravity field (the earth's) outside the moon's own gravity field. This gauge change of a massive particle with velocity can also be shown to be a result of the increased mass of each small component particle which results from its velocity relative to the gravity field through which the combined massive particle is moving.

Note in closing that: (1) Any two types of gauge change can be combined to give the third (ignoring the mass of the kinetic field); (2) Planck's constant is never modified by any gauge change. Thus, it replaces the speed of light as the true universal physical constant.

Comparing the Alternatives

It was mentioned earlier that true curvature of space allows a relativity of gauge to exist. On the other hand, elastic curvature, obtained by elastic deformation of a medium, defines a scale or metric which is conservative, i.e. it is uniquely defined at each point. The spherical surface serves as an illustration again. Even though it is curved, the metric at any point is indistinguishable from any other point. Such is not the case for the metric of an elastic medium. For an elastic medium, the metric is a conservative function of position. While the space curvature Einstein called upon permits the general theory to be labeled as relativity theory, in actual fact the point is moot since gravity is not a relative phenomenon. The gravitational potential, like elastic ether density, is a conservative function of position. Given the mass distribution of the universe (and how each mass is moving), the gravitational potential at every point in space is uniquely defined. This means that gravitational potential can be put in one-to-one correspondence with an elastic ether density.

Einstein moved from the special theory to the general theory by invoking the equivalence principle (the indistinguishability of acceleration force and gravitational force). In what is, I believe, an irrefutable argument, it is easy to show that the reverse path is not valid. When the general theory, the equivalence principle, and the special theory are used to predict the effect of free-fall on clock behavior, a result contrary to experiment is obtained.

Assuming that gravity causes a true or elastic curvature of space, in order for flat space to result from free-fall, acceleration must cause a canceling curvature of space. Acceleration must un-curve the environment (ether or space) in the falling particle's immediate (own gravity field) vicinity. Thus, the spatial integral of the gravitational force (change in the gravitational potential) must cause the spatial integral of the acceleration (change in the kinetic energy) to cancel the gravitational curvature. From the experimental evidence, this canceling does not occur in the time axis. Therefore, I will assume that a flat Euclidean space obtains in free-fall.

> The general theory, the equivalence principle, and the special theory cannot all be true. The equivalence principle is used in the general theory to claim that free-fall in a gravity field is equivalent to unaccelerated motion in the flat Minkowski space of the special theory. But, since unaccelerated clocks in Minkowski space run at a constant rate, this says that all clocks which are in free-fall should run at constant rates. ***But they don't!*** The Global Positioning system (GPS) satellites need clock "relativity" corrections for both the general theory and special theory effects as a function of the eccentricity of the orbit. The separate effects are equal but not opposite. They add instead of canceling.
>
> So which of the three is wrong? I have already argued that the special theory cannot be correct. Therefore, I will proceed on that assumption and see where the equivalence principle applied to the general theory leads.

There are a number of direct conclusions which result from assuming the slightly revised equivalence principle (the effects of gravity and acceleration counteract to result in a flat Euclidean space).

First, assume that the Schwarzschild solution of the general theory equations for a spherically symmetric mass is correct and that it leads to the gravity gauge effects previously described. The gravity gauge scale factor equation (2.11) is repeated here:

$$\gamma_g = 1/\sqrt{1 + 2\varphi/c^2} \qquad (2.11)$$

The gravitational potential per unit mass, φ, is given by:

$$\varphi = -GM/r \qquad (2.27)$$

where: G is Newton's gravitational constant
M is the mass of the Schwarzschild gravity source
r is the distance from the center of the mass

This scale factor, γ_g, is greater than one. The length of each dimension of three-dimensional space decreases as one moves to a lower gravitational potential. If we choose as the standard of length the gauge at an infinite distance from the gravitational source, the length gauge equation for gravity is obtained:

$$\gamma_g l_g = 1 \qquad (2.28)$$

where: l_g is the shorter length due to gravity

The choice of the velocity scale factor, γ_v, is made so that it is also greater than one. (It is equal to one when the velocity is zero.) But the length scale must increase with velocity in order to cancel the gravity gauge effect. This means that the length gauge equation for velocity is given by:

$$l_v/\gamma_v = 1 \qquad (2.29)$$

where: l_v is the longer length due to velocity

The condition for flat Euclidean space of unit length then becomes:

$$l_g l_v = 1 = \gamma_v/\gamma_g \qquad (2.30)$$

But this simply says that the two gauge factors must be equal:

$$\gamma_g = \gamma_v \qquad (2.31)$$

Let a tiny test particle fall from infinity toward the gravity source. (I know it would take an infinite amount of time to fall.) Under these conditions, the decrease of potential energy equals the increase in kinetic energy. Because the potential energy is negative and the integral of gravitational force and acceleration force both have initial values of zero, the potentials can be used in place of the change of potentials. This gives:

$$-\varphi = GM/r = \theta = v_r^2/2 \qquad (2.32)$$

where: θ is the classical kinetic potential per unit mass
v is the velocity obtained after the particle has fallen to the distance r

This equation allows us to solve for the velocity at each point in space which would cancel the curvature induced by the gravitational potential. The velocity is that classically identified with the escape velocity. It is:

$${}_e v_r = \sqrt{2GM/r} \qquad (2.33)$$

where: the leading subscript is used to identify the velocity as the escape velocity
the trailing subscript is used to designate the point (radial distance) at which the velocity applies

That this velocity is the escape velocity makes sense for, in the escape process, both of the scale factors, γ, would return to one. Just as the gravitational potential is a scalar function, so also the escape velocity is a scalar function, since only the speed, not the direction, is significant.

From the above, the gauge of escape velocity is given by:

$$\gamma_v = 1/\sqrt{1+2\varphi/c^2} = 1/\sqrt{1-2\theta/c^2} = 1/\sqrt{1-{}_e\beta^2} \quad (2.34)$$

where: ${}_e\beta$ is the ratio of the escape velocity to the speed of light

It is time to state an obvious conclusion from equations (2.32) through (2.34). For these equations to hold universally (as do the general theory and the equivalence principle), the velocity of the test particle and the speed of light must both be measured relative to the gravity field. Gravitational force causes a velocity relative to the gravity field. Clearly, this again is contrary to the special theory.

Now, still using only the general theory and the equivalence principle (with conservation of energy), it is possible to obtain the laws of motion for orbiting test particles. First, assume that the test particle is dropped at a point a distance ρ from the gravity source with no transverse velocity or radial velocity. Since the total energy of the orbit is the sum of the gravitational potential and the kinetic potential (which is zero), the total energy (per unit mass), E_t, is:

$$E_t = \varphi_\rho = -GM/\rho = -{}_e v_\rho^2/2 \quad (2.35)$$

The gauge at the point of drop must be that of the initial drop point and must remain unchanged. It is given by:

$$\gamma_\rho = \gamma_g \gamma_v = 1/\sqrt{1-2GM/\rho c^2} \quad (2.36)$$

With a little idealization (the test particle does not crash into the physical mass of the gravity source), the fall of the particle will reach the center of gravity and be elastically bounced back (an infinite acceleration over an infinitesimal time) in the same direction at the same velocity. The orbit so described is that of an orbit with eccentricity of one and semimajor axis, a, which is one half the distance ρ. This means that the energy and gauge can be expressed in terms of the semimajor axis:

$$E_t = -GM/2a = -{}_e v_a^2/4 = \varphi_a/2 \quad (2.37)$$

$$\gamma_\rho = \gamma_g \gamma_v = 1/\sqrt{1-GM/ac^2} \quad (2.38)$$

At any point, r, in the orbit, the sum of the gravitational potential energy and the kinetic energy must still equal the total energy given above. Thus:

$$E_t = \varphi_a/2 = \varphi_r + \theta_r \quad (2.39)$$

Solving this equation for θ_r gives:

$$\theta_r = -\varphi_r + \varphi_a/2 = (GM/r) - (GM/2a) = v_r^2/2 \quad (2.40)$$

Solving this for the velocity (squared):

$$v_r^2 = (2GM/r) - (GM/a) = {}_e v_r^2 - {}_e v_a^2/2 \quad (2.41)$$

This last equation is a valid expression for the velocity in any orbit, not just an orbit with eccentricity of one. When the eccentricity is zero, r equals a and the equation still holds. Thus, the square of the velocity in a circular orbit is one half the square of the escape velocity at that orbital distance.

Some conclusions are again in order. If the velocity gauge is just as effective in canceling the gravity gauge when the direction of the velocity is circular or tangential as it is when radial, the length gauge of velocity must be three-dimensional. The special theory encounters two problems here: Its length gauge is of the wrong sign, and it only applies in the direction of the velocity.

The speed of light can also provide information on the velocity gauge of time. In the Schwarzschild gravitational solution, the gravity field caused the time units to increase and the length units to decrease. This means that velocities, including the velocity of light, which have units of length divided by time, are decreased as the inverse square of the gravity gauge scale factor. For the velocity gauge, the velocities are measured with respect to the gravity field and do not change as a function of the velocity itself. Thus, the length increase with velocity must be counteracted by a time unit increase (dilation) with velocity so that velocity units are unchanged. While the special theory also yields time dilation with velocity, in the special theory it is relative and applies symmetrically. To agree with the general theory and the equivalence principle, the effect must be reciprocal, not symmetrical.

As the properties of the velocity gauge have been developed from the general theory and the equivalence principle above, I have repeatedly stated where the results differ from the special theory. However, left unstated but nevertheless true, in each case the derived characteristics do agree with the velocity gauge which was independently developed earlier in the chapter. In other words, the general theory and the equivalence principle lead directly to the ether gauge theory previously obtained.

Another illustration of the harmony of the ether velocity gauge and the ether gravity gauge can be given. In a free-fall eccentric orbit, the two length gauges cancel so that a flat Euclidean space results. But the two time gauge effects are additive. This is because, at the lower gravitational potentials (with their dilated time scales), the orbiting test particle has a higher velocity (with its dilated time scale). Just the opposite effect occurs at the equator of a spinning planet. As the planet spins faster, the centrifugal force causes the equator to bulge or increase its distance from the center of gravity. Thus, the gravitational potential is increased and the velocity is increased. In this example, just as the ether theory predicts, the velocity and gravity gauge factors cancel for the time but are additive for the length. Thus, the gravitational attraction at the equator is reduced because of both gauge effects on the length scale. The clocks of the ground monitor stations for the GPS satellites are observed to run independent of their latitude and, hence, independent of their rotational velocity and sea-level distance from the center of the earth. This verifies the time gauge cancellation effect on a spinning earth.

Conclusion

Two arguments in favor of a solid ether have been presented. Next, a specific ether model was described. That ether was referred to as a modified MacCallaugh ether. It has the proper characteristics to account for both gravitational and electromagnetic phenomena. In addition, a theory of gauge change with gravitational potential, with velocity through the gravity field, and with the speed of light was proposed. The velocity gauge change replaces the symmetrical Lorentz transformations. Instead of being symmetrical, the velocity gauge transformations are reciprocal. This means that there is no paradox inherent in the transformation. Each observer will see the same phenomena as any other observer—but seen in his own local gauge environment. The general theory and the equivalence principle are used together with selected experimental evidence to show that the new ether gauge theory can explain the behavior of test particles in gravitational free-fall. The same evidence cannot be explained by the special theory.

3

UNIFICATION

The Potential of Potentials

The typical method used to attempt the unification of gravity and electromagnetism is to meld quantum theory with the general theory and arrive at a quantum gravity theory (i.e. to combine two of the three theories which constitute the three legs of the stool representing modern physics). In this chapter, the unification of electromagnetism and gravity is addressed. But the unification is actually accomplished using classical electromagnetism. The quantum aspects have only a very minor role to play in the unification.

The link between electromagnetism and gravity has already been mentioned in Chapter 2. In this chapter the relationship is derived in detail. Of necessity, a substantial amount of mathematics is encountered. However, even though the mathematical treatment is somewhat tedious, the reader is encouraged to read through the chapter. The implications and conclusions derived from the mathematics can be understood by all. The prime purpose of the mathematics is to convince those who are mathematically adept that the arguments rest upon a solid logical foundation.

The particular form of the mathematics used is vector analysis, which allows coordinate independent derivatives to be employed. A very brief description of vector derivative functions is given. Those who are not somewhat familiar with vector analysis will need to consult a more exhaustive text.

This review of vector derivatives is followed by: (1) a consideration of the problems encountered when the classical electromagnetic equations are expressed in potential form; (2) modifications to the potential equations which solve the problems and provide new explanations of real physical phenomena; and (3) the gravitational potential equations which parallel the Maxwell electromagnetic potential equations.

Review of Vector Derivatives

The symbol, ∇, is used to describe coordinate-free derivatives. It can act upon both scalar fields and vector fields. The gravitational potential, φ, used in the previous chapter, is an example of a scalar field. It has a magnitude at every point in space corresponding to the potential energy at that point.

The gradient function acts on a scalar field to create a vector field. Thus, the gradient of the gravitational potential, designated $\nabla\varphi$, is the vector field whose direction is such that the spatial derivative of the scalar field is maximum and whose magnitude is equal to the spatial derivative. Thus, the gradient of the gravitational potential is the gravitational force field (i.e. the direction and magnitude of the gravitational force at each point in space).

The divergence of a vector field, $\boldsymbol{\theta}$, designated $\nabla \cdot \boldsymbol{\theta}$, is a scalar field representing the compression or expansion of the field. (Vectors are indicated by bold letters.) Thus, a vector field corresponding to the fluid flow of an incompressible fluid would have no divergence. The divergence results in a scalar field which indicates (magnitude only) how much more (or less) fluid (or other vector field) leaves a small (differential) volume than enters it.

The curl of a vector field, $\boldsymbol{\theta}$, designated $\nabla \times \boldsymbol{\theta}$, is a new vector field which describes the angular rotation of the old vector field at each point. If the original vector field corresponds to fluid flow, the curl of that vector field is the rotational speed which a tiny paddle wheel would experience at each point in the original vector field.

The final differential operator is the Laplacian. It is designated by either $\nabla \cdot \nabla$ or ∇^2. It can act on either a scalar or a vector field. When used on a scalar field, it is equivalent to first finding the gradient of the scalar field and then finding the divergence of the vector field generated by that gradient. Thus, it generates a scalar field from a scalar field. When applied to a vector field, the Laplacian is equivalent to treating each component of the vector field as a scalar field and acting on each. Thus, it generates a vector field from a vector field.

The derivative functions from vector analysis which are needed have now been defined; however, two additional relationships between them are needed. First, the curl of a gradient of a scalar field is always zero. This says the value of a scalar field at any point cannot be less than itself—its gradient cannot curl. Second, the divergence of the curl of a vector field is always zero. This says the curl cannot diverge. The curl is a measure of circularity; but divergence is a measure of spreading (expansion or contraction). The curl or circularity has no expansion or contraction; thus, the divergence of the curl is zero.

The Maxwell Equations in Potential Form

The equations describing the electromagnetic fields derived by Maxwell in 1865 are among the most enduring in all of physics. Maxwell seemed to favor an ether, but the ether models he employed were clearly intended to be illustrative only.

The Maxwell equations can be expressed more succinctly in their potential form, rather than their common electromagnetic field form. However, some problems arise when they are converted to the potential form. Normally these problems are dismissed by the observation that only the electromagnetic fields correspond to reality. The potentials are treated as a convenient fiction for mathematical manipulation.

This view of the potentials has recently received a severe blow by some quantum theory experiments suggested by Aharonov and Bohm. Quoting from a recent article by Imry and Webb (1989):

> The experiments suggested by Aharonov and Bohm revealed the physical significance of potentials: a charged particle that passes close to but in no manner encounters a magnetic or electric field will nonetheless change its dynamics in a subtle but measurable way. The consequence of the Aharonov-Bohm effect is that the potentials, not the fields, act directly on charges.

But, if the potentials do have physical meaning, the problems encountered in moving from the electromagnetic field form of Maxwell's equations to the potential form cannot be ignored.

Jackson (1975) derived the potential equations from the Maxwell field equations. He is used as the primary reference in this section. He used Gaussian units; and, in spite of a strong recommendation to use the SI units which are in more common use today, I have chosen to follow Jackson. The reason for this choice is twofold. First, where practical, I believe that the physics should determine the natural units. It is never the absolute velocity which has a physical effect; but, instead, it is the ratio of the velocity to the speed of light which gives rise to specific physical effects. The Gaussian units reflect this characteristic. Second, it is far easier to relate the separate physical phenomena of electric, magnetic, gravitational and kinetic effects if they can be easily expressed in the same units. In the Gaussian units, the electric and magnetic effects are already in the same units (i.e. the same combination of fundamental units of mass, length and time). The gravitational and kinetic units are also the same, though different from the electromagnetic units. (Even the gravitokinetic and electromagnetic units can be made the same if the mass is scaled by the square root of Newton's gravitational constant.) These reasons, I believe, outweigh the advantage of using more familiar units.

Using the vacuum form of the equations gives:

Absence of monopoles: $$\nabla \cdot \mathbf{B} = 0 \qquad (3.1)$$

Faraday's law: $$\nabla \times \mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} = 0 \qquad (3.2)$$

Coulomb's law: $$\nabla \cdot \mathbf{E} = 4\pi\rho \qquad (3.3)$$

Maxwell-modified Ampere's law: $$\nabla \times \mathbf{B} - \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} = \frac{4\pi}{c}\mathbf{J} \qquad (3.4)$$

where: **E** is the electric field strength
B is the magnetic field strength
ρ is the charge density
J is the current density

Now, following Jackson, these equations are converted to those involving the scalar and vector potentials. Equation (3.1) says that **B** can be expressed as the curl of a vector potential. (Rather than use the normal designation of the letter, **A**, as the vector potential, the Greek symbol, ω, is used. This provides symmetry for subsequent developments, where all potentials are designated by Greek letters.)

$$\mathbf{B} = \nabla \times \omega \qquad (3.5)$$

This allows equation (3.2) to be written as:

$$\nabla \times (\mathbf{E} + \frac{1}{c}\frac{\partial \omega}{\partial t}) = 0 \qquad (3.6)$$

and, if the curl of a vector is zero, it can be written as the gradient of a scalar, ψ. Therefore:

$$\mathbf{E} = -\nabla\psi - \frac{1}{c}\frac{\partial \omega}{\partial t} \qquad (3.7)$$

Equations (3.5) and (3.7) are now just definitions of the fields in terms of the potentials. When these definitions are substituted into the two remaining equations (3.3) and (3.4), the Maxwell equations in potential form are obtained:

$$\nabla^2\psi + \frac{1}{c}\frac{\partial}{\partial t}(\nabla \cdot \omega) = -4\pi\rho \qquad (3.8)$$

$$\nabla^2\omega - \frac{1}{c^2}\frac{\partial^2\omega}{\partial t^2} - \nabla(\nabla \cdot \omega + \frac{1}{c}\frac{\partial \psi}{\partial t}) = -4\frac{\pi}{c}\mathbf{J} \qquad (3.9)$$

The two equations (3.8) and (3.9) are coupled, and normally an additional constraint is imposed in order to separate the two equations. Two different constraints which are used to uncouple these equations are considered below. These constraints are usually referred to as gauge constraints. (Do not confuse this use of the term gauge with that which I have used elsewhere. I have used gauge to designate a systematic change of scale. The use of the term gauge in the electromagnetic potential constraints actually derived originally from the same concept. Weyl (Pauli, 1958, 192-202) attempted to generalize Einstein's general theory to include electromagnetism. Where Einstein allowed curved space so that the direction which a vector pointed was a function of its path, Weyl also allowed its scale or gauge to be a function of its path. While Weyl's theory encountered problems, variations of his theory survive; and the use of the term gauge in the electromagnetic gauge constraints lives on.)

(1) Coulomb gauge

The Coulomb-gauge condition is generally employed in the simplest formulations of quantum mechanics. The Coulomb gauge requires that the divergence of the magnetic vector potential be zero. This results in the following equations:

$$\nabla^2\psi = -4\pi\rho \qquad (3.10)$$

$$\nabla^2\omega - \frac{1}{c^2}\frac{\partial^2\omega}{\partial t^2} = -\frac{4\pi}{c}\mathbf{J} + \frac{1}{c}\frac{\partial \nabla\psi}{\partial t} \qquad (3.11)$$

Classical writers puzzle over the fact that equation (3.10) seems to describe an instantaneous Coulomb field over all space. As stated above, this is often excused by indicating that it is the forces which are important and that the potentials are just mathematical abstractions. This argument can no longer be considered as valid in the light of the Aharonov-Bohm experimental results. Therefore, this instantaneous Coulomb field over all space remains a problem.

The last term in equation (3.11) is shown to counteract the effect of any longitudinal or radial current; and only a rotational or transverse current remains, which, it is said, gives rise to transverse radiation. This can be illustrated (only a small compromise) by an electron in a circular orbit around a proton. In a circular orbit, the electric potential seen by the electron does not change; thus, the last term in equation (3.11) is zero. But the current (moving electron) in a circular orbit is entirely transverse. Thus, the radiation predicted by equation (3.11) is due entirely to the transverse or curl component of the current.

But this gives rise to another fundamental problem. These classical equations predict that an electron in a circular orbit around a proton will give rise to radiation. This is contrary to nature, as is evidenced by atomic structure. The classical solution has been to posit an arbitrary quantization of electron orbits. There is a better way.

(2) Lorentz gauge

The Coulomb gauge gives rise to equations which are not covariant under the Lorentz transformation. Therefore, more complicated equations are developed in the quantum theory, using the Lorentz gauge, which is Lorentz covariant.

The Lorentz gauge condition is specifically:

$$\nabla \cdot \omega + \frac{1}{c}\frac{\partial \psi}{\partial t} = 0 = \nabla^2 \lambda - \frac{1}{c^2}\frac{\partial^2 \lambda}{\partial t^2} \qquad (3.12)$$

where: λ is used to modify ω and ψ such that:

$$\omega' = \omega + \nabla \lambda \qquad (3.13)$$

$$\psi' = \psi - \frac{1}{c}\frac{\partial \lambda}{\partial t} \qquad (3.14)$$

These changes to the potentials do not affect the value of the magnetic field, **B**, or the value of the electric field, **E**. But there is an exchange of energy between the potentials.

The Coulomb gauge results in the separation of the two potential equations and gives:

$$\nabla^2 \psi - \frac{1}{c^2}\frac{\partial^2 \psi}{\partial t^2} = -4\pi\rho \qquad (3.15)$$

$$\nabla^2 \omega - \frac{1}{c^2}\frac{\partial^2 \omega}{\partial t^2} = -\frac{4\pi\rho}{c}\mathrm{J} \qquad (3.16)$$

This separation is nice and results in symmetrical equations. Unfortunately, the meaning of this separation is normally not discussed. The Lorentz condition, in a general sense, gives rise to an oscillating gauge, λ, which implies an oscillating variation in the value of electric and magnetic potentials. This oscillation, though, does not affect the electric and magnetic fields.

This effect is strange and is hard to connect to any physical meaning. Furthermore, it clearly conflicts with the Aharonov-Bohm experiments, which indicate that the potentials are fundamental physical parameters which are not free to oscillate without physical effects.

The fundamental conclusion must be that:

Something is wrong with the classical potential equations.

Modifying Maxwell's Potential Equations

So the classical potential equations are wrong, and potentials do have physical meaning. This implies that something is dramatically wrong in the process of going from the Maxwell force equations to the potential equations. Neither classical physics nor quantum mechanics has suggested a way to avoid the problem. A solution is proposed below.

Several things suggest something of an oscillatory nature about the electron. These include: (1) the wave-like character of matter as postulated by De Broglie; (2) the interference phenomena from electrons which are beamed at two small holes (analogous to Young's double-slit experiment with light); and (3) the quantum mechanics model of the electric force being caused by the exchange of virtual photons—which are certainly wave-like in nature. (The concept of virtual photons arose in quantum mechanics from the imposition of the Lorentz gauge. If the Lorentz covariance requirement is eliminated, virtual photons are eliminated. But they are a superfluous concept. If potentials must act directly, virtual photons are not needed.)

It turns out that to impose an oscillatory character on the potentials derived from the force equations is quite easy to do. The development below follows the traditional development with only two slightly different assumptions.

In the classical derivation, since the divergence of the magnetic force is zero, the magnetic force is represented as the curl of a vector potential. But a non-oscillatory force whose divergence is zero can also be obtained from the partial time derivative of the curl of an oscillating vector potential. (If electric and magnetic fields must act on true point charges, as is classically assumed, then indeed only a constant potential can satisfy the requirement of a non-oscillating force. However, if the force is a result of a standing-wave interaction between two charged particles, the interacting force is spread over a plane bisecting the line joining the particles. This standing-wave interaction is indicated by the Aharonov-Bohm experiments. Under these conditions, a constant average force can result from an oscillating potential.) The equation relating an oscillating magnetic vector potential to a magnetic field is:

$$\mathbf{B} = \nabla \times \left(\frac{1}{c}\frac{\partial \omega}{\partial t}\right) = \frac{1}{c}\frac{\partial}{\partial t}(\nabla \times \omega) \tag{3.17}$$

The question is not whether the classical expression or the expression given in equation (3.17) is correct mathematically. They both are. The question is: Which represents reality?

The equation for the curl of the electric field is similarly modified. Inserting the above result into equation (3.2) gives:

$$\nabla \times \left(\mathbf{E} + \frac{1}{c^2}\frac{\partial^2 \omega}{\partial t^2}\right) = 0 \tag{3.18}$$

In the standard development, the fact that the curl of the electric field (as modified by the partial time derivative of the magnetic vector potential) is zero is used to state that it can then be represented by the gradient of a scalar field. It can, but it is equally acceptable mathematically that it be represented by the partial time derivative of the gradient of a scalar potential—which allows an oscillatory scalar potential. Again, it is not a question of which is mathematically correct but which corresponds to reality. Choosing the oscillatory form gives:

$$\mathbf{E} + \frac{1}{c^2}\frac{\partial^2 \omega}{\partial t^2} = -\frac{1}{c}\frac{\partial \nabla \psi}{\partial t} \tag{3.19}$$

$$\mathbf{E} = -\frac{1}{c}\frac{\partial}{\partial t}\left(\nabla \psi + \frac{1}{c}\frac{\partial \omega}{\partial t}\right) \tag{3.20}$$

At this point a major simplification is possible. The fundamental reason for pursuing this alternate development is the hypothesis that the electric field of an electron is composed of some form of oscillating, but non-radiating, electromagnetic field. If we define an oscillating electromagnetic vector potential which is composed of a curl component and gradient component oscillating in phase, we can identify both the omega, ω, of equation (3.17) and the gradient of psi, $\nabla\psi$, of equation (3.19) as components of this vector potential. This clearly identifies the combined terms in equation (3.20) of the electric field as a non-radiating field—the time derivative ensures that the magnetic component is in quadrature with the electric component; and, hence, the Poynting vector (associated with energy flow) vanishes. Thus, the vector potential, Γ, can be defined, which is an oscillating standing wave of electromagnetic energy. It is given by:

$$\Gamma = \nabla \psi + \frac{1}{c}\frac{\partial \omega}{\partial t} \tag{3.21}$$

This allows a rewrite of equations (3.17) and (3.20) to get:

$$\mathbf{B} = \nabla \times \Gamma \tag{3.22}$$

$$\mathbf{E} = -\frac{1}{c}\frac{\partial \Gamma}{\partial t} \tag{3.23}$$

Now the two remaining Maxwell equations can be developed. The divergence of the "electric" field is quite easy to obtain, and it is simply the divergence of the derivative of the non-radiating vector potential:

$$\nabla \cdot \mathbf{E} = -\frac{1}{c}\frac{\partial}{\partial t}(\nabla \cdot \Gamma) = 4\pi\rho \tag{3.24}$$

The final equation is also easily developed:

$$\nabla^2 \Gamma - \frac{1}{c^2}\frac{\partial^2 \Gamma}{\partial t^2} = -\frac{4\pi}{c}\mathbf{J} + \nabla(\nabla \cdot \Gamma) \tag{3.25}$$

The only questionable item is the presence of the last term in equation (3.25). But, using the continuity equation:

$$\nabla \cdot \mathbf{J} + \frac{\partial \rho}{\partial t} = 0 \tag{3.26}$$

(which is the constraint Maxwell used to modify Ampere's law), together with equation (3.24), gives the longitudinal component of current, $\mathbf{J}_l$, as:

$$\frac{1}{c^2}\frac{\partial^2 \Gamma}{\partial t^2} = \frac{4\pi}{c}\mathbf{J}_l \tag{3.27}$$

Now, using equation (3.27) and recombining two of the terms in equation (3.25) gives the equation of transverse or solenoidal current, $\mathbf{J}_t$, as:

$$\nabla \times \nabla \times \Gamma = \frac{4\pi}{c}\mathbf{J}_t \tag{3.28}$$

But the transverse component of current can be expressed as the total minus the longitudinal component. Similarly, the curl of the curl can be split into two parts, which can be identified as the total minus the longitudinal components. Specifically:

$$\nabla \times \nabla \times \Gamma = -\nabla^2 \Gamma + \nabla(\nabla \cdot \Gamma) \tag{3.29}$$

Clearly, the last term is longitudinal in nature, since its curl must vanish. Finally, equation (3.25) can then be equated with the transverse component of current:

$$\nabla^2 \Gamma - \frac{1}{c^2}\frac{\partial^2 \Gamma}{\partial t^2} = -\frac{4\pi}{c}\mathbf{J} + \nabla(\nabla \cdot \Gamma) = -\frac{4\pi}{c}\mathbf{J}_t \tag{3.30}$$

In the classical development, it is necessary to impose the Coulomb gauge constraint to obtain the equivalent equation. In equation (3.30), no such constraint is needed. Furthermore, the classical development is left with an anomalous instantaneous Coulomb field. No such problem arises in the new development.

The structure of the above equations is important for another reason. As long as the relationship between the scalar potential and the vector potential of the underlying standing wave, as given by equation (3.21), is not disturbed, it will not cause radiation, no matter what value the left-hand side of equation (3.30) becomes. This is because equations (3.22) and (3.23) indicate that the electric and magnetic fields of the combined potential (standing wave of the standing wave) will be in phase quadrature and, therefore, will not radiate.

The important question, then, is how to avoid stimulating the magnetic or electric component of the underlying standing wave such that their phase relationship is altered. One condition is certainly required if the phase relationship between the magnetic vector potential and the electric scalar potential is not to be disturbed. Specifically, if one charged particle is orbiting around another, the orbital rate must be commensurate with the underlying rate of the standing-wave oscillation.

The conclusion is inescapable: If an electric charge is orbiting in an electric potential, it will not radiate if it is in specific quantized orbits. Thus, this new set of equations, instead of disagreeing with reality, predicts behavior that is real but only obtained by fiat in the classical development. Quantized orbits, of course, also imply quantized radiation and absorption when the orbits change.

Can there be any question as to which of the two sets of potential equations represents reality?

Gravitational and Kinetic Forces

If the electric and magnetic forces arise from oscillating potentials, light and what we normally call electromagnetic radiation are not really composed of "electric" and "magnetic" fields. Light is not an oscillation of an oscillation. Thus, light and electric and magnetic potentials must all be oscillations of something more fundamental. One of the most logical candidates to take the place vacated by the constant electric potential is gravity.

If we wish to cast gravity in the role vacated by the model of constant electric potential, another problem immediately arises. Moving electric fields give rise to magnetic fields. An analogous force is needed to pair with gravity. Let's postulate such a force and call it kinetic force. Now assume that the gravitokinetic forces obey the same force equations that Maxwell obtained for the electromagnetic forces. While this might seem preposterous, such is not really the case. In our everyday world, we have no way of experimenting with the effects of significant masses interacting in gravity fields. Our everyday world is much too small to observe such effects (perhaps much too large also). Letting **g** represent the role of the gravity force in the Maxwell equations and **k** the role of the kinetic force allows us to obtain the gravitokinetic equivalent of the Maxwell electromagnetic field equations:

Absence of monopoles: $$\nabla \cdot \mathbf{k} = 0 \tag{3.31}$$

Faraday's law: $$\nabla \times \mathbf{g} + \frac{1}{c}\frac{\partial \mathbf{k}}{\partial t} = 0 \tag{3.32}$$

Coulomb's law: $$\nabla \cdot \mathbf{g} = -4\pi\rho \tag{3.33}$$

Maxwell-modified Ampere's law: $$\nabla \times \mathbf{k} - \frac{1}{c}\frac{\partial \mathbf{g}}{\partial t} = -\frac{4\pi}{c}\mathbf{J} \tag{3.34}$$

where: **g** is the gravitational field strength
k is the kinetic field strength
ρ is the mass density scaled by the square root of Newton's gravitational constant
J is the mass momentum scaled by the square root of Newton's gravitational constant

The values of ρ and **J** are defined to keep the form of these equations the same as their electromagnetic counterparts. (The fact that they are scaled by the square root of Newton's gravitational constant, rather than the constant itself, is not considered significant. The mass on which each field acts is also modified by the square root of the gravitational constant, so that the net effect is unchanged.)

At this point a detour is in order. The new gauge theory is largely compatible with Einstein's general theory. Most of the differences are matters of interpretation, rather than differences in the equations. These differences are addressed below.

The first point of difference is one of interpretation that would seem to matter little, yet it gives rise to a very significant difference. In the general theory, gravity is pictured as the result of space curvature caused by any form of energy. The new gauge theory pictures gravity as the result of the gradient of ether compression. This is normally caused by the presence of mass. Other forms of energy do not generally cause the gradient of compression to change. This point alone solves the problem of the cosmological constant mentioned at the end of the first chapter. The energy in the vacuum fluctuations, even if it changes the compression of the ether, would not change the gradient of the compression, since the energy is isotropic and uniform.

The second point is significant and is a result of the first. The gravitational equivalent of the Maxwell equations, given in equations (3.31) through (3.34), has been obtained (with differences described below) from the general theory in the weak field environment by Thorne (1988). The weak field constraint is significant. In the general theory, energy in any form results in space curvature; and, hence, gravity results in space curvature. Thus, gravity itself creates more gravity. The above equations, then, in the general theory have additional higher order terms, which become increasingly significant as the strength of the gravity field is increased.

The new gauge theory, by contrast, does not have higher order terms in the Maxwell equations. (One of the differences in Thorne's weak-field general theory development was the absence of the continuity constraint term in Faraday's law. This one "higher order" term is retained in my gravitational version of the Maxwell equations.) The gauge equations do indicate that gravitational energy, by compressing the ether, causes the mass of other gravitational particles to increase; and, in this sense, gravity creates more mass. However, the gravitational attractive force results because the combined energy is less when the masses have moved closer together. Thus, gravity does not create more gravity. The Maxwell equations and, I believe, the gravitational equivalent of the Maxwell equations are themselves gauge invariant. This means that the gravitational equations given above are complete and universal. They apply equally as well to strong gravity fields as to weak gravity fields. They are gauge invariant. (In a very recent article Shapiro and Teukolsky (1991) of Cornell University have reported a severe problem which occurs as a direct result of gravity creating gravity in the general theory. They have found that large collections of mass with a prolate spheroidal (football) shape undergo a gravitational collapse which creates infinite density and infinite force. Furthermore, the infinite density is not shielded by a black hole. Previously all known singularities occurred only inside black holes. Thus, it was assumed the singularities could be ignored since nothing inside a black hole can affect anything outside.)

The general theory leads to a difference in equation (3.34), even in the weak-field environment. Specifically, the general theory results in an additional factor of four times the quantity on the right side of the equation. Thorne indicates that this factor is apparently due to the spin-2 nature of the gravity field compared to the spin-1 nature of electromagnetic fields. I do not believe that this is the case. A discussion of the apparent source of this factor-of-four discrepancy is delayed until Chapter 12, where the subject of gravity waves is discussed.

The next difference is again one of interpretation. In the general theory, the gravitational force is split into a gravitoelectric force and gravitomagnetic force. The gravitoelectric force is nothing more than the normal force of gravity. The gravitomagnetic force is a new force and is being studied as the source of strange phenomena observed in distant galaxies. In the new gauge theory, the combined force is referred to as the gravitokinetic force. This combined force is also split into two forces. The first is referred to by the normal gravity label and the second by the term kinetic force. The kinetic force corresponds to the gravitomagnetic force of the general theory but identifies it with the force normally associated with accelerating and decelerating mass (i.e. inertia). This identification has significant implications.

The final difference between the two theories is also one of interpretation. In the general theory, the Maxwell equivalent equations are seen as an instance of parallel phenomena; though they are of the same form as the electromagnetic equations, they are separate from them. Thus, gravitational radiation is distinct from electromagnetic radiation. In the new gauge theory, by contrast, the gravitokinetic and electromagnetic equations are intimately related. The electric and magnetic fields are oscillating gravitokinetic fields; and, thus, the electromagnetic radiation is identified with the gravitokinetic radiation. This means that gravitational or gravitokinetic radiation is nothing more than electromagnetic radiation. This interpretation indicates that additional terms should be present in the electromagnetic equations related to the rate of change of the gravitational and kinetic fields. These additional terms are normally far too small to have any significant effect.

With the detour completed, it is time to return to the task of finding the gravitational potential equations. But this is parallel to the development of the original Maxwell potential equations encountered at the start of the chapter.

Since the divergence of the kinetic force is zero, it can be characterized by the curl of a kinetic vector potential:

$$\mathbf{k} = \nabla \times \theta \tag{3.35}$$

Similarly, since the curl of the gravitational force (as modified by the partial time derivative of the kinetic potential) is zero, it can be represented as the gradient of a scalar potential:

$$\mathbf{g} = -\nabla\varphi - \frac{1}{c}\frac{\partial\theta}{\partial t} \tag{3.36}$$

Next, the equations for the divergence of the gravity field and the curl of the kinetic field are obtained:

$$\nabla^2\varphi + \frac{1}{c}\frac{\partial}{\partial t}(\nabla\cdot\theta) = 4\pi\rho \tag{3.37}$$

$$\nabla^2\theta - \frac{1}{c^2}\frac{\partial^2\theta}{\partial t^2} = \frac{4\pi}{c}J + \nabla(\nabla\cdot\theta) + \frac{1}{c}\frac{\partial\nabla\varphi}{\partial t} \tag{3.38}$$

But these are just the classical electromagnetic potential equations (with sign changes) which disagreed with reality. Does a better fate await them as gravitokinetic potential equations?

It was argued above that the revised electromagnetic equations are preferred because of their correspondence to reality. Do the new gravitokinetic equations also reflect reality?

The new gauge theory is compatible with an elastic ether model. That model can be used to prevent the equations from becoming nothing more than interesting mathematical expressions. A review of the ether model described earlier is in order.

The ether is an elastic solid. Gravitational potential is a measure of the relative density or compressive strain within the ether. From equation (3.37) this compressive strain is caused by the presence of mass. The gauge or scale of all physical phenomena is affected by the relative density of the ether. Thus, the gauge is a function of the gravity field.

The twist or rotational strain within the ether is identified with the kinetic potential. From equation (3.38) the velocity of mass must result in the generation of a kinetic field within the ether. But it is clear that a twist field transverse to the particle motion cannot be generated without a corresponding longitudinal density gradient being generated. This is equivalent to saying that the kinetic vector potential, θ, whose curl represents the kinetic force field, must also have a divergence proportional to the mass velocity (momentum). The divergence is a result of the longitudinal ether gradient due to the velocity. It is negative in front of the moving particle as the ether density increases and is positive in the rear as the density decreases. The gradient of the divergence gives the ether density flow. Mass stationary in the ether is shown in Figure 3.1. When mass moves in the ether, significant distortion results. This is shown in Figure 3.2.

In other words, in a continuous elastic medium, continuity constraints make it impossible to create a twist without simultaneously compacting and expanding portions of that elastic medium. (The combined effects are identified as the kinetic vector potential.) Thus, the curl (twist) of the vector potential and

the divergence of the vector potential are both functions of the velocity. Therefore, the divergence of the vector potential cannot be set independently to an arbitrary value—as was done in the classical electromagnetic choice of gauge.

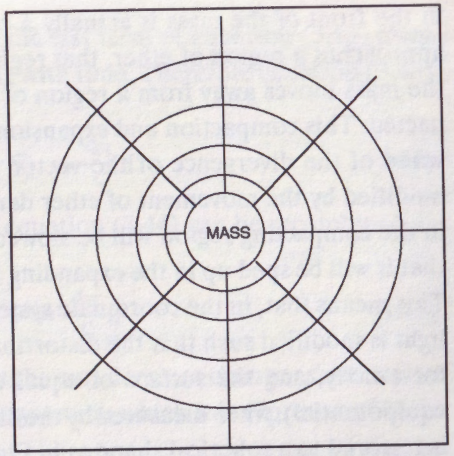


Figure 3.1
Mass Stationary in the ether

This allows a meaningful interpretation of the Coulomb gauge condition to be made. The Coulomb gauge, by requiring that the divergence of the kinetic vector potential be zero, is actually requiring that all mass velocities be zero. With no velocities, the second potential equation is superfluous; and it is not surprising that the first potential equation becomes the instantaneous Coulomb (gravitational) potential over all space. The instantaneous potential is constant in time when no relative motion exists.

But even when the mass is moving, the speed of light is modified proportional to the divergence such that the divergence still appears to be zero. As stated above, the gradient of the divergence of the vector potential gives the ether density flow. This flow of ether density carries other material particles (standing waves in the ether) with it. It also carries the ether disturbance pattern associated with light or electromagnetic radiation with it. Thus, the speed of light is modified by the velocity of the moving mass when it is in the gravity field of that mass.

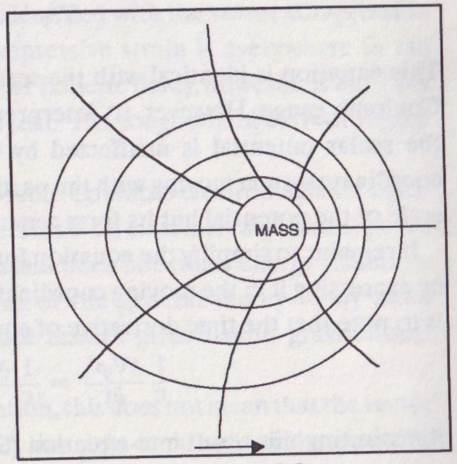


Figure 3.2
Mass moving in the ether

But, even if the speed of light has added to it the velocity of the gravity field in which it is embedded, it is apparent from Figure 3.2 that a significant distortion will still remain. There is a longitudinal compaction in front of the mass and a longitudinal expansion behind the moving mass. But, in the non-moving coordinate system, it is clear that the compaction in the front of the mass is actually a continuing phenomenon. As the mass approaches a region of ether, that region becomes more compacted; and, as the mass moves away from a region of ether, that region becomes less compacted. This compaction and expansion is represented mathematically in the value of the divergence of the vector potential. Since the speed of light is modified by the movement of ether density, it follows that the speed of light in the compacting region will be slowed proportional to the compaction and that it will be sped up in the expanding region proportional to the expansion. This means that, in the coordinate system moving with the mass, the speed of light is modified such that the distortion shown in Figure 3.2 is compensated for exactly, and the surface of equal ether compaction (surface of gravity equipotential), when measured by the distance light travels in one unit of time, is restored to a spherical shape as in Figure 3.1.

This means that, in the moving coordinate system, a potential field, φ', can be defined such that its gradient gives the gravity force field. But the force is not a function of the coordinate system in which it is expressed. Therefore, it is valid to set equation (3.36) equal to the gradient of the potential field, φ':

$$\mathbf{g} = -\nabla\varphi - \frac{1}{c}\frac{\partial\theta}{\partial t} = -\nabla\varphi' \tag{3.39}$$

The gradient of equation (3.39) gives:

$$\nabla^2\varphi' = \nabla^2\varphi + \frac{1}{c}\frac{\partial}{\partial t}(\nabla\cdot\theta) \tag{3.40}$$

Combining this result with equation (3.37) gives the result:

$$\nabla^2\varphi' = 4\pi\rho \tag{3.41}$$

This equation is identical with the scalar potential equation obtained in the Coulomb gauge. However, its interpretation is different. It does not say that the scalar potential is unaffected by velocity. Instead, it says that, in the coordinate system moving with the particle, a change in velocity may affect the scale of the potential but its form remains the same.

It remains to simplify the equation for the vector potential, equation (3.38), by expressing it in the moving coordinate system. The first step in this process is to note that the time derivative of equation (3.39) gives:

$$\frac{1}{c}\frac{\partial\nabla\varphi'}{\partial t} = \frac{1}{c}\frac{\partial\nabla\varphi}{\partial t} + \frac{1}{c^2}\frac{\partial^2\theta}{\partial t^2} \tag{3.42}$$

Substituting this result into equation (3.38) gives:

$$\nabla^2\theta - \nabla(\nabla\cdot\theta) = \frac{4\pi}{c}\mathbf{J} + \frac{1}{c}\frac{\partial\nabla\varphi'}{\partial t} \tag{3.43}$$

But, in the moving coordinate system, the last term of equation (3.43) must clearly be zero, since $\nabla\varphi'$ is not changing with time. Therefore equation (3.43) can be rewritten as:

$$\nabla^2\theta - \nabla(\nabla\cdot\theta) = \frac{4\pi}{c}\mathbf{J} \tag{3.44}$$

But the terms on the left-hand side of equation (3.44) can be recombined to give:

$$-\nabla\times\nabla\times\theta = \frac{4\pi}{c}\mathbf{J} \tag{3.45}$$

Now, use can be made of the fact that the curl does not change as a function of the linear velocity of the coordinate system in which it is expressed. Thus:

$$-\nabla\times\nabla\times\theta = -\nabla\times\nabla\times\theta' = \nabla^2\theta - \nabla(\nabla\cdot\theta) = \nabla^2\theta' \tag{3.46}$$

Since θ' is the vector potential in the moving coordinate system, its divergence must vanish. Substituting this result into equation (3.45) gives:

$$\nabla^2\theta' = \frac{4\pi}{c}\mathbf{J} \tag{3.47}$$

From the comparison of equations (3.41) and (3.47), it is apparent that the vector potential can be expressed in terms of the scalar potential:

$$\theta' = \beta\varphi' \tag{3.48}$$

where: β is the mass velocity vector divided by the speed of light

It is clear that the vector potential is identified with the vector compression of the ether. (The direction of the compressive strain is everywhere in the direction of the velocity.) The curl or twist (kinetic field), however, is due only to the transverse component of the current. The longitudinal current results in a gradient but no twist.

This equation differs from the comparable Coulomb electromagnetic equation in that the radiation term is absent. This is an extremely significant point. The equation says that accelerating a mass does not cause energy radiation. Again, this agrees with the predictions of the general theory. Only more complicated relative motion of separate masses gives rise to gravitational (electromagnetic) radiation.

As stated for the scalar potential equation, this does not mean that the vector potential is not affected by a change in the right-hand side of the equation (accelerations). It simply says that, if the vector potential is expressed in the coordinate system of the moving particle, the scale of the vector potential may change, but its form does not.

Equations (3.41) and (3.47) are the gravitokinetic potential equations when expressed in the coordinates moving with the moving mass. Like the revised Maxwell potential equations, they agree with observed reality.

Conclusion

The classical potentials developed from the Maxwell field equations are not correct. If the classical potentials are replaced with oscillating potentials, a number of benefits are obtained. The quantization of electron orbits results automatically. The quantization of emitted and absorbed energy is likewise automatically evident. But the most significant benefit is undoubtedly the unification of the gravitational and the electromagnetic forces. This has a multitude of diverse implications. Among the more significant are: (1) gravitational radiation is the same as electromagnetic radiation—but unquantized; and (2) the distortion of the ether with velocity causes the apparent speed of light to be with respect to the gravity field and thereby explains the Michelson-Morley experiment.

4

DOPPLER AND ABERRATION EFFECTS

An Aberrant Argument

In this chapter the argument of Jorgensen (1988) and Ashby (1988) regarding the combination of relativistic clock, doppler, and aberration effects is considered. They develop their argument in the context of questions regarding which frame of reference should be employed to analyze crosslink range measurements between GPS satellites. While they are to be commended for attempting to answer the question (JPL simply assumes the answer—see the Pioneer 10 experiment described in Chapter 10), the derivation of an answer (though not the answer itself) is shown to be faulty.

The clock, doppler, and aberration effects in classical physics, in the special theory, and in the new ether gauge theory are developed in order to critique the Ashby solution. A very simple aberration experiment is described which is capable of refuting either the special theory or the new ether gauge theory.

The Global Positioning System (GPS) proved to be a remarkable success in the recent Desert Storm action in Iraq. The GPS satellite navigation system employs the one-way transmission of radio signals from a multitude of orbiting satellites. Of necessity, GPS has become a test vehicle for relativity effects. Recent plans to implement intersatellite tracking, aimed at providing a measure of autonomy from the ground tracking stations, has led to new questions as to the proper reference frame for computing the relativity effects.

The special theory claims that a clock moving with respect to an observer is slowed by an amount proportional to the relative velocity. But the question arises: "In which frame is the observer to be located?" If one considers the observer to be located in the satellite receiving the crosslink signal, one computes an entirely different effect than one obtains by assuming the observer is located in an earth-centered inertial frame. The relativity effect computed for these different frames is substantially different. Which is the correct solution?

It is Jorgensen's claim, based on Ashby's work, that:

> In considering alternative coordinate frames, the differences in special relativity exactly counterbalance those in classical Doppler. Einstein's special relativity is the great equalizer of coordinate systems. We are given the option of choosing the one most convenient to our needs, and in the case of GPS, this is an earth-centered inertial frame.

But the argument is faulty, as we shall see. The separate effects of clock rates, doppler, and aberration in classical Newtonian theory, in the new ether gauge theory, and in the special theory are developed below. The combined effects for each theory are then compared.

Clock and Doppler Effects

Let's consider first the classical doppler effect. Christian Doppler first described the effect in 1842. The effect is easiest to observe with sound waves. A train whistle appears to be higher pitched when it is approaching the observer than when departing, whether due to the train's motion or the observer's. The doppler effect is also observed with electromagnetic waves. Assume that the receiver or observer is stationary in the ether. (The classical equations required an ether or a rest frame which was defined by an isotropic speed of light.) If the transmitter is moving radially toward the observer, the received frequency will be higher than the transmitted frequency. The frequency relationship is given by:

$$f_r = f_t / (1 - \frac{v_t}{c}) = f_r / (1 - \beta_t) \qquad (4.1)$$

where: f_r is the received frequency
f_t is the transmitted frequency
v_t is the transmitter velocity vector with respect to the ether
c is the speed of light
β_t is the transmitter velocity divided by the speed of light

If the velocity of the transmitter is not directly toward the receiver, the last term in the above equation is modified by the cosine of the angle between the velocity vector and the separation vector. In vector notation, the general equation for a moving transmitter becomes:

$$f_r = f_t / (1 - \beta_t \cdot n) \qquad (4.2)$$

where: n is a unit vector in the direction of the signal from receiver to transmitter

When the receiver is moving relative to the ether with a stationary transmitter, the relationship between the transmitted frequency and the received frequency becomes:

$$f_r = f_t (1 - \beta_r \cdot n) \qquad (4.3)$$

where: β_r is the receiver velocity relative to the ether divided by the speed of light

Now the general equation, which is a combination of equations (4.2) and (4.3), can be written for arbitrary transmitter and receiver velocity relative to the ether or isotropic speed-of-light frame:

$$f_r = f_t \frac{(1 - \beta_r \cdot n)}{(1 - \beta_t \cdot n)} \qquad (4.4)$$

The derivation of the doppler shift in the new ether gauge theory is simple and straightforward. The classical doppler shift is simply scaled by the velocity gauge factor for frequencies. Stated another way, the classical equations have no terms for the clock-rate effect of velocity. The new ether gauge theory gives the same doppler effects as the classical doppler effects with the addition of clock-rate scaling factors. The ether gauge theory also defines the isotropic light frame to be identified with the local gravity field so that velocities in the earth's gravity field are defined with respect to an earth-centered inertial (ECI) frame.

The doppler effect for a moving transmitter in the ether gauge theory is the same as equation (4.2) with the addition of a velocity gauge scale factor to adjust for the effect of velocity on the clock rate. The scale factor accounts for the slower running clock in the moving transmitter:

$$f_r = \frac{f_t}{\gamma_t (1 - \beta_t \cdot n)} \qquad (4.5)$$

where: γ_t is given by the inverse of the square root of $(1 - \beta_t^2)$

In similar fashion, the clock and doppler effects for a moving receiver are the same as equation (4.3) with the addition of a scale factor to account for the slower running clock in the moving receiver.

$$f_r = f_t \gamma_r (1 - \beta_r \cdot n) \tag{4.6}$$

where: γ_r is given by the inverse of the square root of $(1-\beta_r^2)$

Now, if we assume a general situation in which the transmitter and receiver are each moving with respect to the ether, an expression corresponding to equation (4.4) is obtained:

$$f_r = f_t \frac{\gamma_r (1 - \beta_r \cdot n)}{\gamma_t (1 - \beta_t \cdot n)} \tag{4.7}$$

The only difference between the classical expression in equation (4.4) and the ether gauge expression in equation (4.7) is the presence of the velocity-dependent scale factors.

The derivation of the relativistic doppler shift is more complicated but is derived in many texts, including Einstein's original paper. Whittaker (1953, 41) gives the following result (with modified nomenclature):

$$f_r = \frac{f_t}{\gamma_{rt} (1 - \beta_{rt} \cdot n_r)} \tag{4.8}$$

where: β_{rt} is the velocity of the transmitter relative to the receiver divided by the speed of light
γ_{rt} is given by the inverse of the square root of $(1-\beta_{rt}^2)$
n_r is the direction of the signal path in the receiver's frame

Note that this expression is identical to that of the ether gauge theory equation (4.5) when the entire relative velocity is due to the motion of the transmitter and the receiver is stationary in the ether. This is appropriate, since relativity theory assumes that the speed of light is isotropic with respect to the observer and the receiver would seem to play the role of an observer. The direction of the signal path in the receiver's frame was identified in equation (4.8). To understand why that direction is different from the signal path direction in another frame requires a discussion of aberration.

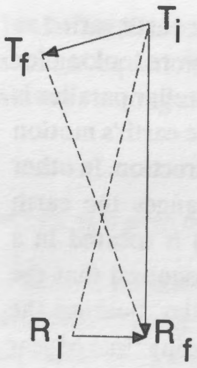
Aberration Effects

In 1725 James Bradley discovered what is generally referred to as aberration of starlight. Together with Samuel Molyneux, Bradley observed that the direction from which light from the star, γ Draconis, arrived at the earth varied as a function of the time of year at which it was observed. They were looking for stellar parallax, which others had claimed to have observed. Stellar parallax is the phenomenon which arises if a star is close enough that the earth's motion around the sun causes the observer to see it from a different direction. In other words, moving from one side of the sun to the other changes the earth observer's position enough that the star (if close enough) is located in a different direction. Bradley and Molyneux immediately recognized that the directional change they observed could not be due to parallax, because the maximum rate of change of the aberration occurred at the wrong time of year considering the direction of the star.

It was about three years later that Bradley arrived at a successful explanation of the effect. The simplest (albeit not quite correct) explanation is given in terms of the particle theory of light, which was the accepted theory in Bradley's day. The direction from which the particles of light arrive is a result of the vector combination of the velocity of light with the velocity of the earth around the sun. The angle at which rain drops fall is a familiar example. If one is running through a rain storm, he needs to hold his umbrella somewhat in front of him if he is to avoid running into rain drops. The angle at which the rain drops appear to fall is a function of the vector velocity of the falling rain and his own velocity.

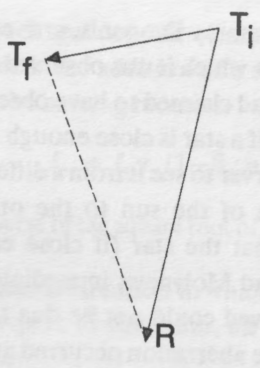
In fact, Bradley "accidentally" arrived at his explanation when he observed that the vane on the mast of his boat as he sailed on the Thames changed direction when the boat changed direction. In other words, the apparent wind direction was a combination of the boat velocity and the wind velocity. (Bradley was able to use the measured aberration and the velocity of the earth around the sun to compute the speed of light. His computation was the first improvement over the value computed by Roemer. Roemer in 1675 had computed the speed of light using the observed eclipse times of the moons of Jupiter.)

It is time to illustrate the aberration effects. It has been demonstrated that wave and particle explanations of light give equivalent aberration effects. I will use particle illustrations, since they are much simpler to visualize. A particle, represented as a spherical ball, when moving through a cylindrical tube (e.g. a telescope), in order to pass through the tube, must have a relative velocity which lies in the same direction as the tube orientation. Thus, when the tube is moving relative to the frame in which the speed of light is isotropic, it must be pointed at an angle relative to the light path vector.



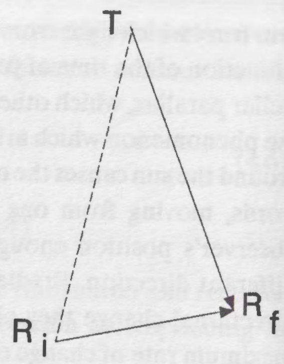
General Frame

Figure 4.1



Receiver Frame

Figure 4.2



Transmitter Frame

Figure 4.3

In Figure 4.1 the classical aberration effects for moving transmitters and receivers are shown. In the figure, the vector defined by $\mathbf{T_i T_f}$ represents the transmitter motion during the time span defined by the light travel time from the transmitter to the receiver. $\mathbf{T_i}$ is the transmitter initial position, and $\mathbf{T_f}$ is the transmitter final position. In like manner, $\mathbf{R_i}$ is the receiver initial position and $\mathbf{R_f}$ the receiver final position. Thus, $\mathbf{R_i R_f}$ is the vector defined by the receiver motion during the light travel time. The "true" light path must move from the initial transmitter position to the final receiver position. Therefore, the "true" light path is defined by the vector $\mathbf{T_i R_f}$. But the apparent light path from the receiver's viewpoint is defined by $\mathbf{T_i R_i}$, since a tube carried by the receiver would need to point toward the initial transmitter position from the receiver initial position in order to allow a light "particle" to enter and traverse the tube. The apparent light path from the transmitter's viewpoint is defined by $\mathbf{T_f R_f}$, since a tube carried by the transmitter would have to point from its final position toward the receiver's final position in order for the light "particle" to traverse the tube.

The aberration angle seen by the receiver is the difference in angle between the "true" light path and the apparent light path seen by the receiver. From the figure it is apparent that the aberration angle seen by the receiver is in the opposite direction of the aberration angle seen by the transmitter. The classical value of the aberration angle is given by :

$$\alpha_r = \beta_r \sin\theta \tag{4.9}$$
$$\alpha_t = \beta_t \sin\theta \tag{4.10}$$

where: α_r is the aberration seen by the receiver
α_t is the aberration seen by the transmitter
θ is the angle which the receiver or transmitter velocity makes with respect to the true light path

According to the special theory, the speed of light is isotropic in the observer's frame. Thus, according to the special theory, an observer located at the receiver would see all the relative movement as due to the transmitter. This means that the "true" path and the apparent path would coincide for that observer. This situation is illustrated in Figure 4.2.

In like manner, an observer located at the transmitter would see light isotropic in his coordinate frame, and the "true" path and the apparent path would coincide for him as well. (Since what is true is relative, according to the special theory, I have put true in quotes above.) This transmitter view is illustrated in Figure 4.3.

It was not stated above, but it is reasonably obvious that the doppler effect is a function of the "true" path. But, since the "true" path is different in the special theory for different observer frames, it follows that the doppler effect will be different. It is also true, according to the special theory, that the clock effects are observer dependent. The observer at the receiver sees the transmitter's clock running slow, while the observer at the transmitter sees the receiver clock running slow. The net effect is a combination of "true" path direction and clock effects.

The clock and doppler effects given by Whittaker in equation (4.8) above corresponds to an observer in the receiver's frame as shown in Figure 4.2 above. Thus, $\mathbf{n_r}$ is a unit vector in the direction of the "true" signal path in the receiver's frame. Einstein, in his original paper, derived a clock and doppler equation corresponding to an observer in the transmitter's frame. Most other texts follow Einstein's example and give for the doppler equation:

$$f_r = f_t \gamma_{rt} (1 - \beta_{tr} \cdot \mathbf{n_t}) \tag{4.11}$$

where: $\mathbf{n_t}$ is a unit vector in the "true" signal direction in the transmitter's frame
β_{tr} is the velocity of the receiver relative to the transmitter divided by the speed of light

It is not difficult to go from equations (4.8) and (4.11) to a general equation for the relativistic doppler effect in an observer frame different from that of the receiver or transmitter. The result is:

$$f_r = f_t \frac{\gamma_r(1-\beta_r \cdot n)}{\gamma_t(1-\beta_t \cdot n)} \tag{4.12}$$

Equation (4.12) is identical in form to equation (4.7). However, the interpretation of the expression is entirely different. In the relativistic interpretation the velocities are taken to be relative to the observer. Thus, the evaluation of the expression is frame dependent. By contrast, the velocities in the ether gauge expression are relative to the gravity field and independent of the observer frame. The two expressions are the same only when the relativistic observer's frame is chosen to be the earth-centered inertial frame (when working in the earth's gravity field). This is the normal choice which the relativists make, and it saves their predictions from experimental contradiction. Jorgensen was quoted above as claiming that the results were frame independent and that the earth-centered frame was simply the most convenient frame for GPS. But the claim is empty, for no one has ever made the equations work in any other frame.

Equation (4.12) corresponds to Jorgensen's equation (10) and equation (4.8) corresponds to Jorgensen's equation (12). The heart of Jorgensen's claim of frame independence is that the ratio between the received and transmitted frequencies is not a function of the observer frame chosen. He shows that, to second order in the velocity to speed-of-light ratio, equations (4.8) and (4.12) give the same result. (Ashby shows the results are exactly identical—not just the same to second order.)

It is easy to show in specific examples that the receiver to transmitter frequency ratios are indeed identical to second order. But that does not mean that the overall argument is correct. Several specific rebuttals to the free choice of observer frame are detailed below.

Choice of Frame

In what sense does an experiment allow free choice of frame? The Michelson-Morley experiment gives the result which Michelson and Morley obtained only if the speed of light is isotropic in the frame in which it is performed. If Michelson had been asked which frame he wanted the observer to choose, he presumably would have selected one which would have given a fringe shift.

There are many more examples of the experiment dictating the frame. The Airy experiment is another example. Airy filled a telescope with water so that the speed of light changed significantly. The fact that the angle of aberration of starlight did not change as a result is often cited as evidence that the apparent and "true" paths of light are identical in the telescope's frame. But that implies the only valid frame for the telescope is the telescope's frame. The choice of any other frame would give a different result. (Because the effect of the earth's spin velocity was below the measurement detection threshold, these experiments are compatible with the new ether gauge theory which demands an earth-centered inertial frame .)

A strong case can be made that, if the special theory is correct, only the receiver's frame is a valid frame, since it is the only place where observations or measurements are made. It is true (see the synchrotron radiation and positron channeling radiation described in Chapter 9) some experimental results can be explained in the special theory by switching to a frame different than that in which the observations are made. But, even in these cases only two different frames are considered, and only one of the two gives the correct answer. There is no free choice of frame.

The Hafele and Keating (1972a and 1972b) experiment also illustrates the restricted choice of frame. In Chapter 1 the experiment was cited because the authors claimed it refuted the twin paradox. While that claim is faulty, the experiment is nevertheless noteworthy—it demonstrates that clocks which move eastward on the surface of the earth run slower than stationary clocks and that clocks which move westward on the surface run faster than stationary clocks. The only way in which this result is compatible with the special theory is for the observer frame to be chosen as the earth-centered inertial frame. And the only justification for such a choice is to make the results agree with the special theory. There is no free choice of frame.

Additional experimental evidence exists that clock rates agree with the special theory only if the earth-centered frame is chosen. At the end of Chapter 2 the counteracting effects of increased gravitational potential and increased speed were cited. The GPS ground tracking stations verify this effect. Because of the centrifugal force, the tracking stations close to the equator are moved outward to a higher gravitational potential. This higher gravitational potential, according to the general theory, causes the clocks to run faster. The only way the actual behavior of the clocks (no change in frequency) can be reconciled with the general theory is to use the higher velocity of the clocks *in the earth-centered frame* to exactly counteract the general theory effect. The results demand the choice of the earth-centered frame for the observer. There is no free choice of frame.

There is another way in which the Jorgensen-Ashby argument is faulty. The GPS crosslink measurements are to be used as range measurements. Ashby and Jorgensen have shown that the frequency ratio is independent of choice of frame. So what? The parameter of interest is the range measurement. The range measurement is a function of the speed of light, and a different result is obtained depending on the choice of frame. An analogy can be made with more common substances. The frequency of reflected light from apple juice and from urine is largely identical. That does not mean they can be freely interchanged when some parameter other than reflected frequency is of interest.

An Experimental Choice

The aberration of starlight was the first phenomenon to be observed which played a significant role in the controversy regarding whether or not the ether was entrained with the earth. The aberration of starlight is particularly significant because it is a first-order effect of velocity. The aberration angle is directly proportional to β, the ratio of the velocity to the speed of light. Most other phenomena involving effects of velocity are second order or higher in β.

In 1871 Airy showed that aberration of starlight was not quite as simple as had been supposed. Since the speed of light is slower in water than in air, one might suspect that the angle would be larger if the telescope used to observe the stars was filled with water. Airy tested this hypothesis and found that, in fact, the aberration angle was unchanged by the substitution of water for air within the telescope. Actually, Fizeau had previously predicted the result on the basis of a partial ether-drag theory, where the amount of ether drag was inversely proportional to the square of the index of refraction. Thus, the result of the experiment was not viewed with a great amount of surprise.

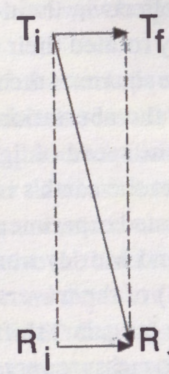
However, part of the attraction of the special theory was that the Lorentz transformation equations simultaneously predicted results which agreed with the Airy aberration (a partial ether-drag requirement) and the Michelson-Morley experiment (a complete ether-drag requirement).

The experimental data are, however, also in harmony with the new ether gauge theory. The gravity field of the earth is a region of space where the speed of light is relative to the earth, and outside the earth's gravity field the speed of light is governed by the gravity field of the sun. (The regions outside the sun's gravity field are irrelevant to the problem.) Though the transition between the earth's gravity field and the sun's is not a sharp line of demarcation, significant simplification (without any adverse effects) can be made by treating the gravity fields as if they are sharply divided. Thus, the velocity of the earth through the sun's gravity field compared to the velocity of light through the sun's gravity field will create the aberration angle observed. Beckmann (1990a) has shown that inside the earth's gravity field, where the velocity of light is with respect to the earth's gravity field, the angle of

aberration will remain unchanged and is no longer affected by the light velocity. This resolution by Beckmann shows that the ether gauge theory satisfies the experimental data. It is also in agreement with Michelson's expectations. Whittaker (1951, 391) says:

> ...Michelson concluded that if there were no choice but between the theories of Fresnel and Stokes, it would be necessary to adopt the latter, and to suppose that the earth's influence on the aether extends to many thousand kilometres above its surface.

But, even though the special theory and the ether gauge theory are in complete agreement regarding the aberration of starlight, this does not mean that the different aberration mechanisms cannot be distinguished. Theocharis (1990) has suggested that theories such as the ether gauge theory predict aberration of terrestrial light sources. On the other hand, such a prediction is in total disagreement with the special theory, since the light source and observer are stationary with respect to one another.



Earth Centered-Inertial Frame

Figure 4.4

Receiver or Transmitter Frame

Figure 4.5

Theocharis is correct. Figure 4.4 and Figure 4.5 illustrate the situation. Figure 4.4 corresponds to the situation with the ether gauge theory. Aberration occurs because of the receiver motion relative to the gravity field which defines the isotropic speed-of-light frame. However, in the special theory, illustrated in Figure 4.5, the relative velocity between the transmitter and receiver is zero and so there are no aberration effects. (Of course, if Jorgensen and Ashby's opinion were to stand, the experimental results would depend on one's free intellectual choice. But, if that were the case, what would be the point in conducting an experiment? Airy's results indicate otherwise.)

The ether gauge theory says that the velocity of light is with respect to the non-rotating gravitational field of the earth. This means that the earth's rotational velocity should cause an aberration effect when light sources to the north or south are observed. Theocharis suggested that this effect could be measured by a modification of Airy's experiment. Two telescopes could be used to observe the light source; and, when one was filled with water, the change in apparent angle could be determined. Since the rotational velocity of the earth is about one millionth the speed of light at nominal latitudes, the precision of the angle measurements required would be on the order of one-tenth of an arc-second. This would stretch the capabilities of typical equipment, due to atmospheric effects.

Ed Hatch (my brother) has suggested what appears to be a much simpler and more economical experiment. He has suggested the use of laser speckle techniques. The idea is to directly measure the apparent transverse shift which a light beam will undergo as the experimental setup is rotated from an east-west orientation to a north-south orientation.

Michelson and Morley were looking for effects in their experiment at the level of one part per hundred million as they rotated their equipment. (They were looking for an effect proportional to the square of the ratio of the earth's orbital speed to the speed of light.) Since the aberration effect is directly proportional to the ratio of the velocity to the speed of light, a sensitivity of only one part per million is needed to detect the earth's rotational velocity. The significant difference between the suggested experiment and the Michelson-Morley experiment is that Michelson and Morley were looking for the apparent change in length (or time of travel) of the traversed path while the new experiment is looking for the transverse (angular) shift in the light path.

Modern laser speckle techniques are used to measure very minute transverse shifts. In an excellent article describing speckle techniques, Chiang and Li (1985) make the following statement:

> Holographic interferometry exploits the amplitude interference of two waves, whereas speckle photography employs the intensity interference of the two. These methods complement each other in that the former is best suited for the measurement of out-of-plane displacement and the latter is essentially used for in-plane displacement measurement.

The standard method of using speckle photography is described by Pickering and Halliwell (1986). First, light scattered from an object (e.g. the dull side of aluminum foil) illuminated with coherent light is photographed. Then, after movement or distortion, it is exposed again to obtain a double exposure. Thus,

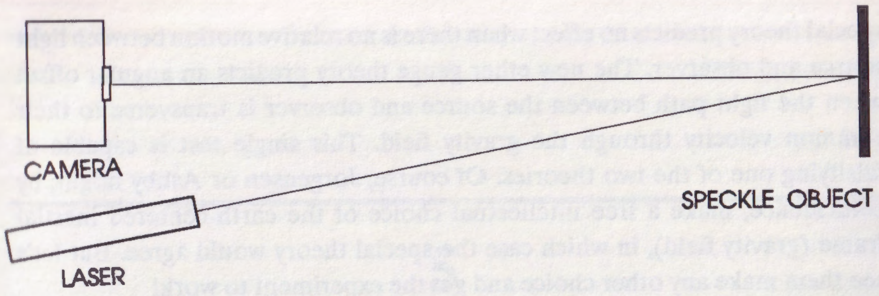


Figure 4.6 Aberration Experiment Using Speckle Techniques

the double-exposed film will have two locally identical but slightly shifted speckle patterns. A thin beam of coherent light is used to illuminate the film in small regions where the shift in the speckle pattern can be assumed constant. The diffracted light from the transparency is then put through a converging lens to focus it on an imaging plane. The correlation of the speckle pattern gives rise to Young's fringes, whose orientation indicates the direction of the displacement and whose wavelength is inversely proportional to the displacement.

An adaptation of the technique to measure the velocity of the earth's rotation via aberration is reasonably simple. One method of generating the appropriate speckle pattern is illustrated in Figure 4.6. Illuminate the speckle object with the laser at near normal incidence. The speckle pattern is then photographed with a camera near the illuminating source. Thus, the first exposure might involve the laser source and camera to the north of the speckle object. Then the second exposure would be obtained after rotating the entire equipment setup by 180 degrees. If the light path between camera and the speckle object is one meter, the earth-velocity effects would give rise to about one millionth of a meter side motion during the light travel time. When the orientation is reversed, the difference in side motion is doubled. The literature indicates that displacements of one-tenth micron can be resolved. Thus, the required precision should be easily achieved. In addition, since the entire double exposure would be translated by the same amount, a large amount of redundant information should be available on the film.

As a control experiment, the same process could be performed with an east-west orientation. The east-west double exposure should give no displacement of the speckle pattern.

The speckle equipment appears to be readily available and reasonably easy to adapt to the proposed experiment. This simple experiment should provide a clear choice between the new ether gauge theory and the special theory. The special theory predicts no effect when there is no relative motion between light source and observer. The new ether gauge theory predicts an angular offset when the light path between the source and observer is transverse to their common velocity through the gravity field. This single test is capable of falsifying one of the two theories. Of course, Jorgensen or Ashby might, by coincidence, make a free intellectual choice of the earth-centered inertial frame (gravity field), in which case the special theory would agree. But let's see them make any other choice and get the experiment to work!

Conclusion

The claim by Jorgensen and Ashby that one is free to choose any observer frame which one desires is based on the demonstration that the combined doppler, clock and aberration effects result in a transmitter to receiver frequency ratio which is independent of the frame. However, only a little thought is sufficient to convince one that the same is not true of the range measurements between the transmitting and receiving satellites—which is the parameter of interest. Apple juice and urine tend to reflect the same light frequencies, but they are not interchangeable for all uses. Frequency measurement frame invariance does not ensure range measurement invariance.

It is claimed that the aberration of light occurs at the gravitational boundary regions due to the relative velocity of the "gravity field" compared to the speed of light. This explains the Airy experimental results. But an Airy equivalent test can be used to clearly distinguish between the new ether gauge theory and the special theory. The proposed experiment, when performed, will clearly contradict the predictions of one of the two theories.

5

FORCE AND MOTION

Relevant Relativity

In this chapter small revisions of the electromagnetic force laws are described which are compatible with the velocity gauge described in Chapter 2. Substantial experimental evidence now exists that something is amiss in the equations used to describe the electromagnetic force. Many of the non-relativists propose a return to Weber or Neumann electrodynamics and the Ampere force equation with which they are associated. By doing so, they would scuttle the Maxwell equations and the associated Lorentz force law. An alternate approach is advocated in this chapter. The Lorentz force equation can be retained by appending to it additional terms required by Newton's third law.

The velocity gauge is reconsidered, and the effects of the mass increase with velocity are explicitly included in the gauge transformation. This modified gauge is used to explore the Coulomb force law as it applies to moving charges. An increase in both charge and mass with velocity is found. The increase in the charge is reconciled with the classical experiments on charge-to-mass ratio. The increased charge with velocity also explains the recently observed Edwards effect.

Motion of particles and motion of fields, relative and absolute, have resulted in a vast amount of literature. And yet there is still much confusion, not only in the relativist camp of scientists but also among those who question Einstein's theories. The ether model which I have described is capable of shedding light in this area.

Motion of the gravity field can be used to help clarify the motion of other fields and vice versa. It is clear that gravity fields move with the mass which generates them—at least in translational motion. It is reasonably clear, though some might question it, that the gravity field does not move with the rotation of the underlying body. The Michelson-Gale experiment, to be discussed briefly in Chapter 10, constitutes evidence in favor of this conclusion. Clearly the interpretation of this new ether theory, which identifies the gravity field as compression of the surrounding ether, fits these two conclusions. Density flow of the ether is required for the gravity field to maintain its position surrounding a translating mass. However, rotational density flow is not required in the region surrounding a rotating mass.

These conclusions can be extended. The moon in its orbit around the earth carries its gravity field with it. But, if the moon were extended into a doughnut ring of mass surrounding the earth at the moon's current radius, its gravity field would no longer move with it as the ring turned. Clearly, in this latter case, no ether flow in the moon-ring's gravity field is required. Similarly, a massive rod of infinite length would have a gravity field which would not move when the rod moves in a longitudinal direction. However, a rod of any finite length would result in an ether-density flow.

An even more general case can be constructed. A huge pipe of relatively small mass can theoretically be constructed in a closed loop, and huge volumes of water pumped through it. Make the pipe so big that it can replace the moon-ring above. Obviously, if water were pumped through the pipe, no ether-density flow would occur. More significant, even if the pipe is now bent into any arbitrary three-dimensional shape, no ether density needs to flow as the water is pumped through it. Of course, if the pipe itself is rotated around any non-symmetrical axis or translated, ether-density flow would occur.

The same principles are supported by experiments involving electric and magnetic fields. Yet confusion is rampant. When should a field or potential move with the generating particle and when should it remain stationary and in what coordinate system should it remain stationary? Beckmann (1990b) has suggested an operational definition which answers the above questions (at least for magnetic fields) by experiment. But such an answer does not allow one to extrapolate to other situations or make predictions. An understanding of the phenomenon is needed to make useful generalizations.

In analogy with the gravitational situation described above, a single electron moving through the gravity field will carry its electrostatic field with it. But, if a constant beam of electrons travels in a closed path, the electric field of the beam does not move with the electrons. The beam current corresponds to the closed ring of moving mass in the gravitational analogy. A current of moving electrons in a wire will generate a static magnetic field (static with respect to the physical wire). If the wire has an axis of symmetry, the rotation of the wire around its axis of symmetry will not rotate the magnetic field. Kennard (1917) long ago demonstrated that the physical rotation of a current-carrying solenoid around its axis of symmetry does not rotate the resultant magnetic field with it.

Muller (1990) has recently conducted some outstanding experiments. He showed that magnetic material which is symmetrical can be rotated around the axis of symmetry without rotating the associated magnetic field. Furthermore, it is not translated by a longitudinal motion of a bar of magnetic material as long as that translation forms part of a closed circuit of moving magnetic material.

The experiments discussed above clearly indicate that moving individual electrons are not the same as current elements in a closed circuit. Yet the interchange between individual electrons and current elements is common in textbooks and literature on electromagnetism.

The experimental evidence and the ether model clearly indicate that any field (gravitational, kinetic, electric, or magnetic) will remain stationary in the coordinate system which requires the least translation through the encompassing gravity field and the least rotation with respect to the distant stars. Thus, a field which is symmetrical with respect to rotation will not rotate with respect to the distant stars. This is independent of the motion of its generating particles. In like manner, a wire containing moving electrons in a closed circuit will generate a magnetic field which does not move with the electrons. But, if the closed circuit is not symmetrical to rotations, rotating it will cause the magnetic field to rotate.

It is an extension of the experimental evidence, but I believe rotating a circuit which has a partial symmetry to rotation will result in a partial rotation of the generated field. For example, in Muller's experiments, when he closed the magnetic field with steel plates which were not symmetrical to rotation, rotation of the entire apparatus caused rotation of the magnetic field. If the magnetic circuit was closed in such a way that only a fractional portion of the magnetic field lines were allowed to be closed through the non-symmetrical plates (by using a saturable material), only that portion of the magnetic field would be rotated with rotation of the entire apparatus. This concept is consistent with an ether model of a moon-ring with a large lump of mass in it. An ether-density flow in such a model would be required only for the portion of excess mass in the lump not symmetrical to the rotation.

Ampere versus Lorentz

In the last decade many papers have been written claiming that the Lorentz (Biot-Savart) law of force is wrong. Most of the papers present experimental evidence which supports their claim. Most of the papers also advocate a return to the original Ampere law of force. Major proponents of the Ampere force equation include Wesley (1990a), Graneau (1985) and Assis (1990).

The evidence indicates that an intracircuit magnetic force of repulsion exists between adjacent current elements in the same circuit. The evidence appears in many different experiments. Graneau (1982a) has repeated the original Ampere bridge experiment, which shows that two portions of the same circuit will repel each other when the connections between the two portions are liquid mercury. In addition, he shows that longitudinal propulsion of the mercury occurs due to longitudinal repulsive forces. Graneau (1982b) demonstrated longitudinal forces with a series of railgun experiments. He also showed that wires could be made to explode from induced longitudinal forces (Graneau, 1983). In a recent article he analyzed the propulsion of salt water from longitudinal forces (Graneau, 1991). Moyssides and Pappas (1986) designed an experimental variation of the Ampere bridge, which could be used to directly measure the repulsive force between two separate portions of a circuit. Pappas (1990) has also shown longitudinal forces upon antenna elements where the circuits are not closed. Hering (1923), many years ago, showed that a wedge-shaped piece of copper in a liquid mercury channel would move when a current was caused to flow in the mercury. Phipps and Phipps (1990) have performed a sensitive and significant experiment, suggested by Wesley, which shows longitudinal forces in a wedge-shaped mercury conductor. All of these evidences, it is claimed, support the replacement of the Lorentz force equation with Ampere's force equation.

If this claim were correct, the developments in Chapter 3, which are based upon the Maxwell equations, would be in doubt. For, although Maxwell himself seemed to think his equations were compatible with Ampere's force equation, I do not believe they are. I believe the critics are correct in assuming that Ampere's force equation requires a new electrodynamics to replace the Maxwell electrodynamics. Both Weber electrodynamics and Neumann electrodynamics have been championed as a replacement. I believe an alternate explanation is available—one which is compatible with the Maxwell equations and which provides an alternate explanation of the impressive experimental data which the Weber and Ampere advocates have marshaled to support their claims.

Two fundamental advantages of the Ampere force equation over the Lorentz force equation are claimed. They are: (1) the Ampere force law agrees with Newton's third law (equal and opposite reaction force) while the Lorentz force law does not; and (2) the Ampere force law explains the internal repulsion force within both open and closed circuits while the Lorentz force does not.

Other additional claims are also made. For example, Wesley (1990a) says that, with Ampere's force law, Bucherer's (or Kaufmann's) experimental demonstration of the increase in mass of a high-speed electron can be explained without an increase in the mass. I will only address the fundamental claims below.

Yes, the Ampere force law certainly does satisfy Newton's third law. No, the Lorentz force law (variations of which are referred to as the Grassmann or Biot and Savart law) does not satisfy Newton's third law. But there is another alternative which is seldom considered.

Wesley makes two statements regarding the failure of the Lorentz force to agree with Newton's third law. He claims: (1) the force is not directed along the line joining the two current elements; and (2) the force does not reverse direction with interchange of the current elements.

Wesley, of course, is correct that the force does not necessarily lie along the radial line joining the two elements. But that does not mean that it violates Newton's third law per se. Most people recognize that one magnet can exert a force upon a second magnet which is not directed along a radial. Furthermore, cutting the magnets into smaller and smaller elements still leaves them able to exert non-radial forces upon each other. Of course, non-radial forces can be exerted only by elements which are not point sources, but magnets and current elements by their very nature cannot be reduced to point sources.

In fact, as Whittaker (1951, 84-88) shows in his analysis of Ampere's original paper, this is precisely the point at which Ampere made an unjustifiable assumption—that the force was directed along the radial joining the two current elements.

Whittaker goes on to show that removing Ampere's unjustifiable assumption leads to an equation which is symmetrical with regard to interchange of the current elements. He obtained the following force law:

$$\mathbf{F} = (\mathbf{A}_1 \cdot \mathbf{n})\mathbf{A}_2 + (\mathbf{A}_2 \cdot \mathbf{n})\mathbf{A}_1 - (\mathbf{A}_1 \cdot \mathbf{A}_2)\mathbf{n} \qquad (5.1)$$

where: $\mathbf{A}_1$ is the vector potential from a differential current element at point 1
$\mathbf{A}_2$ is the vector potential from a differential current element at point 2
$\mathbf{n}$ is a unit vector in the direction $\mathbf{r}$ separating the two points. It is positive when directed toward the point at which the force is to be computed.

The differential vector potentials are defined by:

$$A_i = \frac{I_i \, ds_i}{c\, r} \qquad (5.2)$$

where: i is a subscript which designates either current element one or two
I is the current
ds is the differential circuit element
c is the speed of light
r is the scalar separation distance between the two current elements

By way of comparison, the Ampere equation of force is given by:

$$F = 3(A_1 \cdot n)(A_2 \cdot n)n - 2(A_1 \cdot A_2)n \qquad (5.3)$$

Equation (5.1) was apparently derived by Gauss and Riemann prior to Whittaker (though Whittaker does not ascribe it to them). Both the Gauss-Riemann-Whittaker (GRW) force law, equation (5.1), and Ampere's force law, equation (5.3), obey Newton's third law. To compute the force at current element two rather than current element one, the direction of the vector **n** is reversed. This clearly inverts the direction of the force in every term of both equations while leaving the magnitude unchanged.

Whittaker points out that the Grassmann force law (and also the Biot-Savart or Lorentz force law) has dropped the second term on the right-hand side of equation (5.1) when computing the force at current element one. The justification used to drop the term is that it integrates to zero around any closed loop containing the second current element. By dropping this term, the force laws of Grassmann, Biot and Savart, and Lorentz become valid only for magnetic fields generated by closed loop circuits.

It might seem that Wesley et al. have constructed a strawman weak enough to be defeated by attacking the force laws with the missing term. However, this is not the case. Many respected scholars fail to describe the limitations of the force laws in the form in which they are typically given. For example, Jackson (1975, 171-172) gives the Biot-Savart law with the term missing which makes it symmetrical to interchange of the two points. Yet he claims that it satisfies Newton's third law and is symmetrical—while it clearly does not and is not.

The last term of the GRW equation can be paired with the first term to give the magnetic field interaction with current element one or paired with the second term to give the magnetic field interaction with current element two. A better understanding of the magnetic interactions is obtained by pairing the last term with each of the other terms. This leads to a restructured equation with three separate components of magnetic interaction:

$$F = [(A_1 \cdot n)A_2 - (A_1 \cdot A_2)n] + [(A_2 \cdot n)A_1 - (A_1 \cdot A_2)n] + [(A_1 \cdot A_2)n] \qquad (5.4)$$

The separate components are indicated by the brackets in the equation. But the terms in the first two brackets can be simplified, if desired, to give:

$$F = A_1 \times (A_2 \times n) + A_2 \times (A_1 \times n) + (A_1 \cdot A_2)n \qquad (5.5)$$

or:

$$F = A_1 \times B_2 + A_2 \times B_1 + (A_1 \cdot A_2)n \qquad (5.6)$$

where: B is the magnetic field of the differential element multiplied by the scalar separation distance, r

From the development above, the second and third terms can be combined to give a single term which integrates to zero around the closed current loop containing current element two. This leaves only the first term, which is the normal Lorentz force term involving the magnetic field. It describes the effect of the combined magnetic fields on the vector potential of current element one. Since the equations are symmetrical with regard to the two current elements, it is obvious that the first and third terms could be chosen; and, when they are integrated over the current loop containing current element one, they would cancel. This, in turn, leaves only the second term of equation (5.6), which is the normal Lorentz force term describing the combined magnetic field interaction with the vector potential of current element two. Restating, the first term describes the effect which the gradient of the combined magnetic fields has on current element one. The second term describes the effect which the gradient of the combined magnetic fields has on current element two.

The final term of equations (5.4), (5.5) and (5.6) remains to be characterized. It is the force of repulsion (or attraction) which results from the average increase (or decrease) in the density of the lines of force in the region between the two current elements. It is this term which gives rise to the force of repulsion within a current loop. This repulsive force has been dramatically demonstrated by Hering, Pappas, Graneau and Phipps. Obviously, such a "within loop force" must integrate to zero around a closed loop. But that does not mitigate its demonstrable effects. So the GRW force equation can also be used to explain the "within circuit forces" which have been amply demonstrated.

Equation (5.1) is the easiest form of the equation to use to compute numerical values. It is more compact than equation (5.4); and, when the current elements both lie in the same plane, it involves no out-of-plane vectors like equations (5.5) and (5.6).

When the two current elements lie in the same plane, the GRW equation becomes particularly simple. Let the direction of current element one be defined as the x axis. Now two angles can be defined. The first is the angle that the separation vector forms with the x axis, and the second is the angle that current element two forms with the x axis (see Figure 5.1). The repulsive force in the x direction and the repulsive force perpendicular to the x axis (y axis) can be computed. The result is:

$$F_x = A_1A_2\cos(\theta+\varphi) \quad (5.7)$$
$$F_y = -A_1A_2\sin(\theta+\varphi) \quad (5.8)$$

where: θ is the angle between the x axis and the separation vector
φ is the angle between the x axis and current element two
the x axis is in the direction of current element one
the y axis is in the direction of the separation vector when θ is 90°

When the two current elements are aligned (i.e. φ is zero), the force can be easily expressed in terms of the radial repulsive force and the clockwise torque:

$$F_r = A_1A_2\cos 2\theta \quad (5.9)$$
$$F_t = A_1A_2\sin 2\theta \quad (5.10)$$

where: the r subscript designates the radial component
the t subscript designates the torque component

It is not difficult to extend the above planar results to cover the completely general case. Form a plane defined by current element one (x axis) and the separation vector. Then form a second plane defined by current element two and the separation vector. Now rotate the two planes around their respective current elements until they are parallel to each other (or in the redundant case coincident). Let the angle which the separation vector forms with each plane be designated as α.

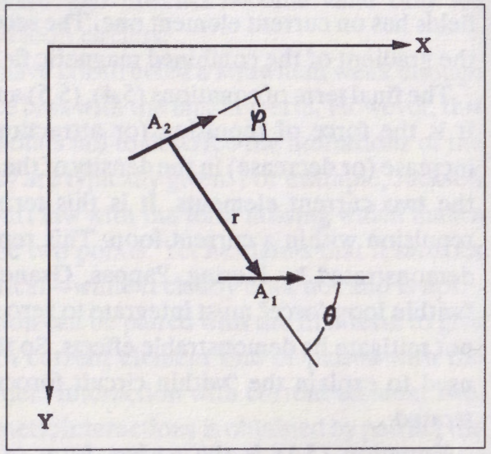


Figure 5.1
Relative Geometry of Current Elements

The general force equation between the two current elements then becomes:

$$F_x = A_1A_2\cos(\theta+\varphi)\cos\alpha \quad (5.11)$$
$$F_y = -A_1A_2\sin(\theta+\varphi)\cos\alpha \quad (5.12)$$
$$F_z = -A_1A_2\sin\alpha \quad (5.13)$$

where: the z axis forms a right-handed coordinate system with the x and y axes defined above

These equations illustrate one of the most interesting characteristics of the GRW force equation. Specifically, the magnitude of the force is independent of the angular relationships between the current elements. Only the direction of the force is determined by the angular relationships. The Ampere force equation is simpler than the GRW force equation in that the force is always directed along the separation vector. However, it is much more complex in its dependence of the force amplitude upon the angular relationship between the current elements.

The repulsive force between the two current elements when the angles defined above are all zero (the three vectors are aligned) is the same using either the GRW equation or Ampere's equation. However, the repulsive force when θ is 90°, φ is 180°, and α is 0°, (i.e. the separation vector is perpendicular to the current elements and the current elements are directed opposite each other in the same plane) is twice as big using Ampere's equation as it is using the GRW equation. Without considering the more complex situation when the two current elements are at right angles to each other (φ equal to ±90°), the above results indicate that, in a nearly rectangular plane circuit, the GRW force equation will result in a smaller repulsive force than the Ampere force equation.

This qualitative observation appears to be in accord with experiment. Wesley (1990a) computed the theoretical force on an Ampere bridge circuit (circuit split into two parts with a mercury fluid connection between the parts) and compared it to the force measured by Moyssides and Pappas. He found that the theoretical force exceeded the measured force by about 20 percent. Thus, the GRW force equation, at least for this example, is probably in better agreement with experiment than is the Ampere equation. (To ensure the above statement is correct, the detailed integration of the GRW force equation over the specific geometry of the circuit needs to be carried out.) Both Wesley and Phipps cite the large surface tension of mercury to explain why the force is less than that predicted by the Ampere equation. Thus, the evidence from this experiment is not conclusive.

Graneau's (1991) water-arc explosions also contain some quantitative numbers. In one example he computes a pressure using Ampere's equation of 721 atmospheres due to the longitudinal forces, together with 23 atmospheres of pinch forces due to attraction between adjacent elements whose current is flowing in the same direction. The pressure actually measured in the experiment was 2000 atmospheres. While the GRW pinch forces are only half as big for adjacent elements (θ is 90°, φ and α are 0°) as they are for Ampere forces, the GRW equation gives a component of pinch (transverse) force for all angles of θ except zero and a repulsive longitudinal force for all angles of θ except 90°. By contrast, from the Ampere equation, when θ is less than 35.25°, there is a repulsive force both transverse (an anti-pinch force) and longitudinal; and, when greater than 35.25°, the pinch force exists but the longitudinal force component becomes attractive. The net effect of these differences will clearly lead to significantly larger repulsive forces in a hydrostatic environment from the GRW equation than from the Ampere equation. In addition, the pinch forces will also be significantly larger from the GRW equation. This seems to fit the experimental data much better.

Phipps (1990) gives a preliminary report on an experiment where he specifically compares the GRW and Ampere force equations. His results favor the Ampere force equation. He uses fine flexible silver wires rather than mercury. He cites this as an advantage because of the high surface tension of mercury. However, he ignores the fine wires in the force analysis. I think this is a potential problem. It is easy to imagine that longitudinal magnetic forces could cause a force which would tend to straighten the wires no matter how fine and flexible they are. Thus, I find the Phipps results far from conclusive.

A number of the other experiments which have been cited as supporting the Ampere force equation provide quantitative numbers. Typically, the experimental data have been used to argue that the Ampere equation is better than the Lorentz equation. No argument. But, I believe, the Gauss-Riemann-Whittaker equation will fit the data, in many cases, even better than the Ampere equation.

Eventually, the correct force equation will undoubtedly be identified experimentally. However, while it remains in doubt, one is free to choose the force law one prefers on the basis of other factors. The relativists prefer the Lorentz law—to the point of ignoring the evidence against it. Though the Maxwell equations are Lorentz covariant, I do not hold this against them. They are also gauge invariant, which is, I believe, significant.

My particular preference for the GRW force law is that it seems to be compatible with the Maxwell equations. While Maxwell himself felt that his equations were compatible with Ampere's force law, I am not so sure. The Lorentz force law can be derived directly from Maxwell's equations, and both Ampere's force law and the GRW force law reduce to it when the magnetic field is generated by an external closed circuit. However, the GRW force law, it seems to me, converts to the Lorentz law much more gracefully. In the form of equation (4.1), the GRW force law becomes the Lorentz law because the second term integrates to zero over a closed circuit. In the form of equation (4.6), each of the terms can be identified with a specific physical effect. I have been unable to identify specific physical effects to tie to the Ampere equation terms or to see how it converts gracefully to the Lorentz force equation.

I find no compelling reason to abandon the Maxwell equations. And the GRW force equation is the only force equation which contains a longitudinal term and yet still converts gracefully to the Lorentz force equation under the appropriate constraints.

Velocity Gauge Revisited

The Ampere and GRW force equations are concerned with magnetic forces. Before considering the Coulomb force equation and the effect of velocity on the electrostatic force, the velocity gauge changes must be revisited.

In Chapter 2, a table of gauge changes with velocity through the gravity field was given. The velocity gauge table given there applies to changes within the gravity field of the moving particle. As was shown in parenthesis in that table, external to the gravity field the mass will be increased by the kinetic field energy. This mass increase changes the velocity gauge factors for all physical parameters which involve mass. (In the preceding chapters the use of the velocity gauge did not involve the mass of the moving particle. Thus, it was immaterial which variation of the velocity gauge was involved.) Since the gravity field of atomic and nuclear particles is extremely small, the velocity gauge of interest is the external form.

The external velocity gauge is different in nature from the other gauge changes considered earlier. It does not represent a direct effect of a change in ether density throughout the region where the effect is observed. It results, instead, from the change of mass with velocity. Thus, all measurement standards involving mass are affected (i.e. a gauge change occurs). The external velocity gauge is the same as the internal velocity gauge except for the mass change.

The internal (within the gravity field) velocity gauge presented in Chapter 2 is given below, together with the external (outside the gravity field) velocity gauge which is of interest here. As before, the scale factor, γ, for the velocity gauge is greater than one and given by the inverse of the square root of the quantity one minus the square of the ratio of the velocity to the speed of light:

$$\gamma = 1/\sqrt{1-\beta^2} \tag{5.14}$$

where: β is the ratio of the velocity to the speed of light

Also, as before, a superscript plus indicates a parameter which is modified by the scale factor and a superscript minus indicates a parameter which is modified by the inverse of the scale factor.

Velocity Gauge

	Internal	**External**
length units expand	l^+	l^+
mass units decrease/increase	m^-	m^+
time units dilate	t^+	t^+

As a result, other parameters change:

velocity units are unchanged	v	v
speed of light is unchanged	c	c
frequency units are smaller	f^-	f^-
electrostatic charge (esu) units are unchanged/increased	q	q^+
force units are smaller/unchanged	$\mathbf{F}^{--}$	$\mathbf{F}$
electrostatic potential is decreased/unchanged	ψ^-	ψ
electrostatic field is decreased/decreased	$\mathbf{E}^{--}$	$\mathbf{E}^-$
magnetic vector potential is decreased/unchanged	ω^-	ω
magnetic field is decreased/decreased	$\mathbf{B}^{--}$	$\mathbf{B}^-$

The external velocity gauge is the gauge which applies to moving charges and electromagnetic phenomena in general. This is because the standing electromagnetic waves, of which the electron and other charged particles are composed, are large compared to their underlying gravitational structure.

The experimental evidence clearly indicates that a moving electron gains mass. In addition, it is generally acknowledged that the electron mass corresponds to the energy resident in the electromagnetic field of the electron. And, while it is acknowledged that to one traveling with the electron its field appears as an electrostatic field, the strength of that field is assumed to be unchanged. The above implies that the charge of the electron should increase with velocity just as the mass does. Indeed, the external velocity gauge table above indicates

that the charge of the electron will increase in direct ratio to the mass increase. By contrast, the magic of the Lorentz transformation causes the excess mass to disappear to the one moving with the electron, and the charge remains unchanged. The external velocity gauge does not deny apparent relativity. The one moving with the electron becomes more massive, larger, etc. Therefore, his measurement standards change; and the increased mass and increased charge of the electron appear to be unchanged.

The Coulomb Force Equation

How is the Coulomb force equation affected by the velocity of the charged particles? This question can now be addressed directly, with the aid of the external velocity gauge above.

The Coulomb force equation between two charged particles not moving in a gravity field is given by:

$$\mathbf{F} = \frac{q_1\, q_2\, \mathbf{n}}{r^2} \tag{5.19}$$

where: q_1 and q_2 are the charges
r is the distance between them
$\mathbf{n}$ is a unit vector in the direction of r pointing toward the charge at which the force is to be computed

Now consider the balance between the centripetal and centrifugal forces in a hydrogen atom which is stationary in a gravity field. (Assume the electron mass is negligible compared to the proton mass.)

$$-\frac{q_1\, q_2}{r^2}\mathbf{n} = \frac{mv^2}{r}\mathbf{n} \tag{5.20}$$

Now, if the atom is caused to move in the gravity field, this equation is rescaled per the gauge table above to give:

$$-\frac{(\gamma\, q_1)(\gamma\, q_2)}{(\gamma\, r)^2}\mathbf{n} = \frac{(\gamma\, m)v^2}{(\gamma\, r)}\mathbf{n} \tag{5.21}$$

Equation (5.21) shows that the principle of Galilean relativity applies to velocities through the gravity field. It also shows that the external velocity gauge transformation is consistent. The greater mass and greater charge of the electron and proton lead to an atom which is larger by the same scale factor. The larger size of the atom agrees with the gauge transformation as well. The gauge transformation is found to be coherent and consistent with reality. An apparent relativity is the result. However, observers external to the moving system can see changes in radiation coming from the moving system.

Charge Increase with Velocity

But there is an apparent problem with the prediction of a charge increase with velocity. Specifically, a number of experiments appear to disagree with the prediction that the charge will increase as the velocity increases. Several of these experiments are considered below, since they shed light on the underlying mechanism.

(1) The Bucherer Experiment

Several experiments have detected a decrease in the charge-to-mass ratio of electrons as the velocity was increased. These anomalous results need to be explained. The Bucherer experiment is representative.

Bucherer placed a small grain of radium fluoride at the center of two parallel circular disks. Radium fluoride emits beta particles (high speed electrons) in a radioactive decay process. An electric field was impressed across the two plates, and a magnetic field was generated parallel to the circular plates. If the magnetic field defines the x axis and the electric field the y axis, Figure 5.2 illustrates the experimental arrangement. The beta particles emitted radially from the radium fluoride experienced an upward force, qE, due to the electric field. They also experienced a downward force which depended upon their velocity and their direction relative to the magnetic field. This magnetic force is given by, $Bq(v/c)\sin\theta$, where the angle θ is the angle between the velocity, v, and the x axis in the xz plane. Only those electrons with a velocity such that the electric and magnetic forces were balanced could escape radially out the narrow slot between the two circular plates. Thus, for the particles which escaped, the velocity was determined from the balance-of-forces equation:

$$Bq\frac{v}{c}\sin\theta = Eq \tag{5.15}$$

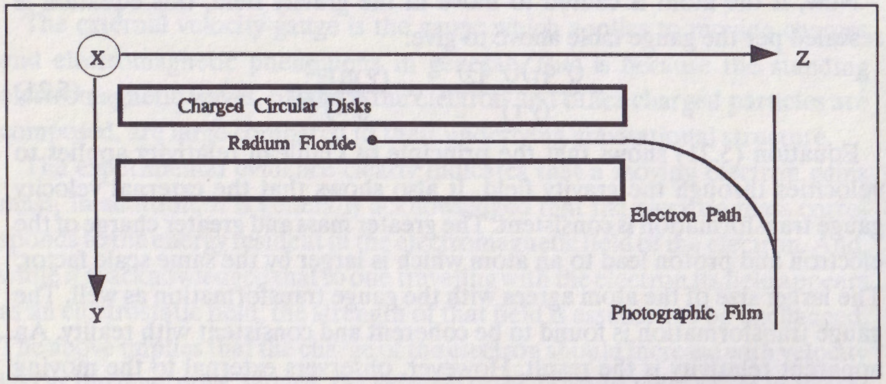


Figure 5.2 Bucherer's Experiment

The above equation can be solved for the velocity to give:

$$\frac{v}{c} = \frac{E}{B\sin\theta} \tag{5.16}$$

Note that equation (5.16) is accurate in both the laboratory gauge and in the gauge of the moving electron. This is true because, from the external velocity gauge table given above, the electrostatic field and the magnetic field, though effectively weaker in the velocity gauge, counteract each other so that the net result is unchanged.

Finally, after leaving the area between the two disks, the electrons continued moving in the magnetic field. Those particles which came out perpendicular to the magnetic field (i.e. in the direction of the z axis) followed a circular path until they struck a photographic plate. From the spot on the photographic plate, the radius of curvature was determined. The balance of centripetal and centrifugal forces gives the equation:

$$Bq\frac{v}{c} = \frac{mv^2}{r} \tag{5.17}$$

Equation (5.17) can be solved for the ratio of charge to mass:

$$\frac{q}{m} = \frac{vc}{Br} \tag{5.18}$$

The measured radius of curvature inserted into equation (5.18) leads to the conclusion that the charge-to-mass ratio decreased as the velocity of the electron was increased. However, the external velocity gauge indicates that the strength of the magnetic field appears weaker to the moving electron. If the magnetic field is decreased by the scale factor, the result of the above equation, instead of yielding a decreasing charge-to-mass ratio, yields a constant ratio as the velocity is changed.

All other experiments which have yielded a decreasing charge-to-mass ratio also assume no change in the strength of the electrostatic and/or magnetic field interaction with the moving electron. But an unchanged force is consistent with an increased charge from a larger standing-wave structure. If, as was claimed earlier, the electrostatic force represents an interaction of the electric potentials, the above results make intuitive sense. Each potential is defined in its own gauge. The moving electron has a larger structure and charge, but its interaction with the smaller standing-wave structure of the stationary electron would no longer generate a force at the plane midway between the moving and stationary electrons. Instead, the interaction would occur closer to the moving electron, where the wavelength in the two electron structures would match. The resultant force is larger because it is closer to the moving electron but smaller because it is farther away from the stationary electron. The two effects counteract each other (i.e. q^+ times E^- or q^+ times B^- is unchanged).

(2) Synchrotron Induction Potential

Bartlett and Ward (1977) describe four experiments which, according to their interpretation, show a smaller increase in charge with velocity than is indicated by the external velocity gauge. According to Bartlett and Ward, the synchrotron induction potential, using measurements taken by Simanton, shows that the charge increases by a fraction which is less than 0.2 of the square of the ratio of the electron velocity compared to the speed of light.

But the synchrotron induction potential depends upon the repulsion force which the passing electrons exert on the electrons in the metallic induction plate. And, as shown above, this force is unchanged even though the charge of the moving electrons is increased. Thus, the velocity gauge is consistent with the experiment.

(3) Charge Neutrality of Atoms

Bartlett and Ward also cite the results of King. The difference in the velocity of the orbiting electrons in molecular hydrogen and atomic helium is used by King to show that the orbital velocity does not cause the atoms to become negatively charged. Bartlett and Ward recognize that the situation with electrons bound in orbit may be different. They say:

> It is conceivable that in this binding a renormalization of charge can occur which would cancel the effect of a v^2/c^2 term.

It is generally acknowledged that the binding energy of the electron in its orbit reduces its mass. By the same token it should reduce its charge, since the charge represents all the mass energy of the electron. This is consistent with the revised Maxwell equations described in Chapter 2.

The quantum theory postulates two quantum numbers for electron orbits. These two quantum numbers describe all the acceptable orbits of the electron. For each of these orbits the total kinetic energy exactly equals the orbital binding energy. Lindsay (1950) shows that the quantum numbers of the electron lead to orbits, whose semimajor axis and period are given by:

$$a = \frac{(n_1 + n_2)^2 h^2}{4\pi^2 m q^2} \tag{5.22}$$

$$P = \frac{(n_1 + n_2)^3 h^3}{4\pi^2 m q^4} \tag{5.23}$$

where: a is the semimajor axis
P is the orbital period
n_1 is the angular momentum quantum number
n_2 is the eccentricity quantum number
h is Planck's constant
m is the mass of the electron
q is the charge of the electron

From these two equations, it is easy to compute the average orbital speed:

$$v = \frac{2\pi a}{P} = \frac{2\pi q^2}{(n_1 + n_2)h} \tag{5.24}$$

Equation (5.24) shows that the average orbital speed is quantized as successive integer fractions.

Now the semimajor axis and the orbital period can be expressed in terms of the average orbital speed:

$$a = \frac{q^2}{mv^2} \tag{5.25}$$

$$P = \frac{2\pi q^2}{mv^3} \tag{5.26}$$

Equation (5.25) can be used in the expression for the orbital binding energy to give:

$$E = \frac{q^2}{a} = mv^2 \tag{5.27}$$

The total kinetic energy (twice the classical kinetic energy) in equation (5.27) is exactly the mass energy which caused the difference between the internal velocity gauge and the external velocity gauge, which was described earlier in the chapter. Thus, the loss of this amount of mass/energy in the orbital binding will cause the electron charge to revert to the charge of the internal velocity gauge—exactly the amount which maintains the charge neutrality of the atom.

(4) Thermal Electron Velocities

Bartlett and Ward describe an experiment in which they show that changing the temperature of a block of metal does not change its charge. Yet the mean speed of the conduction electrons within the metal is clearly changed by the change in the temperature. Furthermore, the electrons are clearly moving at velocities much higher than the translational vibrations of the ion lattice.

I believe the charge of a group of electrons is a function of the average velocity, not the average speed. The difference between the average speed and the average velocity is exactly what gives rise to the thermal blackbody radiation. As was shown in Chapter 2, the increased size and charge of an electron is a result of a feedback interaction of the standing wave of electromagnetic energy. Thus, the standing-wave structure of the electron is in transition as it is accelerated. The thermal electrons are continually being accelerated. Thus, the acceleration results in thermal blackbody radiation, rather than increased size, mass, and charge of the electron.

(5) Spinning Wire Coil

The main thrust of Bartlett and Ward's paper was to describe an elaborate experiment designed to detect a change in the electron charge with velocity. Since the electron's drift velocity is typically very small and the effect is proportional to the square of the ratio of the velocity compared to the speed of light, the effect is very minute. Bartlett and Ward attempted to enhance the effect by spinning the coil in which the electrons were moving. This gave an electron velocity of:

$$(V+v)^2 = V^2 + 2Vv + v^2 \tag{5.28}$$

where: V is the spin velocity imparted to the coil
v is the drift velocity of the electrons within the wire

The spin also caused the positive ions to move, which caused the first term of the above equation to be canceled. However, by making the spin velocity substantially larger than the electron's drift velocity, the second term of equation (5.28) was made much larger than the last term.

Bartlett and Ward obtained results which clearly indicated that the charge was not increased as a result of the velocity of the electrons. I find no fault with their experiment. How can the results be reconciled to the velocity gauge predictions of the new theory?

Bartlett and Ward tacitly assumed that it was the electron velocity with respect to the laboratory which was important. The gauge theory would seem to indicate that it is the velocity through the gravity field which is important. But, whether it is the velocity with respect to the laboratory or velocity with respect to the gravity field, the same effect would be predicted.

The only way that the Bartlett and Ward measurements can be reconciled with the Edwards results (considered next) is if the significant velocity is the velocity of the electrons with respect to the positive ions which comprise the conducting wire. There are several heuristic arguments which lead to the above conclusion.

In the strictest sense, the ether gauge theory says that the velocity is with respect to the coordinate frame in which the velocity of light is isotropic. As

Fresnel hypothesized and Fizeau later demonstrated, the coordinate frame in which the speed of light is isotropic is dragged along by a moving material body. The lower the speed of light within the material, the closer the isotropic frame velocity is to the velocity of the moving material. At zero velocity the frames are coincident. But zero velocity for electromagnetic waves is another way of saying that electromagnetic waves cannot be propagated in the medium. This is a characteristic of metals.

A second heuristic argument derives from the argument above regarding the charge neutrality of a moving atom. It was shown above that the electron bound to the atom loses just enough energy (mass and charge) to remain in the same effective gauge as the nucleus. While conduction electrons are not bound to specific atoms, they are bound to the metallic conductor as a whole. Thus, it is not surprising that the wire behaves in general the same as individual atoms would behave.

The conclusion is that the velocity gauge of conduction electrons in a wire is defined in terms of the velocity of the electrons with respect to the positive ions within the metallic conductor rather than with respect to the gravity field. This solution agrees with both the Bartlett and Ward experiments and the Edwards experiment.

The Edwards Effect

Consider the electrostatic potential outside a current-carrying wire. Assume the wire is not moving in the gravity field. The current of negative electrons will give rise to an increased static Coulomb potential, which is given by:

$$\psi_e = -\frac{\rho'_e}{r} = -\gamma\frac{\rho_e}{r} \tag{5.29}$$

where: ρ'_e is the charge density of the moving electrons
ρ_e is the equivalent charge density if the electrons were not moving
r is the distance perpendicular to the wire measured in the laboratory gauge

The moving electrons also give rise to a static magnetic potential. But that is not of interest in this particular case and will not be considered further.

The static positive ions give rise to a static Coulomb potential, given by:

$$\psi_i = \frac{\rho_i}{r} \tag{5.30}$$

If extra electrons are not allowed to exit the wire as the current is generated so that the number of electrons and positive ions remains balanced, the

Coulomb potential outside a current-carrying wire is given by the sum of equations (5.29) and (5.30). This sum gives:

$$\psi = -\psi_i(\gamma - 1) \tag{5.31}$$

Because of the increase in the charge with velocity, the moving electrons have a greater potential than the stationary positive ions. Thus, a net negative potential is developed outside a current-carrying wire.

If the wire is moving in the gravity field and if it is the velocity with respect to the gravity field which is significant, equation (5.31) needs to be modified to reflect the velocity of the laboratory. This gives:

$$\psi = -\psi_i(\gamma_e - \gamma_i) \tag{5.32}$$

where: γ_e is the scale factor associated with the velocity of the electron through the gravity field
γ_i is the scale factor associated with the velocity of the positive ions in the wire through the gravity field.

Equation (5.32) can result in either positive or negative potential, depending on the difference in the absolute velocities of the wire and the electrons in the wire with respect to the gravity field.

It would appear that equations (5.31) and (5.32) could be tested by a suitably designed experiment. The critical element in such a test is to ensure, as stated above, that the number of electrons and positive ions remains balanced as the current is varied. This can be ensured by the use of superconducting circuits. Such an experiment has already been performed, and the effect described above is known as the Edwards effect.

Hayden (1990b) attempted to explain the Edwards effect and brought the appropriate experiment to my attention. Edwards (1974), first by himself, and then in more exhaustive experiments with others (Edwards, Kenyon, and Lemon, 1976), showed, using a superconductor, that an excess negative potential is developed by a current moving in a wire. As expected from the gauge theory, the excess negative potential is proportional to the square of the current. (An increase in the current represents either an increase in the number of charges moving or an increase in the velocity of the charges. Either of these means that the potential will increase proportional to the gauge scale factor which is proportional to the velocity squared.) Edwards et al. found the anomalous potential was proportional to the square of the current and that it was not caused by:

> the self-Hall effect, configurational emf's, non-steady-current effects, thermoelectric effects, flux-flow emf's, and possible charge transfer on helium bubbles.

They go on to state:

> The signal appears to be a real field effect and is as yet unexplained.

The new gauge theory directly predicts the Edwards effect. Hayden, without whose article I would have been unaware of the effect, offers an impossible explanation. He ascribes it to an interaction between the static charges and the moving magnetic field. But there is no moving magnetic field. The magnetic field in the vicinity of a conductor is stationary. This is amply proven by experiment.

Because the laboratory in the Edwards experiment is moving with respect to the gravity field, it might be expected that equation (5.32) should apply rather than equation (5.31). But the superconducting wire allows free movement of electrons from one portion of the circuit to another. Therefore, it is the average of equation (5.32) which applies. The average is essentially the same as equation (5.31).

Actually, the Bartlett and Ward experiment discussed above indicates that it is the electron velocity with respect to the positive ions rather than their velocity with respect to the gravity field which is significant. Assuming that is the case, equation (5.31) would simply be scaled by the velocity gauge of the moving wire (ψ_i would be scaled by γ_i).

A variation of the Edwards experiment could be used to verify the Bartlett and Ward results. If the original Edwards experiment were mounted on a turntable, the velocity of the positive ions with respect to the earth's gravity field could be increased at the same time the velocity of the electrons with respect to the gravity field is decreased. The results should remain unchanged.

Conclusion

This chapter opened with a discussion of when and why a field (electric, magnetic, gravitational or kinetic) moves. (This is important because the significant velocities which appear in the force equations are relative to the field involved.) Next, the magnetic force equations were discussed and the Maxwell equations defended against those claiming that observed longitudinal forces within circuits were not consistent with Maxwell. The Gauss-Riemann-

Whittaker force equation, which is a corrected form of Ampere's equation, was shown to provide a reasonable solution.

The velocity gauge was reconsidered next and was modified to include the increase of mass with velocity. The modified velocity gauge predicts an increase in the charge with velocity, in addition to the commonly accepted increase in mass with velocity. This increase in charge required a look at the classical experiments which yield a decrease in the charge-to-mass ratio as the velocity is increased. This apparent conflict was seen to result from an unacknowledged decrease in the effect of electric and magnetic fields upon a moving charge. Other experiments which indicate no change of charge with velocity were also considered. They showed that the velocity of the electrons in a wire is with respect to the positive ions, not with respect to the gravity field.

Finally, the external velocity gauge was used to predict the development of an electric potential outside an isolated current-carrying wire. This is precisely the effect observed by Edwards—an effect that has remained unexplained by classical electromagnetic theory.

6

ROTATIONAL MOTION

The Sagnac Saga

> Rotational velocity effects are considered in this chapter. It is claimed that no coherent explanation of the Sagnac effect and Thomas precession effect exists within relativity theory. However, the two effects are easily demonstrated to be a direct result of the ether gauge theory.

The current situation regarding rotational motion is a mess. One can find a multitude of conflicting statements without looking far at all.

Virtually any motion in the presence of gravitational mass has curvature and can be characterized as rotational motion around some instantaneous center of curvature. Thus, confusion about rotational motion is ultimately confusion about virtually all motion.

But rotational motion clearly has characteristics of absolute motion. It is not relative. The distant stars define the only non-rotating reference frame. A person isolated in a closed container, with the appropriate equipment, can determine his absolute rotation with respect to the distant stars. The appropriate equipment can be as simple as a bucket full of water. If the water in the bucket is rotating with respect to the stars, its surface will deform into a parabolic shape.

Siefert (1987) argues effectively that, if space has an absolute rotational reference, it must also have an absolute velocity reference. Conklin's (1969) measurement of the velocity of the solar system with respect to the distant stars strongly supports Siefert's claim. Part of the original attraction of the concept of relative velocity rather than absolute velocity was the claim that there was no way to even measure an absolute velocity with respect to distant stars. This foundational claim was clearly contradicted by Conklin's measurement of the background radiation from the "big bang."

Rotational phenomena can come in several forms. Distinguishing between these forms is critical to sorting order out of the conflicting claims. Rotational motion may be induced and/or constrained by gravitational, by electromagnetic, or mechanical forces. The laboratory on the surface of the earth has a rotational motion which results from gravitational and mechanical forces.

Einstein's general theory treats the rotational motion of a satellite in orbit around the earth as unaccelerated motion. The satellite is in free-fall. The new gauge theory does not treat it as unaccelerated. Instead, the new gauge theory treats gravitational forces the same as all other forces.

The Sagnac Effect

Sagnac performed one of the first tests which seemed to show the speed of light was medium dependent rather than observer dependent. The Sagnac experiment is intimately related to the modern ring laser gyrocompass. By sending a beam of light in both directions around the periphery of a rotating structure, its absolute state of rotational motion can be determined. This is done by comparing the travel time of the light in the two directions. The travel time of the light going counter to the direction of rotation is shorter than the travel time moving with the rotation. Rather than measure the actual travel times, a much more precise measurement can be made by comparing the interference patterns of coherent monochromatic light from two counter- rotating beams.

Figure 6.1 is an illustration of a slightly simplified Sagnac experiment. Light from the source is split by a half-silvered mirror into two counter-rotating beams which are reflected from four mirrors around the periphery of the rotating platform. The two beams are recombined by the same half-silvered mirror which was used to split them. The amount of the interference fringe shift is then measured.

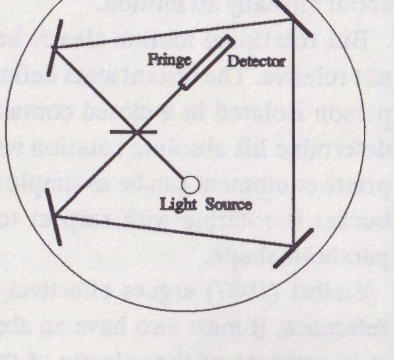


Figure 6.1
Simplified Sagnac Experiment

The amount of the fringe shift is given by:

$$\Delta = \frac{4A\Omega}{c\lambda} \qquad (6.1)$$

where: Δ is the fringe shift
A is the area enclosed by the light path
Ω is the angular rotation rate
c is the speed of light
λ is the wavelength of the light

This fringe shift has been shown to be independent of the center of rotation and of the shape of the area encompassed by the light beam.

The simplest explanation of the Sagnac effect is that the light velocity is not affected by the rotational velocity of the structure. This means that the elapsed travel time in the direction counter to the structural rotation is the result of the shorter distance it needs to travel. This shorter distance is due to the movement of the structure while the light is in transit. This solution is simple and obvious, but it is unacceptable to most scientists because it is in conflict with the special theory.

Many people trace the need for the special theory to the experiment of Michelson and Morley. They showed in 1887 that the speed of light on the surface of the earth was not affected by the earth's velocity in orbit around the sun. Michelson, rather than accepting the special theory interpretation of the experiment, simply interpreted the experiment as evidence that the ether was carried along by the earth. (The new gauge theory accepts the equivalent—the effective speed of light is with respect to the gravity field.)

Michelson also interpreted the Sagnac experiment in the simple fashion described above. Together with Gale, he used the Sagnac effect to measure the rotational velocity of the earth. They successfully obtained an interference pattern from counter-rotating beams using a large (two-tenths mile by four-tenths mile) earth-fixed rectangular path. Michelson interpreted these results to mean that the rotational velocity of the earth did not carry the ether along with it.

Michelson's explanation was not accepted by the vast majority of scientists. The most commonly accepted explanation of the Sagnac effect today is that proposed by Post (1967). The Post explanation makes use of an "ad hoc" adjustment to the special theory. Specifically, Post obtains the observed Sagnac phenomenon by assigning to free-space (the vacuum or ether) a "constitutive relationship." In other words, he physically distinguishes the dielectric displacement, D, from the electric field, E, and also the magnetic induction, B, from the magnetic field, H, of free-space. By then defining a rotational dependence of free-space which maps E and H into D and B, he can obtain the observed effect. In Post's (1967, 486) words:

> A [standard free-space] d'Alembertian wave equation can in no way whatever, explain the nonreciprocal asymmetry between the clockwise and counterclockwise beams observed in the Sagnac effect, because a nonreciprocity requires the presence of mixed space-time derivatives ($\partial/\partial t\ \partial x$) in the wave equation. Thus in order to account for the asymmetry one has to assume that either the Gaussian field identification [E=D and B=H] does not hold in a rotating frame or that the Maxwell equations are affected by rotation.

Or, in lieu of either of Post's options, one can reject the special theory.

Some have claimed that, though the special theory cannot explain the Sagnac effect, the general theory can. Post denies that it is possible to use the general theory. He states (1967, 481):

> The search for a physically meaningful transformation for rotation is not aided in any way whatever by the principle of general space-time covariance, nor is it true that the space-time theory of gravitation plays any direct role in establishing physically correct transformations.

A search of the literature reveals some claims that the Sagnac effect can be explained by the general theory. An article by Ashtekar and Magnon (1975) purports to give such an explanation. However, the argument is nearly impossible to follow and, most important, fails to show why the same argument would not give a similar effect for the earth's orbital rotation around the sun—an effect which is contradicted by the Michelson-Morley experiment.

An article by Alley et al. (1988, 280) gives a derivation of the metric on a rotating body, using the general theory. They conclude that the speed of light would be different eastward than westward; but they go on to say:

> It is not clear whether we should actually observe this difference, however, since the metric of Eq. (15) seems to assume that the observer is located at the center of rotation.

Alley et al. go on to show that the Yilmaz variation of the general theory predicts that the speed of light is the same eastward as it is westward. Finally, they show that a generalization of the Lorentz transformation for an accelerated, rotating frame of reference does not give a difference in east-west speed of light velocity for an observer on the surface of the earth. These comments from recognized relativity experts clearly indicate that, while some may feel

the Sagnac effect can be explained by the general theory, the opinion is far from universal.

A question and answer exchange following the Alley et al. paper (1988, 285) is illuminating:

> **Dr. Gernot Winkler, USNO:** Actually, I have a comment, I would like to emphasize your remark that there is a dispute about the interpretation of the Sagnac Effect on the basis of General Relativity. It is not uniformly understood. I think that the least that one can expect from an experiment like this is...to settle that kind of a dispute.
>
> **Dr. Alley:** I am not sure that these disputes will get settled, but I think that it may help to clarify the situation.

Ives (1938) presents a powerful argument that the Sagnac effect cannot be due to general theory phenomena. He shows that motion of the mirrors does not contribute to the Sagnac effect. He argues that only the motion of the detector is significant and that that motion can be along a cord of the encompassing polygon—hence, properly addressed by the special theory, not the general theory. I am convinced that the general theory has nothing to contribute to the Sagnac phenomenon.

The Post assumption of "constitutive" properties of free-space leads to a rotational transformation which, it might be argued, applies only to light beams or electromagnetic radiation. Perhaps to counteract this limitation, Post in an appendix (1967, 492-493) shows that the same transformation can be obtained directly from the Lorentz transformation with the aid of two added assumptions. These assumptions are: (1) the transformations are non-symmetrical between the rotation center and the rotation periphery; and (2) the center of rotation is the principal frame.

Whether the Post rotational transformation is obtained by the assumption of constitutive equations for rotations in free-space or by the two assumptions above, it results in a problem. The transformation was constructed to make the special theory compatible with the Sagnac effect. But the compatibility as constructed creates an incompatibility with the Thomas precession effect.

Thomas Precession

The Thomas precession effect was first explained by Llewellen Thomas in 1926. Thomas derived the effect from the Lorentz transformation to explain an anomalous precession of the spin of an orbiting electron in an atom. In the Thomas derivation, the precession arises due to the acceleration of the electron in its orbit around the nucleus. As described in Chapter 1, the instantaneous Lorentz transformation (often referred to as a Lorentz boost) is used to account for the acceleration. Thomas showed that two successive Lorentz boosts used to account for radial acceleration are equivalent to one Lorentz transformation together with a coordinate rotation. Thus, a transverse acceleration causes the coordinate system to rotate. This rotation is referred to as the Thomas precession. Jackson (1975, 541-547) provides a recent derivation via the same route Thomas used.

The problem is that any alternative to the Lorentz transformation must also give rise to the Thomas precession effect. It is unreasonable that the two different types of rotational phenomena should require different theories to explain them. It is clear and acknowledged that the Lorentz transformation, as it stands, cannot explain the Sagnac effect. If the Post transformation cannot explain the Thomas precession, a coherent explanation is still lacking.

Post does, in fact, claim that his rotational transformation gives rise to a precession equal to the Thomas precession. I have two problems with his claim: (1) A check of his equations indicates that his claim is false. (2) Even if his claim is granted, it involves a mechanism which is different from the Thomas precession mechanism obtained by Thomas.

The second problem is addressed first. The Thomas-derived precession arose as a result of accelerations. Post claims his precession is due to differences in the measure of time. While it is common in physics for the same phenomena to be derived in different fashions, it is not common that completely different mechanisms can explain exactly the same effect. There is a severe incompatibility between Post's explanation of the Sagnac effect and Thomas's explanation of the Thomas precession effect.

Post (1967, 493) claims that his rotational transformation leads to the Thomas precession phenomenon by:

> ... a change in time "measure" associated with a "centrifugal" potential, similarly as the change in time "measure" that is associated with a gravitational potential.

There is a change in time measure due to a change in gravitational potential, but it does not cause any precession. And, when Post's derivation of the Thomas precession from his equations is checked carefully, I find it causes no precession either. Post is in a no-win situation. If his rotational transformation did give rise to a Thomas precession as claimed, it would still be incompatible with the Lorentz transformation mechanism derived by Thomas. If it does not give rise to a Thomas precession, it fails to explain the spin precession of the

electron in its orbit around the nucleus. Before exploring the validity of Post's precession derivation, a quick look at the prediction of the new gauge theory is in order.

Ironically, it turns out that Post's claims for his rotational transformation (that it explains the Sagnac effect, that it gives rise to the Thomas precession, and that it is analogous to gravitational effects) are true for the rotational transformations given by the velocity gauge in the new gauge theory. These claims will be demonstrated mathematically below.

The Post transformation from the rotational periphery to the center of the rotation is given as:

$$dt = \gamma\, dt' \tag{6.2}$$
$$dr = dr' \tag{6.3}$$
$$d\varphi = d\varphi' + \gamma\,\Omega\, dt' \tag{6.4}$$
$$dz = dz' \tag{6.5}$$

where: γ is $1/\sqrt{1-(v/c)^2}$ or $1/\sqrt{1-(r\,\Omega/c)^2}$
Ω is the angular rotation rate
r, φ, and z are cylindrical coordinates with z in the direction of the axis of rotation

The z component of the transformation is not normally specified; but, to contrast it with the new gauge transformations given later, it is included here. The transformation given is for a positive rotation around the z axis.

The reverse transformation is not symmetrical as it was with the Lorentz transformation. Post gives the inverse transformation from the center of rotation coordinates to the rotation periphery as:

$$dt' = (1/\gamma)\, dt \tag{6.6}$$
$$dr' = dr \tag{6.7}$$
$$d\varphi' = d\varphi - \gamma\,\Omega\, dt' = d\varphi - \Omega\, dt \tag{6.8}$$
$$dz' = dz \tag{6.9}$$

From the two parts of equation (6.8), one can get the two equations:

$$(d\varphi - d\varphi')/dt' = \gamma\,\Omega \tag{6.10}$$
$$(d\varphi - d\varphi')/dt = \Omega \tag{6.11}$$

The difference between equation (6.10) and (6.11) gives:

$$\Delta\,\Omega = (\gamma - 1)\Omega \tag{6.12}$$

While this is the right expression for the Thomas precession, there is no justification for taking the difference. Just because my watch runs faster than yours when both of us measure how fast something is spinning does not cause it to precess.

The new gauge theory also gives rise to the Thomas precession but in an entirely different manner. The gauge transformation from the rotating periphery coordinates to the coordinates at the center of rotation (corresponding to Post equations (6.2) through (6.5)) is:

$$\begin{aligned} dt &= \gamma\, dt' && (6.13)\\ dr &= \gamma\, dr' && (6.14)\\ d\varphi &= \gamma\, d\varphi' + \gamma\, \Omega\, dt' && (6.15)\\ dz &= \gamma\, dz' && (6.16) \end{aligned}$$

The inverse transformation from the coordinates at the center of rotation to the coordinates at the peripheral is:

$$\begin{aligned} dt' &= (1/\gamma)\, dt && (6.17)\\ dr' &= (1/\gamma)\, dr && (6.18)\\ d\varphi' &= (1/\gamma)\, d\varphi - (1/\gamma)\, \Omega\, dt && (6.19)\\ dz' &= (1/\gamma)\, dz && (6.20) \end{aligned}$$

These gauge transformations are parallel to the transformations given by Post. But, no matter how one manipulates these equations, they provide no information at all on any rotational precession. The reason is no great mystery. They describe the relationship between a coordinate system at the center of rotation and a coordinate system at the periphery. But, if a precession is taking place at the periphery, it will not appear in the equations given above. A precession at the periphery does not change the coordinates if it is located at the center of the coordinate system. To remedy this defect, the Post and the gauge rotational transformations can be restated holding the peripheral coordinates' origin and orientation identical to the origin and orientation of the center-of-rotation coordinates. In other words, only the gauge effects are incorporated into the transformations.

This modification only affects the expression for the angular differential. The complete Post transformation from the periphery to the center is:

$$\begin{aligned} dt &= \gamma\, dt' && (6.21)\\ dr &= dr' && (6.22)\\ d\varphi &= d\varphi' && (6.23)\\ dz &= dz' && (6.24) \end{aligned}$$

The inverse of this transformation is obvious. Only the time equation needs to be written.

$$dt' = (1/\gamma)\, dt \qquad (6.25)$$

The time measure is the only measure which is different in the two coordinate systems. This obviously cannot give rise to any precession effects.

The velocity gauge rotational transformation from the periphery coordinate system to the center-of-rotation coordinate system is now given with the constraint of common origin and orientation:

$$\begin{aligned} dt &= \gamma\, dt' && (6.26)\\ dr &= \gamma\, dr' && (6.27)\\ d\varphi &= \gamma\, d\varphi' && (6.28)\\ dz &= \gamma\, dz' && (6.29) \end{aligned}$$

The inverse transformation from the coordinates at the center of rotation to the coordinates at the peripheral is:

$$\begin{aligned} dt' &= (1/\gamma)\, dt && (6.30)\\ dr' &= (1/\gamma)\, dr && (6.31)\\ d\varphi' &= (1/\gamma)\, d\varphi && (6.32)\\ dz' &= (1/\gamma)\, dz && (6.33) \end{aligned}$$

A precession does arise, however, due to the difference in angular size (length measure) in the two coordinate systems. The velocity gauge does not affect the measured velocity. Thus:

$$v = r\,\Omega = r'\,\Omega' \qquad (6.34)$$

But from the definition of angular rate:

$$\Omega = \frac{d\varphi}{dt} = \frac{d\varphi'}{dt'} \qquad (6.35)$$

From this and equation (6.30) one can obtain:

$$(d\varphi' - d\varphi)/dt = (\gamma - 1)\,\Omega \qquad (6.36)$$

This is just the Thomas precession seen by an observer at the center of rotation.

The new gauge theory mechanism of precession is significantly different from the Thomas mechanism. The velocity gauge mechanism results from the difference in transverse length with radius. This is exactly the same kind of mechanism which causes a gravitational precession (geodetic precession) for a satellite in orbit around the earth. The general theory ascribes the geodetic precession to the curvature of space. The ether gauge theory ascribes it to the difference in transverse length with radius. But the original Thomas mechanism ascribes the precession to the action of acceleration and the Lorentz boosts.

The situation can be summarized as follows. If the Post explanation of the Sagnac effect is correct, there is no compatible explanation of the Thomas precession effect. If, instead, the original Thomas precession mechanism is correct, there is no compatible explanation of the Sagnac effect.

There is further evidence that the Post and Lorentz transformations are incompatible. As the radius r is increased in the Post transformation and allowed to approach infinity, the peripheral motion approaches linear motion. Presumably, then, the Post transformation ought to approach the Lorentz transformation under this limiting condition. It does not do so. It remains an absolute reciprocal transformation and exhibits no velocity relativity.

There is even evidence that the Post and Lorentz transformations are incompatible before the radius is increased to infinity. If the radius of the Post transformation is allowed to increase to the radius of the earth's orbit around the sun, the Sagnac effect should give a first-order measure of the second-order effect which Michelson and Morley attempted to measure in their 1886 experiment—*unsuccessfully*.

The incompatibility of the normal explanations of the Sagnac and Michelson-Morley experiments is explored in some detail in a recent article by Hayden and Whitney (1990). Their exploration of the problem is excellent. However, I am not impressed by their list of ways in which the incompatibility might be resolved.

First, they suggest that perhaps the special theory is right and that some unknown mechanism creates the Sagnac effect in spite of the special theory. Anyone can suggest unknown mechanisms, but a mechanism which acts as a result of earth-spin velocity but not as a result of earth-orbital velocity is difficult even to imagine.

Next, they suggest that maybe the effects of earth-orbital velocity and solar-galactic velocity are present in the data but simply have not been recognized. Such a solution flies in the face of so many experiments that I cannot imagine taking such a suggestion seriously.

Hayden and Whitney's third suggestion is that cosmic (orbit and galactic) velocities are detectable but not by round-trip experiments. From comments at the end of the article, this solution seems to be particularly championed by Whitney. She cites a previous article regarding Silvertooth's one-way velocity experiment. Silvertooth (Wesley, 1987a) claims to have detected the galactic velocity using a one-way velocity laboratory experiment. By proposing such a solution, the authors ignore the Global Positioning System (GPS) data which they cited earlier in the article. The GPS system is used to transfer time from one ground site to another by observing the difference in the *one-way* time of reception of signals from the satellites. But, to achieve the ultimate accuracies, the Sagnac effect (earth's spin velocity) has to be taken into account (Allen, 1985). If the one-way signals were affected by the earth-orbit velocity, there would be a 100 times larger effect. The galactic velocity would cause a 1000 times larger effect. Obviously, the one-way signals of the GPS system are not affected by these velocities.

Ironically, in the very same issue of the same magazine in which the Hayden and Whitney article appears, Silvertooth (1990) has an article where he describes the error in satellite positioning caused by ignoring the Sagnac effect from the earth's rotational velocity. Most of my professional career has been spent working with satellite navigation systems. Anyone attempting precise navigation always corrects for the effect. But I have never heard of anyone ever attempting to correct the one-way signals by the earth-orbital or galactic velocities. Yet such a correction would be needed if Silvertooth's one-way experiment really were capable of detecting the galactic velocity.

The fourth solution to the incompatibility suggested by Hayden and Whitney is the ether-drag explanation (the speed of light is relative to the gravity field). I believe this is the only viable solution.

Their fifth and final solution is "others." This seems open minded but rather hard to test experimentally.

The solution provided by the new gauge theory is simple. The Sagnac effect is obtained directly. It results because the speed of light is not affected by the physical rotation. The Thomas precession effect is obtained directly from the transformation equations (6.26) through (6.33). There is no problem with these equations as the motion approaches linearity with large radius of rotation. The Michelson-Morley experiment is not a problem, because it involves no velocity at all with respect to the preferred ether frame (the gravity field). The linear velocity transformations are exactly the same equations except expressed in Cartesian coordinates. *The new gauge theory gives a consistent explanation of the Sagnac effect, the Thomas precession effect, and the Michelson-Morley experiment.* Furthermore, the gauge explanation of the Thomas precession effect is fully parallel to the geometric precession effect caused by length change with the gravity gauge (or curvature of space).

Conclusion

The Lorentz transformation is in conflict with the Sagnac effect but can be used to explain the Thomas precession and the Michelson-Morley experimental results. On the other hand, the Post explanation of the Sagnac effect has no explanation for the Thomas precession and, when extrapolated to orbital phenomena, predicts effects in disagreement with the Michelson-Morley results. The new gauge theory seems to offer the only explanation compatible with both the Sagnac effect and the Thomas precession. It provides a simple and coherent explanation. In addition, it does not conflict with the Michelson-Morley results.

7

THE BUILDING BLOCKS OF PHYSICS

What's the Matter?

In this chapter a model of the fundamental constituents of matter is generated. This chapter is not critical to the overall character of the ether gauge theory. However, it does show that rational models of the fundamental particles of physics can be constructed which solve some of the previously intractable problems.

The Maxwell potential equations were investigated in Chapter 3. It was found that gravity and electricity are intimately related. In fact, it was shown that what is normally referred to as electromagnetic waves is actually gravitational or gravitokinetic waves. The electron was found to be a standing wave of electromagnetic energy. An electric field was just an oscillating gravity (compression of the ether) field and a magnetic field an oscillating kinetic (twist of the ether) field. Assuming that all of the above are correct, the Maxwell electromagnetic equations should have additional terms related to the time rate of change of gravitational and kinetic fields.

It is not hard to imagine large-scale situations where the revised Maxwell electromagnetic potential equations should include terms relating to changing gravitational and kinetic fields. But these are not the things of everyday concern. Neither is it hard to imagine the very small-scale situation where interacting electromagnetic fields give rise to small oscillating fields of gravitation. This is, I believe, the everyday world of nuclear and sub-nuclear particles. A brief discussion of the large-scale situation is reserved for a later chapter. The nuclear or very small scale interactions are considered here.

The nuclear interactions between gravitokinetic and electromagnetic effects are of great importance if the new gauge theory is correct. It provides a new stimulus to models of nuclear and sub-nuclear particles.

One of the most puzzling questions of science in the last 50 years, as the nature of the vacuum or ether has become better understood, is whether the electromagnetic fluctuations of the vacuum which give rise to spontaneous production and annihilation of pairs of electrons-positrons are related to the vacuum fluctuations which give rise to other more energetic particles of other types. Spontaneous production of proton-antiproton pairs gives rise to fluctuations in the gravity field and, by Einstein's general theory, to fluctuations in the space curvature. Are these geometric fluctuations related to the electromagnetic fluctuations? In the words of Misner, Thorne and Wheeler (1973, 1202):

> No point is more central than this, that empty space is not empty. It is the seat of the most violent physics. The electromagnetic field fluctuates. Virtual pairs of positive and negative electrons, in effect, are continually being created and annihilated, and likewise pairs of mu mesons, pairs of baryons, and pairs of other particles. All these fluctuations coexist with the quantum fluctuations in the geometry and topology of space. Are they additional to those geometrodynamic zero-point disturbances, or are they, in some sense not now well-understood, mere manifestations of them?

The new gauge theory says that the background fluctuations of gravity are one and the same as the background electromagnetic fluctuations, which are one and the same as the background ether (geometry) fluctuations.

While it is not critical to the theory, a model of the first generation leptons is generated below. Then a possible explanation of quark structure is offered. This quark model indicates that the strong nuclear force is most likely the alter ego of the gravitational force itself.

The Electron

In Figure 2.2 of Chapter 2, an oscillating electromagnetic (gravitokinetic) standing wave is shown. It is essentially one-dimensional in expanse with oscillations orthogonal to that dimension. It consists of oscillations which are strong and of short wavelength near the center. As the distance from the center is increased (not shown in the figure), the oscillations become weaker and of longer wavelength. Since the compressive (one-dimensional) gravity displacement is out of phase with the kinetic twist, it does not move. This standing wave is labeled as a "B" (for beginning) particle. (I do not believe in a wave/particle duality. All particles are ultimately waves.)

If two of these B particles are superimposed in the same plane with one of the standing waves orthogonal to the other, one could obtain different types of oscillatory behavior, depending on the phase relationship of the two particles. It could be an entirely kinetic standing wave (oscillating twist) or an entirely gravitational standing wave (oscillating volume). But there is no phase relationship which gives rise to a spin phenomenon—as is required of an electron model.

But a structure can be found which introduces a spin phenomenon. Let six B particles be combined as the six faces of a cube. The spacing between opposite faces is the dimension of the central wavelength of the B particle. Choose the expanse dimension (as opposed to the oscillation dimension) of the opposite faces (a pair of faces) to be identical and such that the three pairs of faces do not have the expanse dimension in the same direction. In other words, the three expanse dimensions and the three oscillation dimensions from the three pairs of faces are orthogonal. As the standing waves of the faces oscillate, the eight corners of the cube will alternately form regions of three-dimensional compressed ether and expanded ether. Now a very interesting energy-conserving phenomenon can take place. At the peak of the compression/expansion cycle, the expanse dimension and the oscillation dimension can switch directions (by interchange among the pairs), such that the compressive inertia of the ether continues in the same general direction. Less energy is needed to maintain the structure via spinning faces than by oscillating faces. For simplicity, the faces are now referred to as spinning faces; but it must be remembered that, without the three-dimensional structure, this spin cannot occur.

A model of the heart of the electron can be constructed from the interaction of the six spinning standing waves. Because of the pairing, the opposite faces must spin in the same direction. This means that one corner of the cube must have the spin vector pointing out of the cube and its opposite corner have the spin pointing inward. Spin up, then, implies that the outward-pointing spin vector is aligned upward and spin down that the outward-pointing spin vector is aligned downward. Choosing the spin-up orientation allows us to identify the outward-pointing spin vector as the north pole and its opposite corner as the south pole. The remaining six corners will be located two-thirds of the way toward the spin equator—three in the upper (northern) hemisphere and three in the lower (southern) hemisphere.

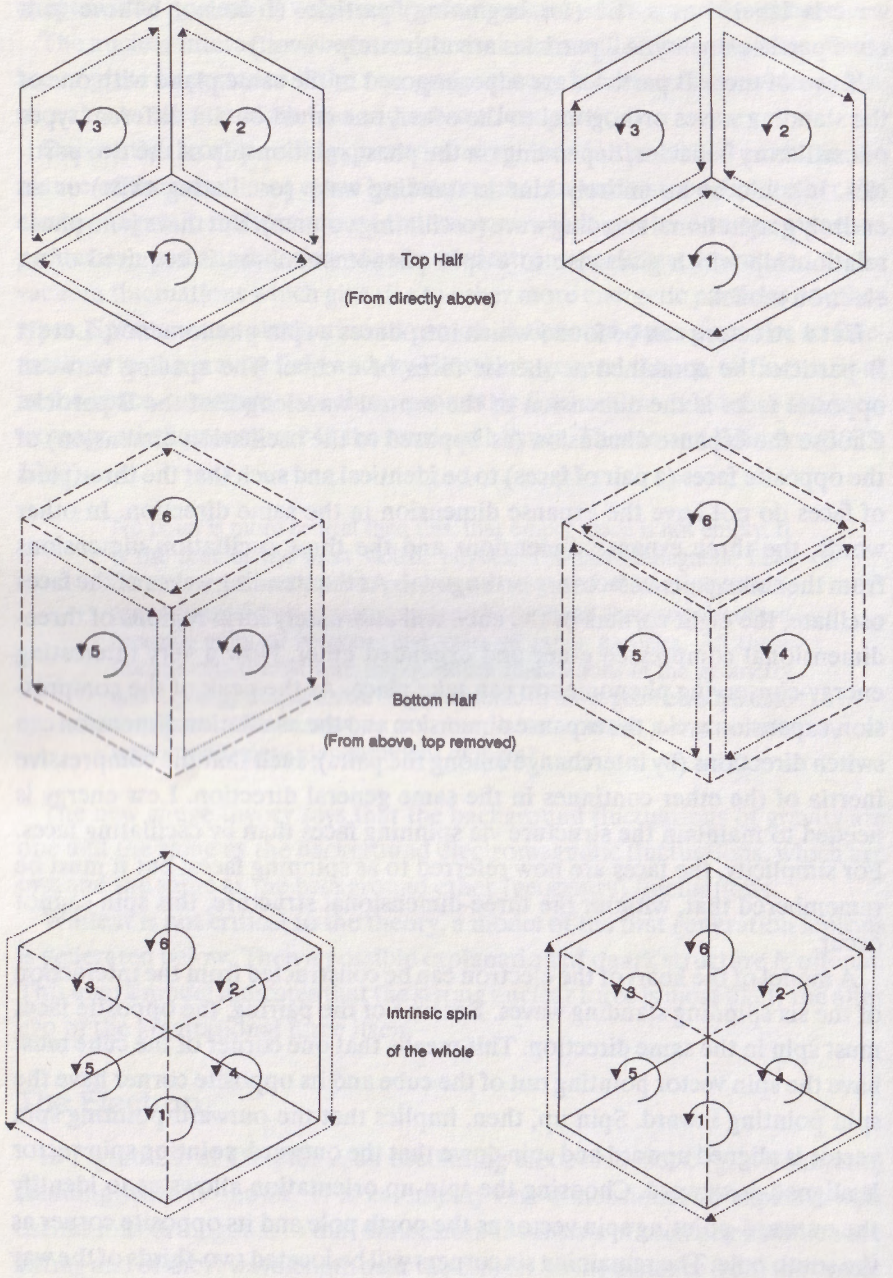


Figure 7.1 The Electron
A cube—six faces of spinning standing waves

A top view of the electron is shown in Figure 7.1 The head of each of the dotted arrows represents a compaction of the ether in the plane of the face. The corners without arrows represent an expansion of the ether. Each view shows the compression/expansion of the faces in one position and then rotated 90 degrees. A top view, bottom view, and then transparent view are shown. Each face is numbered, and the number of the opposite faces sum to seven.

As stated earlier, the interacting faces will, in effect, create three-dimensional gravity waves oscillating together at the corners; and, without this effect, no spin is obtained. When the top (spin up) corner is compressed, the three corners above the spin equator will be expanded. At the same time, the three southern corners will be compressed, and the south pole (spin inward) will be expanded. The compression followed by expansion of the corners will oscillate in phase while maintaining the opposing relationships described above. But, if each corner is oscillating in phase, there must be a radial change of phase with distance from the center of the structure. It is not difficult to see that this phase may move inward or outward.

An inward or outward movement of phase cannot occur without energy radiation, unless there is an apparent spin of the standing-wave structure. Because of entropy considerations, the electron is chosen to have outward-moving phase and the positron an inward-moving phase. Note that the two poles of the electron will also have outward-moving phase and that the two poles of the positron will have inward-moving phase.

It is also apparent from the model that the correct, but unusual, relationship between spin and magnetic dipole moment will result. The three pairs of spinning faces combine as a vector to give the total spin value, but half of the spin is canceled at the common boundaries of the faces. The angular relationships are such that the spin of the total particle is slightly less than the spin of one pair of opposite faces. The spin of a pair of faces is the inverse of the square root of three, while the spin of the entire structure is one-half (in units of Planck's constant over 2π). The magnetic dipole of each pair of opposite faces adds as a vector without any canceling effect. Thus, the approximate g-factor (very close to two) of the electron is obtained directly. The magnetic dipole moment is twice as big as it would be if the structure were spinning as one combined whole.

The mutual compression and expansion of the ether comprises the gravitational force which holds the electron together. This means that there is no internal stress within the electron and the electrostatic energy leads directly to the proper mass energy. The oscillation of the compression seen by nearby particles is nothing more than the electrostatic potential.

A model of the electron has been defined, and it has a number of characteristics which argue strongly in its favor (e.g. the proper g-factor and no internal stress energy). Furthermore, if the standing wave acts back upon itself, it is not at all surprising that it should be quantized at one specific size of mass and charge.

The Neutrino

The neutrino is clearly related to the electron. But it has no charge, very little, if any, rest mass, and is not quantized at one specific energy value. But it would have the same spin-1/2 value of the electron and the quarks. Is there a structure similar to the electron which could give rise to such a particle?

I have found a structure which seems to provide the right characteristics—the top half of an electron combined with the bottom half of a positron. This structure still would have the oscillating three-dimensional corner structure necessary for spin-face formation. This particle clearly would have no charge, since the opposing sides would have canceling inward- and outward-phase motion. The canceling phase motion of the opposite faces would result in a field cancellation, except in the immediate vicinity of the cubic structure itself. Thus, the standing-wave structure would not act back on itself; and a wide range of energies would result in stable particle structures. The size of the cubic structure would simply vary inversely with the particle energy. A net zero charge results from the fact that the oscillating compression of space outside the immediate structural vicinity is canceled by the action of the opposite faces.

But the particle constructed above is a magnetic monopole, since each face of the cube has an outward-pointing magnetic field vector. The top three faces have a magnetic vector pointing upwards as a result of the spinning negative faces, and the bottom three faces have a magnetic vector pointing downwards as a result of the positive faces spinning the same direction.

But a strange thing happens to this particle on its way to reality. The phase of the negative north pole still moves outward at the speed of light, and the phase of the positive south pole still moves inward at the speed of light. Thus, the energy of the particle will be minimized if it moves in the downward direction (opposite to its spin vector) at the speed of light or at least very close to the speed of light.

What happens to the characteristics of this particle if it moves at the speed of light? A strong indication is provided by the example of an electron which is caused to move at speeds approaching that of the speed of light. The moving electron appears to the stationary observer to have a surrounding magnetic

field whose ratio of magnetic field strength to the underlying electric field strength approaches infinity. If the motion of a magnetic monopole has a similar effect, it must be accomplished by generating a finite surrounding electric field, together with the disappearance of the magnetic field. The electric field would be very small and local due to the counteracting charges of the opposing faces. Furthermore, direct consideration of the combined structure leads to the same conclusion. The neutrino should have a circular electric field in a plane perpendicular to its direction of motion. This electric field is analogous to the circular magnetic field which surrounds the electron in a plane perpendicular to its direction of motion.

Let's recap! The characteristics of the neutrino appear to have been met by only slightly modifying the electron structure. It has no charge (except in its immediate cubic structure). It has the proper spin-1/2 value. It has no (or very little) rest mass and moves at (close to) the speed of light. And, in fundamental nature, it is the missing magnetic monopole (with no magnetic field). Behold, the neutrino!

The anti-neutrino is constructed in similar fashion from the top half of a positron and the bottom half of an electron. It would travel in the direction of the spin vector at the speed of light and be identified with the magnetic monopole of opposite sign.

This model indicates a way by which the neutrino characteristics may be studied and explains the recently observed variation of the solar neutrino flux. It predicts that, just as a magnetic field bends the path of an electron, an electric field should bend the path of a neutrino. I believe that it is this last characteristic which gives rise to the phenomenon of the observed scarcity of neutrinos arriving from the sun when the solar cycle is at its maximum.

The solar cycle is at its maximum level of activity when its magnetic field is changing polarity. Whether it is cause or effect, it is reasonably clear that a homopolar generator effect must exist during the maximum solar magnetic field (minimum of the solar cycle). This effect will cause the region of the sun's equator to be charged negative during one solar cycle while the magnetic field is at a maximum and positive during the next solar cycle when the magnetic field has reversed. This means that a radial electrostatic potential will exist in the vicinity of the ecliptic plane when the solar cycle is at its minimum. This electrostatic field should guide the neutrinos outward in the ecliptic plane, just as electrons are guided along magnetic field lines. During solar maximum, the electrostatic field is in the process of changing state. The solar flares during the solar maximum indicate the magnetic fields are chaotic. If the magnetic field is any indication of the electrostatic field, it is also chaotic during solar maximum. This presumably will cause the neutrinos to be deflected out of the ecliptic plane. The guiding or disturbing effect would be larger the smaller the energy (longer wavelength of standing-wave structure) of the neutrino.

The Quarks, Up and Down

Now, how can quarks and anti-quarks be formed? I have tried several models, but the most interesting arises from physically spinning electrons and positrons. From the discussions above, it is apparent that the compressions and expansions of each face and of the entire standing wave appear to be spinning. However, the three-dimensional regions of compaction and expansion at the six semiequatorial corners of the cube are not themselves spinning. They are simply oscillating. Thus, the structure is not spinning; but the standing wave appears to be. To distinguish this situation from physical spin, it will be referred to as intrinsic spin.

There are a number of things which suggest physical spin for the quarks. First, it leads to the simplest explanation for their mass. Spin can create a large local kinetic field whose energy outside that local field is seen as mass. The presence of angular spin particles, neutrinos, in the baryon decay process also is an indicator of physical spin. Finally, the quark model involving physical spin can explain the fractional electric charges and gives rise to a logical explanation of the strong and weak nuclear forces.

What happens if an electron is caused to spin physically? Choosing a face in the northern hemisphere and imparting enough spin to counteract the intrinsic spin of that face has an interesting effect. The outward-moving phase in the plane perpendicular to the physical spin stops moving outward and becomes a stationary pattern. Thus, it loses its charge in that dimension; and the total charge drops to minus two-thirds. It appears to be an anti-up quark. Furthermore, the three-dimensional regions of compressed and expanded ether are now physically spinning and moving at high velocity. This implies increased kinetic mass and a kinetic field. A physically spinning electron would then create a dipole kinetic field similar to a dipole magnetic field.

It is also apparent that three quarks oriented with the physical spins orthogonal could interact such that the stationary oscillation pattern forms regions of compacted and expanded ether. The result would be a strong gravity field caused by what had been a charge before the spin caused it to lose its charge. The strong gravity field can be identified with the strong nuclear force. The fact that the charge-canceling spins must be orthogonal to interact properly explains the three-color nature of the strong force.

Bubble and string models of baryons have been used in explaining aspects of nuclear behavior. The bubble model pictures the quarks as moving relatively freely inside a bubble in the vacuum. This fits the description above and can explain a portion of the baryon mass as well. A low density region or bubble would cause the ether outside the bubble to be more compressed. Thus, its mass would be greater. If the three quarks comprising the baryon each have a pair of faces whose physical spin has canceled the intrinsic spin to create a stationary pattern and these stationary patterns are orthogonal to each other, they can interact to form a lower density region of the ether.

A second model of nuclear and quark forces is the string model, which prohibits free quarks. Assuming the spin model of quarks is correct, the kinetic lines of force naturally lead to aspects of the string model. The kinetic lines of force will tend to concentrate in the more dense parts of the ether, since the same amount of twist requires less energy in the denser ether. Thus, the bubble described in the preceding paragraph would tend to be "lined" with kinetic lines of force. When a quark separates from other quarks in its vicinity, these kinetic lines of force are stretched and must become more diffuse due to the collapse of the stationary wave interaction of the quarks. If the energy required to separate the quarks substantially exceeds the energy required to create new quark pairs from the ether, the observed confinement is obtained.

The extension of this model to form the remaining quarks and anti-quarks is not difficult. I have attempted to construct not only the first generation quarks and anti-quarks from simple spin variations of the electron and positron but also the second and third generations. While coming close to models that fit, I have not been completely successful. The first generation model is easy, though. In fact, it is a bit too easy. If the electron is physically spun about its intrinsic spin axis, such that the two spins combine for no total spin, the residual charge would be 1/3 (from the charge of the two polar regions). This would appear to be a logical model for the down quark. For reference below, it is called a "temporary down quark."

However, it may be that the total spin, and not just the intrinsic spin, must be a multiple of one half the quantum-spin value. If this is the case, the down quark has not been modeled yet. Three additional physical spins of 1/2 the quantum-spin value could be added to the "temporary down quark." These three physical-spin values correspond to causing the combined spin axis to move to different physical corners of the structural cube. The three corners just north of the spin equator are not physically unique, and causing any one of them to be the location of the combined spin vector corresponds to the anti-up quark described earlier. When the combined spin vector is located at one of the three corners just south of the spin equator, the quark corresponds to spinning the electron around two faces simultaneously. This would apparently lead to an alternate model of the down quark, and this model of the down quark would have a combined physical and intrinsic spin that summed to a proper one-half total spin.

There are more alternatives. The combined spin vector could be made to point at the south pole of the electron by adding a second unit of physical spin opposite to the intrinsic spin. This could result in a quark with a charge of +1/3 if the phase of the equatorial spin moved inward or a charge of -1 if the phase of the equatorial spin moved outward. Presumably, either situation is possible. The first case might be a logical model for the anti-strange quark and the latter a model of the muon. Unfortunately, I see no way to extend these results to populate the entire three generations of quarks and leptons.

The presence of kinetic lines of force is very interesting, and it is with these forces that the weak nuclear force can be identified. It follows from the kinetic force consisting of twists in the ether that: (1) they can only exist in the region where the gravity field exists; and (2) they could add to the gravity field or strong force to bind quarks in the observed fashion. The quarks would be bound loosely as long as the kinetic force and the gravity field encompass them. The quarks would be bound tightly as the distance between them approaches and exceeds the size of the encompassing gravity field.

The model of the quark as a spinning electron is supported by the modern quantum picture of the quark having a mass about the same as that of the electron.

> However, looking in depth at modern quantum theory we find that when a u or d quark floats about in the middle of the hadron, its effective mass is very small, of the order of the electron mass. The nucleon's mass then mostly reflects the tremendous potential energy carried by the carriers of the string-like forces between the quarks (Ne'eman and Kirsh, 1986).

Two particles spinning in the same direction—one above the other—would be attracted to each other and their fields combine, just as orbiting electrons create magnetic fields that attract when electrons revolve in the same direction one over the other. Similarly, two particles spinning in opposite directions will be attracted to each other and their fields partially combine when they are side by side. Also, like magnetic fields, which repel each other when generated in opposite directions by electrons orbiting in opposite directions, the kinetic force generated by masses spinning one over the other in opposite directions would tend to repel each other.

The identification of the physical spin with the weak interactions is supported by the fact that weak interactions invariably involve neutrinos in the interactions, and neutrinos are carriers of angular momentum.

Conclusion

The conclusion is rather startling. The strong nuclear force is identified with the gravitational force, and the weak nuclear force is identified with the kinetic force. This ironic pairing of the weakest and strongest forces of nature is not obvious, primarily because the relationship between gravitational and electric forces is not obvious.

As stated at the start of the chapter, the models of the leptons and baryons obtained in this chapter are not critical to the new gauge theory. However, the models do show that the new theory can give rise to reasonable explanations of phenomena never before explained. For example, classical computations of the energy in the electric field of the electron lead to an electron mass four-thirds of that actually measured. The extra one-third of the energy was ascribed to the self-repulsion or self-stress energy of the electron. The model of the electron obtained above has no internal stress and leads to the proper mass of the electron. It also explains the electron's anomalous g-factor. In addition, classically gravity has had no role in the electron because it was simply too weak to contribute. But, with the link between electric fields and gravity fields, an electric field in three orthogonal planes can interact to give a potent gravity field even at nuclear dimensions.

8

QUANTUM MECHANICS CONSIDERATIONS

Quantum Qualities

> The impact of the new ether gauge theory on quantum mechanics is considered in this chapter. The ether gauge theory and the quantum theory are largely compatible as they stand, but a number of new insights is afforded into the nature of quantum phenomena. Even though the two theories are largely compatible, there are, nevertheless, some significant changes which are required in the quantum theory to eliminate its dependence upon the special theory. These changes are considered briefly in this chapter.

Unlike Einstein's relativity theories, the new gauge theory is largely compatible with quantum theory. And there are a number of unresolved issues within quantum theory which the new gauge theory can address. At the same time the quantum theory is very successful; and, in a sense, one of the legs it has stood on (Lorentz covariance) is being removed. Though I am not qualified to address the changes required in detail, the general scope of the modifications is clear; and these will be addressed briefly.

The new gauge theory, by revising the classical electromagnetic equations, obtains equations which predict the emission and absorption of energy in quanta. However, the gravitokinetic equations also lead to radiation which has the same nature, namely, what we call electromagnetic radiation. But the electromagnetic radiation from gravitational sources shows no hint of a quantization requirement. This strongly suggests that electromagnetic radiation is not quantized as radiation. Instead, the quantum phenomenon is simply a manifestation of the normal emission and absorption of radiation.

Planck originally postulated that radiation is simply absorbed and emitted in quanta but is not itself quantized. Einstein proposed otherwise, but it was Compton's experiments which convinced physicists that light is indeed quantized.

Compton showed that light scattered by an electron was present at a new wavelength which represented the new energy of a "photon" which had imparted some of its energy to the electron. The particle nature of the photon was the only way this observed effect could be reconciled with the particle nature of the electron. *That is no longer the case.* The view of the electron as a standing wave of radiation would explain exactly the same phenomenon. The radiation at the new wavelength is simply the resultant beat frequency of the recoiling electron's standing wave with the incoming radiation. No quantization of radiation is required to explain the result.

The idea that radiation itself is not quantized has been argued by a number of people recently and is referred to as a neoclassical or semiclassical approach. There are actually very few experiments that seem to require quantization of the radiation itself. But there are indeed some that are difficult to explain if radiation is not quantized.

The presence of unquantized radiation has a number of interesting implications, particularly in the light of this new gauge theory where any background radiation is simultaneously electromagnetic and gravitational or geometric. It would mean that there is a background radiation which is everywhere present which is more energetic the shorter the wavelength. In fact, the energy in this background would obey a cubic law of power (due to the three dimensions) with wavelength. Just such a "zero-point" radiation field has been detected (Boyer, 1985). And it is scaled by one-half Planck's constant. This is undoubtedly the same background field which creates the uncertainty and unobservability in quantum mechanics phenomena.

The very mechanism which was used in demonstrating the background radiation shows that free electrons in metallic conductors interact with this background radiation. Thus, the background radiation is almost certainly the source of the probabilistic nature of quantum models of electron motion.

Selleri (1989) has a section on "Noteworthy Experimental Facts." The experiments which he describes are interesting to consider in the light of the new gauge theory. The first experiment discussed is that of Blake and Scarl, who showed that "no correlations appeared to exist between incident and induced photons," when light at different intensities was amplified by a laser gain tube. This was contrary to all expectations. Selleri attempts to explain the result in terms of "empty waves" which guide the photons. I believe a better explanation is available.

The second strange phenomenon referred to by Selleri is the modification of fluorescence lifetimes in the presence of mirrors, as demonstrated by Milonni and Knight. Again, Selleri argues for empty waves guiding photons. He says:

> These results are extremely interesting since it appears virtually impossible to give any rational explanation of their existence in terms of a purely undulatory (or purely corpuscular) description of radiation.

Again, I disagree.

The model of the electron as a standing wave allows a rational explanation of both phenomena. As argued earlier, a standing wave acts back upon itself. Therefore, a mirror in the vicinity also must act back upon the electron. Thus, the effect of a mirror in inhibiting or stimulating fluorescence as a function of the mirror distance from the atom is an expected phenomenon.

The most significant improvement in understanding diverse quantum phenomena is, I believe, the movement from "particle" to "standing wave" pictures of physics. This provides for non-locality and probability wave collapse that remains profoundly puzzling from a particle point of view. If an electron and a positron interact and annihilate each other, the reaction is not a local phenomenon but is extended over a volume of space. The interaction, by taking place virtually simultaneously at all points in the volume, can result in a collapse which appears to proceed faster than light from a particle point of view.

The "entanglement" of multiple states of a quantum system makes sense when the components are seen as standing-wave structures. The interaction between the background radiation and the waves is a significant part of the physics as well. The detection of a "photon" by a detector must be seen as a simultaneous coincidence across a non-local volume of the waves from the detector, the background radiation, and the radiation being detected. This makes it understandable that photons split into two parts do not lead to simultaneous detection. A photon with only half its energy is submerged even farther into the background radiation and must have a higher uncertainty of detection and a higher uncertainty in time of detection. Thus, the proof of the indivisibility of photons seems to be no proof at all.

The domain of quantum mechanics, then, is the study of phenomena in which the background ether (electromagnetic) fluctuations interact with the wave fluctuations of the "particles" and with the wave fluctuations of the instruments. A polarization device must polarize the background fluctuations, just as other devices, such as mirrors and detectors, also affect the background radiation.

Clearly, significant changes in quantum mechanics are called for if this new theory is correct. Many changes are needed in quantum mechanics, but most of the changes will not be particularly difficult to make. In some places, the substitution of the gravitokinetic potentials in place of the electromagnetic constitutes the major change.

One of the most encouraging things about modern quantum theory is that it is soundly based on the principle of gauge invariance (Aitchison and Hey, 1989). While the gauge invariance spoken of is not quite the same as the gauge invariance of the new theory, it is very similar. Furthermore, gauge invariance can often be substituted for the more restrictive Lorentz covariance with no adverse effects. For example, Dirac is famous for his "relativistic" modification of the Schrodinger wave equation, which gave rise to electron spin. But the modification involved only the gauge change of mass with velocity. Thus, the same result is obtained from gauge invariance together with the generation of the kinetic field energy.

A very promising characteristic of the new theory is the implications it has for the Glashow-Salam-Weinberg gauge theory of electroweak interactions. If the electroweak interaction is modified to become a gravitoweak interaction, a number of puzzling questions are answered. The fact that the weak interactions require a hidden gauge invariance is no longer surprising with the new theory. The interaction of the three-dimensional background (zero-point) radiation with itself creates oscillating regions of compacted and expanded ether (space). These small regions would exhibit gravitational forces between themselves and would act to shield the gravitational forces between the quark gravitational regions. This means that the expected value of the gravitational potential of the vacuum is not zero. The Higgs field, which is normally called upon to explain mass, can in this role simply be identified with the scalar gravity field.

The Coulomb gauge of the Maxwell equations is used to derive the quantum electromagnetic field theory in its simplest derivation. But the equations in the Coulomb gauge are not Lorentz covariant. Thus, the more detailed quantum field derivations use the Lorentz gauge, which is Lorentz covariant. This leads to a number of problems in the development and a few new results. In the gauge theory equations developed in Chapter 3, the Coulomb gauge is directly obtained and is assumed to be correct. Thus, any new results obtained in quantum theory using the Lorentz gauge must be questioned. One of these questionable results is the transmission of electromagnetic forces via the exchange of virtual photons. The concept of virtual photons is unnecessary. The direct interaction of the potential is sufficient. I believe that, in every case, any benefits in understanding provided by the Lorentz covariance constraint can be obtained via other less restrictive constraints. The problems associated with Lorentz constraints which have been detailed in other chapters are of course removed directly in the new gauge theory.

The new gauge theory indicates that the electromagnetic radiation and the background radiation are not themselves quantized. And the quantum theory directly assumes and models them as quantized fields. This is not in and of itself a problem, since the aim of quantum mechanics is to study how the fields interact with particles. To the particles the fields to which they react must of necessity appear to be quantized. In other words, the quantization is not intrinsic to the fields but intrinsic to the particles with which they interact.

Conclusion

In conclusion, many modifications are needed in quantum theory. The new ether gauge theory creates new problems by removing the requirement of Lorentz covariance. But it also shows promise of resolving many of the current problems. The expected result of the merger of the new ether gauge theory with the quantum theory is a much stronger and better quantum theory.

9

CLASSICAL PROOFS OF THE SPECIAL THEORY

Paradox Panacea

The theoretical foundations of the new gauge theory are now complete. In this chapter and the rest of the book, attention will be focused on the experimental evidence for and against the new theory.

The task in this chapter is to review the experimental data which are cited in support of the special theory. It is the intent to show that the new theory is in agreement with the same data. In fact, the data will often be easier to explain using the new theory than it is using the special theory. There is, of course, no way in which all experiments cited can be analyzed in detail. Therefore, the experimental data are organized into categories; and, in each category, at least one experiment is analyzed. The extension of the analysis to other experiments of the same kind will generally be obvious.

This chapter is organized into four sections. The easy tasks are addressed first. The first section shows that the new theory agrees with experiments which measure what is normally referred to as the relativistic increase in mass. The second section is concerned with experiments which show time dilation. There are no experiments suggested to date which can reveal directly the contraction of lengths. Those which indirectly do so are included in the third section. The third section deals with experiments which are designed to reveal the presence of any absolute or preferred ether frame of reference. A final section is used to address experiments which do not fit neatly into any of the above categories but are usually explained by the special theory.

The Increase of Mass with Velocity

The equivalence of mass and energy, which was clearly predicted by Einstein's special theory, indicates that a particle whose kinetic energy is increased ought to become more massive. This has been verified by experiment.

One of the first experiments to demonstrate the effect was performed by Bucherer (Semat, 1954) in 1906. The experiment actually measured the charge-to-mass ratio of the electron as a function of the electron velocity. The emission of high-speed electrons (beta decay) from radium fluoride was used as the electron source. The source was placed at the middle and between two circular metal plates with only one-fourth millimeter separation. An electric field was placed across the plates and a magnetic field parallel with the planes of the plate. In the direction perpendicular to the magnetic lines of force, only electrons traveling at the specific velocity which caused the magnetic force to exactly counteract the electric force could escape from between the plates. These electrons, with a velocity determined by the applied electric field, were then allowed to continue traveling in the magnetic field until they struck a photographic plate which was placed on the inside of a cylindrical surface surrounding the metal plates. The amount of additional deflection by the magnetic field after the electron emerged from the plates was a measure of its charge-to-mass ratio.

The Bucherer experiment has already been considered in Chapter 5. At that point it was argued that the charge-to-mass ratio did not change. This was not because the mass did not change but because both the mass and the charge changed with velocity.

Though the experimental setup was not extremely precise, the resultant data did support the increase of mass with velocity. Of course, many experiments run in the intervening years support the predictions of the special theory with much greater accuracy.

The new ether gauge theory predicts the same mass-increase effect. In general, it is a result of the generation of the energy embedded within the kinetic field of the moving particle. In the case of the electron, however, the mass increase is a result of the energy embedded within the electromagnetic field of the electron. There are differences, of course, in the details between the theories. The new theory predicts a rest-mass decrease due to gauge effects, but the kinetic energy is twice that normally ascribed to it. Thus, the net change in mass is the same.

It is also worth pointing out, though no famous paradox exists to illustrate it, that the mass increase is symmetric in the special theory. Thus, to the moving electron the mass of the electrons at rest in the laboratory appears to increase in weight. This does create problems related to conservation of energy which are not easy to reconcile. The new ether gauge theory does not have this problem. The moving electron in the ether gauge theory sees the electrons at rest in the preferred (gravity field) non-moving frame as less massive than they are. The conservation of energy follows directly and simply.

The Dilation of Time with Velocity

There are many experiments which demonstrate the dilation of time. But, before discussing any "hard" experimental data, it is appropriate to consider the thought experiment introduced in the first chapter. The twin paradox simply cannot be explained by the special theory. Does a better fate await this thought experiment in the new gauge theory? Consider again the twins and their paradoxical age.

(1) The twin paradox revisited

Stella, who traveled to the stars, can transform her position and time to Terrance's coordinates via the Lorentz transformation. By the special theory and the associated Lorentz transformation, her coordinates expressed in his coordinate system and time frame are:

$$\mathrm{Tc} = \gamma \mathrm{T'c} + \gamma\beta \mathrm{X'} \tag{9.1}$$
$$\mathrm{X} = \gamma \mathrm{X'} + \gamma\beta \mathrm{T'c} \tag{9.2}$$
$$\mathrm{Y} = \mathrm{Y'} \tag{9.3}$$
$$\mathrm{Z} = \mathrm{Z'} \tag{9.4}$$

where: γ is given by $(1-\beta^2)^{-1/2}$
β is the ratio of the velocity to the speed of light

The last two equations were not given in Chapter 1, since they are a simple unchanged one-to-one relationship. Here they are included for comparison with the gauge equations.

With the help of the scale or gauge relationship to velocity described in Chapter 2, the gauge transformation which maps Stella's coordinates into Terrance's is obtained:

$$\mathrm{Tc} = \gamma \mathrm{T'c} \tag{9.5}$$
$$\mathrm{X} = \gamma \mathrm{X'} + \gamma\beta \mathrm{T'c} \tag{9.6}$$
$$\mathrm{Y} = \gamma \mathrm{Y'} \tag{9.7}$$
$$\mathrm{Z} = \gamma \mathrm{Z'} \tag{9.8}$$

It is interesting that the X equation is actually identical in the two transformations. (Terrance's distances are contracted compared to Stella's distances, so her coordinates need to be amplified by γ.) However, each of the other coordinate relationships is different.

Before discussing any further implications of the differences in these transformations, the corresponding inverse transformations are given. The inverse of the Lorentz transformation in equations (9.1) to (9.4) is the transformation which maps Terrance's coordinates into Stella's coordinate system. This transformation is:

$$T'c = \gamma Tc - \gamma\beta X \tag{9.9}$$
$$X' = \gamma X - \gamma\beta Tc \tag{9.10}$$
$$Y' = Y \tag{9.11}$$
$$Z' = Z \tag{9.12}$$

The only difference in this Lorentz transformation compared to the first is the change in sign of the velocity term, which reflects the different direction of the relative velocity.

The inverse transformation from Terrance's coordinate system to Stella's in the gauge theory is:

$$T'c = (1/\gamma)Tc \tag{9.13}$$
$$X' = (1/\gamma)X - (1/\gamma)\beta Tc \tag{9.14}$$
$$Y' = (1/\gamma)Y \tag{9.15}$$
$$Z' = (1/\gamma)Z \tag{9.16}$$

The X equation is no longer the same in the inverse transformations. (Terrance sees Stella's distances expanded or dilated, not contracted, so his coordinates need to be decreased in her coordinate system.) The inverse gauge transformation has an inverse gauge or scale, while the inverse Lorentz transformation does not.

It is the symmetrical but non-reciprocal nature of the Lorentz transformation which creates the paradox problem in the special theory. But the gauge transformations, equations (9.5) through (9.8) and equations (9.13) through (9.16), are truly reciprocal. They create no paradox with the twins.

This can be illustrated for a velocity so close to the speed of light that the value of γ is 365. Equations (9.5) through (9.8) say that Stella, because she is moving so fast (with respect to the background gravity field), is 365 times larger than Terrance and her clock runs 365 times slower than Terrance's. Both Terrance and Stella obtain the same velocity for Stella, since time and distance is stretched equally for Stella. But all distances are to Stella 365 times shorter

than they are to Terrance. Therefore, she can complete her journey to a (nearby) star in 15 days of her own time. When these 15 days are transformed via equation (9.5) into Terrance's time, they become 15 years. Similarly, equations (9.13) through (9.16) take the long distance and long elapsed time observed by Terrance and divide by 365 to obtain Stella's equivalent observations.

When Stella returns home after 15 more days, both Terrance and Stella agree that Stella has aged 30 days and Terrance 30 years. Each has been able to continuously monitor the other via the gauge transformations and signals at the speed of light. The only effect of acceleration when Stella turns around is the change in gauge which the acceleration produces, and the gauge is given directly by the velocity through the gravity field.

There is no paradox at any point in time, and there is no non-simultaneity of time. The gauge transformations are non-symmetrical in the gauge or scale sense. Instead, the transformations are reciprocal or inverse relationships.

The dilation of time and the FitzGerald contraction of distances are observed, but they involve transformations in different directions. The laboratory observer sees the elapsed time of others who are moving at velocities through the earth's gravity field which are greater than his own velocity (from earth rotation) dilated or expanded. The moving observer sees the laboratory distances contracted compared to his own—not just in the direction of the relative velocity but in the orthogonal directions as well.

(2) The Ives and Stilwell experiment

What about "hard" experimental evidence instead of thought experiments? Ives and Stilwell (1938) verified the time-dilation effect by measuring the average wavelength of radiation in the forward direction and the backward direction from accelerated hydrogen atoms. The measured values agreed closely with that predicted by the special theory. Since the velocities are velocities through the gravity field (earth's spin velocity is relatively negligible), the results are also in agreement with the ether gauge theory.

(3) The mu-meson decay rate

The evidence of the mu-mesons or muons (Frisch and Smith, 1963) has already been cited in Chapter 1. Yes, time is dilated with respect to the laboratory, but the Lorentz transformation has trouble explaining why. These muons are in free-fall in the earth's gravity field, while the laboratory observer is accelerated. Yet the muons seem to have their time dilated with respect to the laboratory and not vice versa. The new gauge theory fits the data just fine, since it is the velocity with respect to the earth's gravity field which gives rise to the time dilation.

A Preferred Frame of Reference

Is there a preferred frame of reference? It is an old question to which Einstein's answer was "No." The answer given by the new theory is "Yes." Though the answers to the question are different, the two theories can both satisfy most of the experimental data. It is worth reviewing again the historical background of the question.

With the discovery that light was polarized and, therefore, consisted of transverse vibrations came the concept of a solid ether, since only solids are capable of sustaining transverse vibrations. This concept naturally led to questions as to how solid matter could move through such a solid ether. A number of suggestions were made, but I like Sir Oliver Lodge's solution the best. Solid matter, he claimed, was not solid but only whirls in the ether.

More to the point of the present subject was the question as to whether or not the earth moved through the ether. There were three answers to this question which, at one time or another, were popular during the nineteenth century. Francois Arago suggested in 1818 that matter carried the ether along with it. (He made this hypothesis to explain why the motion of a prism did not affect the refraction of light.) This solution was championed by Stokes and Hertz. Fresnel suggested that the ether was only partially dragged along by the motion of matter. Lorentz believed that the ether was not affected by the motion of matter. The differing views on the ether cried out for an experimental resolution.

(1) Aberration

Aberration was considered in some detail in Chapter 4. It is considered very briefly again since it has always played a significant role in discussions of the ether. One reason for its significance—aberration is proportional to the first-order ratio of the velocity to the speed of light.

The general interpretation in the last part of the nineteenth century seemed to be that the aberration of light ruled out the possibility that the earth carried the ether along with it. If, as Beckmann (1987, 27) suggests and the new ether gauge theory indicates, the effective preferred frame is defined by the gravity field, this elimination was premature. Thus, since the gravity field is carried along by the earth, the preferred frame is carried along by the earth. But this does not at all rule out aberration effects. As was argued in Chapter 4, the

aberration can still be caused at the border between the earth's and the sun's gravitational fields. The aberration is caused by the velocity of the earth's gravity field through the sun's gravity field. This solution is compatible with Airy's water-filled telescope experiment, as Beckmann (1990a) has shown.

(2) The Fizeau experiment

Fresnel suggested that the ether was partially carried along by the earth, and this seemed to be verified by Fizeau in 1851. Fizeau caused light to be transmitted in opposite directions around a circulating stream of water. Thus, he was able to detect the amount by which the velocity of water affected the velocity of light. His experiment confirmed the predictions of Fresnel that moving matter affected the velocity of light as a function of its index of refraction. Since the air has an index of refraction very close to one, the implication from Fizeau's experiments was that the earth did not drag the ether along with it in its orbit. Thus, the partial-ether-drag hypothesis was practically identical with the no-drag ether theory.

At the time of the Fizeau experiments, the electromagnetic nature of matter was unknown. Thus, the ether interpretation of light velocity in material objects was natural. Today, the propagation of light in material objects is associated with its electromagnetic properties, not with its ether-drag effects.

(3) The Michelson-Morley experiment

The crucial ether-drag experiment was clearly the Michelson-Morley experiment, and it did not yield the expected result. It, therefore, precipitated a crisis. The Maxwell equations (the equations discussed in Chapter 3), which James Clerk Maxwell had proposed in 1864, showed that light was an electromagnetic wave. If the ether did not move with the earth and the speed at which light moved was relative to the ether, the velocity of light in the direction of the earth's orbital motion would be $(c-v)$. In the direction opposite to the earth's orbital motion, it would be $(c+v)$. Perpendicular to the earth's motion, the Pythagorean theorem shows the velocity of light would be $(c^2-v^2)^{1/2}$.

The measurement of the one-way velocity of light was completely unfeasible in the late nineteenth century. Two-way, round trip, velocity of light involved much smaller effects. The transit time of a round trip in the direction of the velocity through the ether and back would be:

$$\tau_v = \tau_o + \tau_i = \frac{d}{(c-v)} + \frac{d}{(c+v)} = \frac{2\gamma^2 d}{c} \qquad (9.17)$$

where: τ_v is the round-trip time in the direction of the velocity
τ_o is the elapsed time on the outbound portion

τ_i is the elapsed time on the return inbound portion
γ is as defined in the Lorentz transformation

The transit time of a round trip perpendicular to the velocity through the ether can be obtained in similar fashion:

$$\tau_p = \tau_o + \tau_i = \frac{\gamma d}{c} + \frac{\gamma d}{c} = \frac{2\gamma d}{c} \tag{9.18}$$

where: τ_p is the round-trip time perpendicular to the velocity

The difference in the round-trip times is:

$$\tau_v - \tau_p = \frac{2\gamma d(\gamma - 1)}{c} \tag{9.19}$$

For low velocities γ is very close to one, and the value excluding the (γ-1) term is just the round-trip travel time itself. The significant multiplying term in equation (9.19) is, therefore, the (γ-1) term. For low velocities, this term can be approximated by $\beta^2/2$, where β is the ratio of the velocity through the ether to the velocity of light through the ether. The ratio, β, for the earth's orbital velocity is one ten-thousandth. Thus, the difference in the round-trip travel time for light signals sent with the earth's velocity and perpendicular to the earth's velocity would be only five billionths of the total transit time.

This can be illustrated by a one-second light path in each of the two directions. Since light travels 186,000 miles per second, this would correspond to putting a mirror 93,000 miles away in each direction. Then, if a light signal was sent out simultaneously to the two mirrors, the signals would arrive back at the source five billionths of a second (five nanoseconds) apart in time. This is equivalent to one of the paths being five feet (out of 186,000 miles) longer than the other. This shows the immensity of the task of detecting the motion of the earth through the ether.

Maxwell (Shankland, 1964, 109) did not think such small differences could be measured. He stated:

> ... in all terrestrial methods of determining the velocity of light, the light comes back along the same path again, so that the velocity of the earth with respect to the aether would alter the time of the double passage by a quantity depending on the square of the earth's velocity to that of light, and this is quite too small to be observed.

Michelson apparently saw this quote of Maxwell's in a letter to a colleague at the Nautical Almanac Office. He set out to make the measurement.

Michelson took a two-year leave from the U.S. Navy in 1880 in order to study optical techniques in Europe. In Professor Helmholz' laboratory in Berlin, Michelson made his first attempt to measure the effect of the earth's velocity through the ether on the speed of light. There he made the first instrument which used the interference effect of parallel light beams to make high-precision measurements. The instrument was designed to exploit the interference pattern generated by two parallel beams of monochromatic light from slightly extended sources. The energy in the two beams would interfere in constructive and destructive fashion to create light and dark regions respectively. These regions of light and dark interference were referred to as fringes. (The interference phenomenon is similar to the familiar appearance of colored bands which appear on the surface of water covered by a thin layer of oil. When the oil is one-half wavelength in thickness, the light reflected from the top of the oil is constructively aided by the light reflected from the oil-water boundary.) Since typical visible light has wavelengths of about one-half of a billionth of a meter, it is possible to make extremely precise measurements by observing changes in the position of the fringes as a function of the light-path length in one of the two interfering beams.

Michelson constructed an instrument (Figure 9.1) which used a very lightly silvered mirror oriented at 45 degrees with respect to a monochromatic source of light. About half of the light passed straight through the mirror, and half was reflected perpendicular to the original beam. At equal distances from the half-silvered mirror, a fully-silvered mirror was used to reflect each beam back along its original path. (In Figure 9.1, the beam reflected from the fully-silvered mirror is offset to one side to show the traversed paths.) When each beam arrived back at the half-silvered mirror, half of its energy was either transmitted or reflected back towards the original source and half was either transmitted or reflected into an interference-detecting telescopic sight. Thus, the telescopic sight was used to detect the interference between two beams, each of which had traversed paths through the ether at 90 degrees with respect to the other and each containing one-fourth of the original light energy.

If the two paths were not exactly of equal length, no problem resulted. What Michelson looked for was a change or movement in the fringe pattern when the interferometer was rotated by 90 degrees. Such a change would indicate that light took a different amount of transit time to travel the two paths as a function of their orientation in the ether.

Michelson's first attempt in Berlin to measure an effect was unsuccessful. The experimental apparatus was so fragile that vibrations from street traffic swamped any effects from the earth's velocity. In 1881 he repeated the experi-

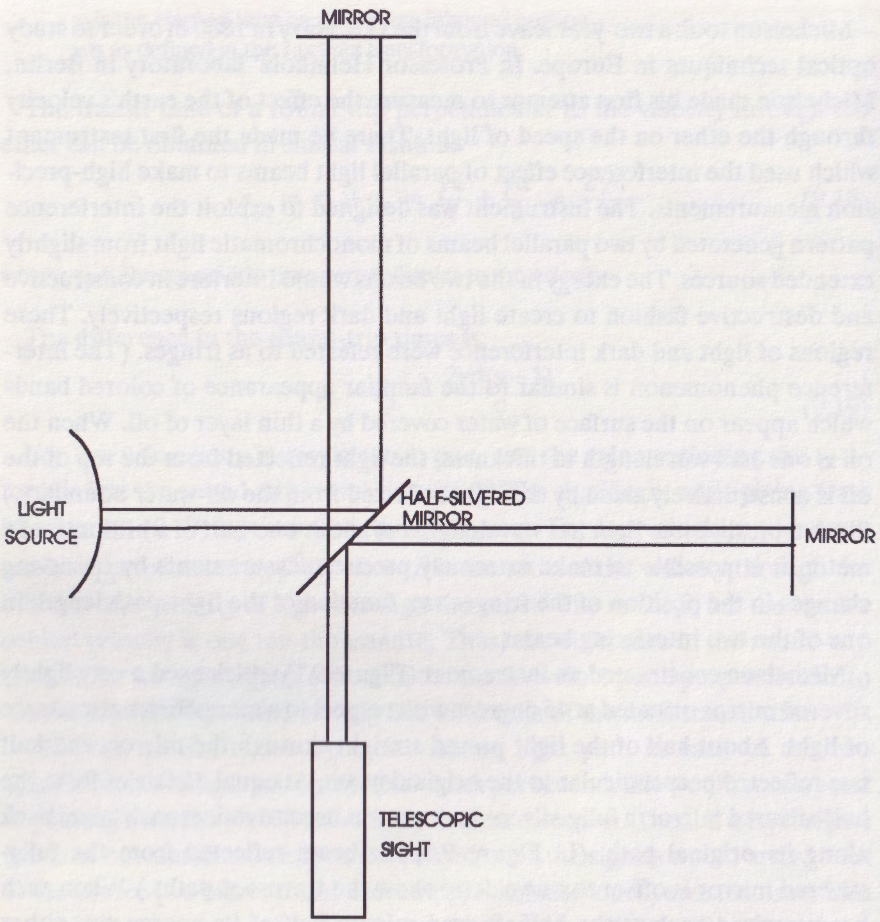


Figure 9.1 Michelson-Morley Experiment

ment in Potsdam. The effect he expected for the size of his apparatus was only 0.04 fringes (wavelengths), and this was barely discernible considering the vibrational noise in the instrument. Nevertheless, Michelson (Shankland, 1964, 110) published the results with the following conclusion:

> ... the interpretation of these results is that there is no displacement of the interference bands. The result of the hypothesis of a stationary ether is thus shown to be incorrect.

Michelson was disturbed by the null results. He might not have attempted a more precise measurement without the encouragement of Lord Rayleigh and Lord Kelvin (Sir William Thompson) during their visit to the U.S. in 1884.

With the encouragement to try again, Michelson, then at Case School of Applied Science in Cleveland, together with Edward Morley, a chemistry professor at Western Reserve University, set out to perform more precise measurements.

They achieved their goal in 1886. The necessary rigidity, together with the ability to rotate the experimental set up, was obtained by floating a granite slab in a doughnut-shaped trough containing mercury. The precision was improved as well by the use of multiple mirrors to increase the effective path length several times over that of the original experiment.

The net result was the same—no discernible effect could be measured. This time the precision was good enough that the experimental result could not be ignored. The most widely accepted notion of the ether had just been proved false.

Michelson himself felt the experiment simply proved the ether was carried along with the earth. That is, of course, the effective position of the new ether gauge theory as well.

A more radical solution was suggested by FitzGerald. He suggested in 1892 that motion through the ether caused distances of material objects to shrink in the dimension parallel to the motion. This concept was picked up by Lorentz. He showed the concept was compatible with his electron theory and with the Maxwell equations. He went on to develop the Lorentz transformation equations.

Einstein, in the special theory, proposed the currently accepted solution to the Michelson-Morley null results. He derived the Lorentz transformation equations from only two fundamental principles. It is a bit ironic that Poincaré suggested prior to Einstein essentially the same principles, yet he did not accept Einstein's solution.

Einstein's special theory does solve the null results of the Michelson-Morley experiment (by the contraction of distance effect). But so does Michelson's ether drag. The most common complaint against the ether drag was the aberration-of-starlight effect. However, as I have argued earlier, aberration is not automatically ruled out.

The new ether gauge theory is effectively an ether-drag theory. While the ether itself does not move, the density of the ether does flow and it carries the light disturbance pattern with it such that the speed of light is with respect to the gravity field. Thus, the moving density pattern (gravity field) is the preferred reference frame. The ether gauge theory satisfies the Michelson-Morley result simply because the speed of light is isotropic with respect to the preferred frame. Actually, to be more precise, as Michelson himself proved with Gale's assistance in 1925, the earth's rotational velocity should cause an effect on the Michelson-Morley experiment. However, the effect is 10,000 times smaller, since the rotational velocity is about 100 times smaller than the earth's orbital velocity. This very small effect has been too small to observe until very recently.

(4) The Kennedy-Thorndike experiment

Kennedy and Thorndike realized that the Michelson-Morley experiment would not necessarily lead to the same null result if one arm of the interferometer was made much longer than the other. They showed (assuming no ether drag) that a null result would be obtained only if, in addition to length contraction, a simultaneous time dilation were to occur also. A null result was obtained in a suitably modified experiment, and it is cited as further proof of the special theory. Of course, ether drag would also satisfy the experiment, since there is no motion with respect to the preferred ether (gravity field) frame. Again, the small earth rotational velocity should lead to an effect which is below the threshold of measurability.

(5) The Cedarholm-Bland-Havens experiment

With the development of the laser and the use of the Mossbauer effect, much more precise measurements of time and frequency have become possible. This has enabled a number of new experimental methods to be used to measure various effects of motion. One of the earlier experiments was the CBH or Cedarholm-Bland-Havens (1958) experiment.

The experiment, performed at the IBM Watson Laboratory at Columbia University in 1958, involved the comparison of the frequency of two masers whose ammonia molecules travel in opposite directions. Analysis indicates that the effect of an ether velocity would be to cause a differential frequency shift in the maser output proportional to the product of the velocity of the ether times the velocity of the ammonia molecules divided by the speed of light squared. By rotating the entire pair of masers through 180 degrees, the change in the frequency difference of the two masers should be doubled.

When the experiment was performed, a change in frequency slightly greater than one Hertz was detected. This corresponds to an apparent ether velocity of about 1.5 kilometers/second. This velocity is about one-twentieth the velocity of the earth in its orbit and five times the rotational velocity of the earth. The effect was observed to be unchanged as a function of the time of day, so the limit on the effect of the orbital velocity could be reduced even

more to about 30 meters per second maximum. The one-Hertz signal was ascribed to an effect of the earth's magnetic field and ignored.

The experiment agrees with the special theory and can be interpreted as a more accurate version of the Michelson-Morley experiment. It is also in agreement with the ether gauge theory, which predicts a differential velocity effect due only to the earth's rotational velocity. Since the ignored "magnetic" effect was five times greater than the earth's rotational velocity effect, it is clear that such an effect could be embedded within this signal.

(6) Jaseja-Javan-Murray-Townes experiment

The JJMT (Jaseja et al., 1964) experiment is another modern variation of the Michelson- Morley experiment. In this case, two helium-neon masers were mounted with their axes perpendicular on a rotating table. The maser frequency was close to $3x10^{14}$ Hertz. This experiment was almost the same as the CBH experiment, except that in the JJMT experiment the expected frequency shift was proportional to the square of the velocity through the ether.

Again, a relatively large frequency change of 275 kilo-Hertz was measured as the apparatus was rotated. This corresponds to an apparent ether velocity of 25 kilometers/second—not much below the earth's orbital velocity. However, as in the preceding experiment, the effect was observed to be unchanged with time of day and, also as in the preceding experiment, blamed on the magnetic field of the earth. By measuring the change in the value over 24 hours, the orbital effect could be reduced to about the same 30 meters/second effect claimed for the above experiment.

The agreement with the ether gauge theory is also the same as the previous experiment. Obviously, no orbital velocity effect should result considering the earth as the preferred frame; and the 25 kilometer/second signal could easily contain the signal from the earth-spin velocity of about 300 meters/second.

(7) The Brillet and Hall experiment

The Brillet-Hall (1979) experiment is a recent, very precise, Michelson-Morley equivalent test. It was performed in 1979. In the experiment Brillet and Hall claimed a fantastically improved accuracy. The experiment involved the comparison of a stationary ammonia laser with a helium-neon laser which is rotated slowly. The helium-neon laser was servostabilized by a Fabry-Perot interferometer. The servo was designed so that length variations in the Fabry-Perot interferometer cavity were caused to modify the helium-neon laser and, therefore, to affect the measurements. Presumably, any anisotropy of space such that the FitzGerald-Lorentz contraction was not exactly met would cause a frequency difference term. Because any length contraction effects (and even any ether or preferred-frame effects on a laser's frequency) are sinusoidal at twice the frequency of rotation, the desired signal would appear as a sinusoidal signal at twice the rotation rate of the helium-neon laser.

Two signals labeled as spurious were obtained. The first was a signal of about 100 Hertz sinusoidal at the platform-rotation frequency. This signal was blamed on a slightly off-vertical orientation, which allowed a small gravitational force to slightly stretch the interferometer. A second "persistent spurious" signal was found at a sinusoidal frequency of twice the rotation rate of the platform. This 17 Hertz signal corresponded to an equivalent ether-drift rate of 186 meters/second. Like the spurious signals in the previous experiments, this signal did not change as a function of the time of day and so could be excluded from an effect due to the earth's orbital velocity. The orbital-velocity effect, by averaging over many days, was limited to 0.13 Hertz, or about 16 meters/second of ether drift.

How does this experiment agree with the new ether gauge theory? The orbital effect is obviously in agreement, since the new theory says that there is no motion with respect to the preferred frame of reference. However, the earth's rotational velocity at Boulder, where the experiment was performed, is about 355 meters/second. This is almost twice as big as the 17 Hertz signal indicated. While this could be simply labeled as spurious, as Brillet and Hall have done, a more careful analysis is needed.

There are two effects which could lead to the lower velocity value measured in the experiment. The details of the experiment are simply insufficient to determine whether either or both of the effects could contribute. First, there is no indication whether the error term out of the Fabry-Perot interferometer is fed directly back to control the helium-neon laser or whether it is integrated or even partially integrated before being fed back. If the signal is fed back without integration, multiple cycles of signal could be lost in the slack in the control loop. The frequency noise in the one-second cavity stabilized laser is stated to be 20 Hertz. If the error signal is not integrated before being fed to the laser mirror control, the missing 14 Hertz of signal (the rotational velocity corresponds to a 31 Hertz signal) by which the 17 Hertz signal is small could easily be lost in the slack of the error signal, which apparently corresponds to about 20 Hertz.

A second more likely source of signals could reside in the differential lengths of the optical path. The experimenters implicitly assume what they set out to prove, that the velocity of light is the same in all directions. The figure in their paper indicates that the light signal from the laser to the interferometer is not symmetrical in the light path. No dimensions of the light path are given. But, if the light speed is a function of direction and the distances of the path in orthogonal directions are not equal, the number of cycles of signal in transit between the laser and interferometer will change in a cyclic fashion. The integrated number of cycles which correspond to the missing 14 Hertz signal is only about 50 cycles.

If there is an ether drift, the portion of the optical path which is perpendicular to the laser and interferometer axis would give rise to a frequency change sinusoidal at the rotation frequency. This could be the true source of part of the 100 Hertz spurious signal mentioned above. Thus, some of the ether drift signal which is missing in the twice-per-revolution signal could have created an alias in the once-per-revolution signal.

In conclusion, two mechanisms have been offered as possible reasons the "persistent spurious" signal is not as large as it should be according to the gauge theory. By contrast, no explanation was offered at all for the presence of the spurious signal by the experimenters.

(8) The Hughes, Drever, and related experiments

There are a number of recent tests, Hughes et al. (1960), Drever (1961), Prestage et al. (1985) and Lamoneau et al. (1986), which rely on measurements of the relative energy radiated during nuclear state transitions. In these tests, extremely minute limits on any ether drift due to either the sun's galactic motion or the earth's orbital motion have been achieved. However, in each case laboratory magnetic fields were used to hold the atoms stationary with respect to the laboratory. Thus, any effects due to earth's rotational velocity would be constant and undetectable in the experiments. The tests are, therefore, in complete agreement with both the special theory and the new ether gauge theory.

(9) The Krisher et al. one-way speed-of-light experiment

Krisher et al. (1988), (1989), (1990) have conducted one-way speed-of-light experiments using two of NASA's Deep Space Network (DSN) tracking stations separated by 21 kilometers. The east/west separation is only 10 kilometers. Hydrogen maser clocks at each station were sent via a 29 kilometer ultra-stable fiberoptics cable to the other station, where the difference in phase was measured. The rotation of the earth causes the station-separation vector to rotate with respect to the earth's orbital velocity and with respect to the galactic velocity. The difference in the phase differences at the two sites should exhibit a 24-hour periodicity if the orbital velocity of the earth or the galactic velocity affect the propagation speed of the light. The measurements showed that the speed of light was isotropic to about one part in 10^6. Thus, this experiment, using the one-way speed of light, agrees with the Michelson-Morley experiment. The earth's orbital velocity does not affect the speed of light on the earth.

What about earth's spin velocity? Since the orientation of the DSN tracking stations does not change with respect to the earth's spin velocity, no cyclical effect is expected. Instead, a bias in time of about 70 picoseconds or about 8 degrees of phase in the difference of the phase differences is expected according to the new ether gauge theory. It is very questionable whether such a small bias could be detected. Krisher et al. did not attempt to detect any biases in the phase. Thus, the experiment is in complete agreement with the new ether gauge theory, as well as the special theory.

Other Special Theory Experiments

In this section a number of experimental phenomena are addressed which do not fit neatly into any of the previous categories. However, each has been cited as evidence for the special theory.

(1) Thomas precession

The Thomas precession was first explained by Thomas in 1926. It explains the otherwise puzzling details of the spectroscopic splitting of atomic radiation under a magnetic field. In order to explain the Zeeman effect, the g-factor of the electron was assumed to be equal to 2. But this caused a problem with the fine structure, since it caused the spin-orbit interaction to be a factor of 2 too large. The Thomas precession neatly resolved the spin-orbit interaction by cutting the effect in half.

The Thomas precession has already been considered at some length in Chapter 6. It is clearly and simply explained by the special theory (although Mocanu (1991) has shown that severe inconsistencies arise when the successive Lorentz "boosts" are not collinear). In the only alternative derivation of which I am aware, the new ether gauge theory also explains the effect clearly and simply (and no problems arise with non-collinear velocities). But the mechanism is completely different from that of the special theory.

(2) The Trouton-Noble experiment

The Trouton-Noble experiment could have been included in the ether-drift experiments in the preceding section as far as the special theory is concerned. However, it is different as far as the new ether gauge theory is concerned. There are those who question the special theory and yet accept the Lorentz transformation for electromagnetic phenomena.

The Trouton-Noble experiment is an attempt to directly detect the effect of FitzGerald contraction on a moving electron. Such a contraction, according to the Lorentz transformation, causes the electrostatic force between electrons to be described by a vector which does not necessarily pass through the center of the electron. Thus, it should give rise to a torque on the electron. A charged capacitor should then experience a torque which tends to align its electrostatic field with the direction of motion through the ether.

Trouton and Noble attempted to detect the above torque by suspending a charged capacitor on a very fine torsion wire. No torque was detected.

It is claimed that the special theory explains the null result, but it is certainly a tortured explanation. Even those who reject the special theory but still accept the validity of the Lorentz transformation should expect a torque to arise due to the earth's rotational velocity. Hayden (1990a) has recently attempted to make torque measurements precise enough to detect any velocity effects from earth rotation, if there are any. He asks for predictions on the results. The new ether gauge theory prediction is clear. While there are apparent velocity expansion effects (and from an inverse view contraction effects), they are isotropic as far as the speed of light is concerned. Thus, the clear prediction is that more precise versions of the Trouton-Noble experiment will still yield null results. Hayden himself apparently expected to detect an effect (Pool, 1990).

(3) Synchrotron radiation

The Lorentz transformation is called upon to explain the very short wavelengths obtained in synchrotron radiation or free electron lasers. Jackson (1987, 40-41) gives a brief description of the phenomenon. A more lengthy explanation is given by Winick (1987). The radiation is caused when high-speed electrons are caused to deflect transverse to their high velocity by closely spaced "wiggler" magnets.

While the special theory and the Lorentz transformation can be used to explain the effect, one is left, of course, with the nagging question: "Why is it the electron sees the laboratory lengths contracted and not vice versa?" Furthermore, one *must* transform to the electron's frame in order to compute the wavelengths. Why? In fact, a mental Galilean transformation is then used to map the results back into the laboratory frame.

The new gauge theory gives the same (or very close to the same) effects, and there is no possible ambiguity. In addition, the wavelength can be computed using either coordinate frame. The laboratory-frame computation is actually simpler. The computation of the wavelength of the energy radiated in the forward direction is given for both reference frames below.

In the laboratory frame, the frequency of the radiation is given by:

$$f = v/d \tag{9.20}$$

where: f is the frequency
v is the velocity of the electron
d is the spacing between the magnetic poles of the same polarity

In the new ether gauge theory, the velocity of light with respect to the electron in the forward direction is given by (c-v). Therefore, the wavelength is given by:

$$\lambda = \frac{(c-v)}{f} = \frac{(c-v)d}{v} = \frac{d}{\gamma^2\beta(1+\beta)} \tag{9.21}$$

where: γ and β are the now familiar definitions

For the very high velocities of the synchrotron, β, is very close to one and equation (9.21) simplifies to:

$$\lambda = \frac{d}{2\gamma^2} \tag{9.22}$$

But equation (9.22) is the same value which Jackson gives for radiation in the forward direction. The only differences in these equations for the electron's frame using the new ether gauge theory are that the frequency in equation (9.20) is increased by γ. This causes the wavelength to decrease by $(1/\gamma)$ in the electron's rest frame. When this is mapped back to the laboratory frame (by multiplying by γ), the same final answer is obtained.

The new ether theory can explain the same consistent result while using either frame of reference. The same cannot be said of the special theory.

Since the ether gauge theory results in transformations which are reciprocal, one can obtain no advantage by transforming to an alternate frame, working the problem, and then transforming back again. In the ether gauge theory, any advantage one might obtain in a new frame is yielded back again when one returns to the original frame. Isn't that what is really desired of a coordinate frame? Why should a coordinate frame affect the physics?

(4) Positron channeling radiation

Jackson (1987, 41-42) also describes channeling radiation, which occurs when a positron is caused to pass through a crystal in a direction parallel to

two planes of crystal atoms. Sorensen and Uggerhoj (1989) give a more detailed description of the channeling radiation. The frequency is again higher than one obtains by directly considering the laboratory-frame forces. The special theory solves the problem by transforming to the positron frame.

Jackson shows that, after the Lorentz transformation is applied, the positron sees a force of repulsion from the crystal atoms that is γ times as large as in the laboratory frame. Again, one wonders why one *must* use the positron-reference frame to get the correct result.

The new theory gives the same result simply and directly. There is no reason to transform to the positron frame. Since in the new ether gauge theory the transformations are reciprocal, any change one gets from the transformation is simply undone when one transforms back. The new gauge theory says that the force (as was detailed in Chapter 5) results from an increase in the charge with velocity. The potential of the atoms in the crystal is not affected by the positron's velocity, but the positron's potential is. The positron standing wave becomes larger. This causes the potential of the positron in the laboratory scale to be increased by γ. This gives the same result that Jackson was able to obtain by the Lorentz transformation manipulation. Note that this effect is directly analogous to the Edwards effect, which was discussed in Chapter 5.

Conclusion

A wide variety of experiments has been considered in this chapter. These experiments are normally called upon to support the special theory. It has been shown that these same experiments can be explained by the new gauge theory. In fact, overall, the new theory explains the data more easily and without the shenanigans often required using the special theory.

10

THE IMPOSSIBLE AND THE DIFFICULT

Not So Evident Evidence

In this chapter those experiments which are in conflict with either the new gauge theory and/or the special theory are addressed. In the first section, those experiments which, I believe, are faulty are considered. In the second section, those experiments which cannot be adequately explained by the special theory but are explained by the new ether gauge theory are considered.

The Impossible

At one point, I had hoped that this section could be a blank page. No such luck. I have become aware of two experiments which are in direct conflict with the new theory. These two experiments are also in conflict with the special theory. I believe the two experiments are faulty. In any case, they do not favor the special theory over the ether gauge theory.

(1) The Silvertooth experiment

Silvertooth claims to have measured the one-way velocity of light and to have found that it is affected by the galactic velocity of the sun. This claim is clearly at odds with both the special theory and the new ether gauge theory.

The Silvertooth (Wesley, 1987b) experiment used a standing-wave interferometric method to obtain the result. Marinov (1987) claimed to have duplicated the Silvertooth results. According to Wesley (1990b), however,

others were unable to duplicate the results; and Marinov subsequently indicated he had erred in his verification.

There is abundant evidence which shows the one-way velocity of light is not affected by either the galactic velocity of the sun or the orbital velocity of the earth. I work daily with data collected from the Global Positioning System (GPS). In the GPS, the one-way velocity of light is used to measure ranges from the satellites to receivers on the ground. Very precise positions can be computed. The signals are clearly not affected by the galactic or orbital velocities.

(2) The Marinov experiment

The Marinov (Wesley, 1987a) experiment used spinning disks with holes to measure the one-way velocity of light. Marinov also claimed to have detected the galactic velocity of the sun. To the best of my knowledge, no one else has attempted to duplicate his experiment. I cannot fault anyone for not attempting. It would be a waste of time. As stated above, there is no lack of evidence from a multitude of sources which show that the one-way velocity of light is not affected by either the galactic velocity of the sun or the orbital velocity of the earth. The Global Positioning System is a prime source of data which contradicts Marinov's claim.

GPS also rules out other unusual theories of light speed which have been proposed to explain the Michelson-Morley experiment. For example, Wesley (1987c) claims there is a difference in the phase velocity of light and the energy velocity of light. GPS clearly contradicts his claim. The GPS satellites send radio signals which are modulated by a pseudorandom sequence which allows a measurement of the transit time from satellite to ground to be determined. The modulation or group (energy) velocity differs only slightly from the phase velocity. The difference in the two velocities is caused by the ionosphere and can be corrected by transmitting two different frequencies from the satellite. The two frequencies allow the computation of the precise difference in the velocity of the modulation and the velocity of the phase. The modulation velocity is clearly not affected by the galactic velocity of the sun. Wesley's hypothesis is clearly proved false.

The Difficult

In this section, I consider those experiments which are unusually difficult (or impossible) to explain using the special theory but can be explained relatively easily by the new ether gauge theory. The Mossbauer experiments are considered here for the first time. The Sagnac and Edwards effects have been encountered previously. The Jupiter decametric radiation, the lunar effect on the earth's magnetic field, the Venus radar data, and the Pioneer 10 experiment are also considered for the first time.

(1) Spinning disk, Mossbauer effect experiments

There have been a number of spinning disk experiments performed which employed the Mossbauer effect in the emission and absorption of gamma rays. These experiments have been widely cited as supporting the special theory. Yet, when the data is analyzed carefully, it actually contradicts the special theory and supports the ether gauge theory. The argument presented here is largely the same as that put forward by Hayden (1991).

Ruderfer (1960) appears to be the first to explicitly conceive of gamma ray experiments using the Mossbauer effect to contrast the special theory predictions with predictions of other theories which postulate an ether drift. He contrasts his proposed experiment with the earlier Hay et al. (1960) experiment by noting the importance of the angular position of the detector relative to any ether-drift velocity. Hay et al. were simply looking for a time dilation effect due to the second-order effect of the spin velocity. They did not expect or look for an ether-drift effect.

Ruderfer predicts a first-order effect in the rotational velocity proportional to the dot product of the ether-drift velocity and the rotational velocity of the source and/or absorber. Thus, he expected an ether drift to cause the measurements to be a function of the relative direction of the spin velocity and the ether-drift velocity. (The ether-drift velocity is taken to be the reverse of the velocity of the entire experiment relative to the ether.) The mechanism of the effect is the variation in the time it takes for the gamma ray to move from the source to the absorber. (Subsequently, I will refer to the effect as the "transit time" effect.) The cyclic time variation is caused by the anisotropic relative velocity of light in the presence of an ether drift. The cyclic variation in the time of propagation results in a cyclic variation in the phase as received at the absorber. But the time derivative of the phase variation gives the frequency variation. The resultant frequency variation is given by:

$$\frac{\Delta f}{f} = -\frac{(u \cdot v)}{c^2} = -\beta_u \cdot \beta_v \tag{10.1}$$

where: u is the velocity of the absorber relative to the source
v is the ether-drift velocity
β_u is the absorber/source velocity divided by the speed of light magnitude
β_v is the ether-drift velocity divided by the speed of light magnitude

In the above equation, the velocity of the gamma ray absorber relative to the gamma ray source was used, so that all of the experimental variations are covered. The equation in this form applies when the absorber is at the center of the disk and the source is at the edge, or vice versa. It also applies if both source and absorber are at the edge, 180 degrees apart. Figure 10.1 shows one experimental variation where the source is located at the edge and the absorber is located near the center of the disk.

Champeney, Isaak and Khan (1963) implemented an experiment along the lines indicated by Ruderfer. The CIK experiment is widely cited as supporting the special theory. Let's describe the experiment in more detail before analyzing it. A cobalt, Co^{57}, source of 14.4 keV gamma rays, was attached to one side of a spinning rotor. An iron, Fe^{57}, absorber was attached to an opposite symmetrical point on the rotor. The characteristics of the absorber can be seen in Figure 10.2, which describes the relative absorption of gamma rays versus the proportional frequency offset of the gamma rays provided by the source. The relationship is similar to an upside-down normal (gaussian) distribution

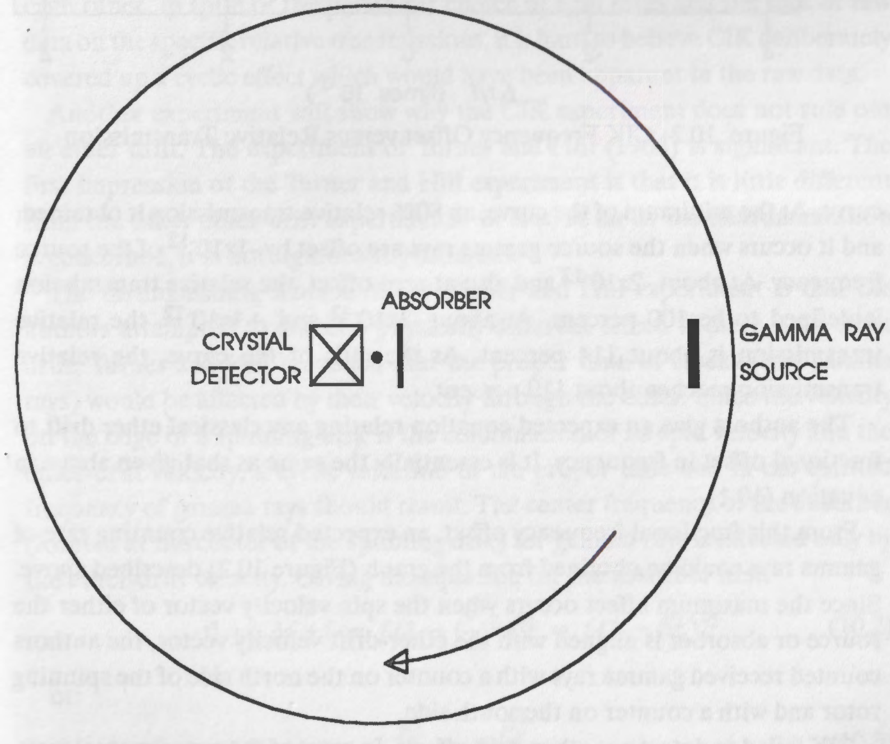


Figure 10.1 Typical Rotating Mossbauer Experiment

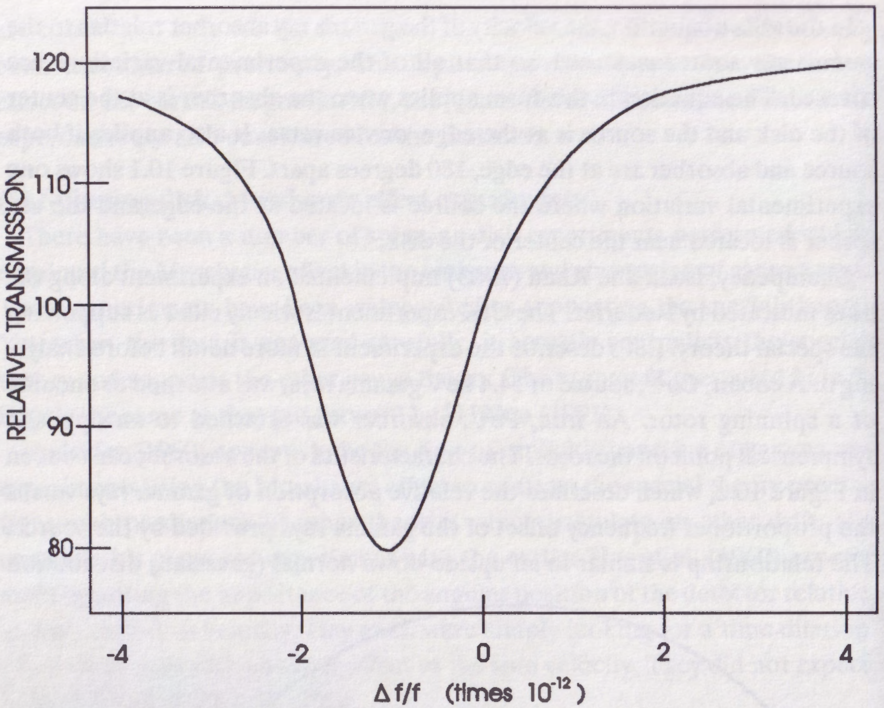


Figure 10.2 CIK Frequency Offset versus Relative Transmission

curve. At the minimum of the curve, an 80% relative transmission is obtained; and it occurs when the source gamma rays are offset by -1x10^{-12} of the source frequency. At about -2x10^{-12} and also at zero offset, the relative transmission is defined to be 100 percent. At about -3x10^{-12} and +1x10^{-12}, the relative transmission is about 114 percent. At the tails of the curve, the relative transmission reaches about 119 percent.

The authors give an expected equation relating any classical ether drift to fractional offset in frequency. It is essentially the same as that given above in equation (10.1).

From this fractional frequency offset, an expected relative counting rate of gamma rays could be obtained from the graph (Figure 10.2) described above. Since the maximum effect occurs when the spin velocity vector of either the source or absorber is aligned with the ether-drift velocity vector, the authors counted received gamma rays with a counter on the north side of the spinning rotor and with a counter on the south side.

CIK failed to detect any ether-drift effects. In most of the experimental tests, the primary emphasis was on detecting ether-drift velocities due either to the

solar galactic velocity or the earth's orbital velocity. However, the experiments are sensitive enough that even earth-spin effects should theoretically be detectable. According to the ether gauge theory, only the earth's spin velocity creates an effective ether drift. Since no ether drift was detected, it would appear, at first blush, that the special theory is right and the ether gauge theory wrong. Not so!

The CIK results are not as conclusive as one would like. CIK took measurements at two different spin rates. At each spin rate they took the ratio of the north relative transmission to the south relative transmission. Each of these measurements would presumably show an ether drift if one existed. However, CIK did not report these measurements. Instead, as the final measurement of interest, a further ratio was computed from the ratio obtained at a slow spin rate to the ratio obtained at a high spin rate. But, according to my analysis, the specific spin rates chosen by CIK are such that, for the earth-spin velocity at their laboratory, the final ratio of a ratio measure would not detect the ether drift. Instead, the ratio obtained at each of the two spin rates would counteract each other. In spite of the particular choice of spin rates and the lack of raw data on the specific relative transmissions, it is hard to believe CIK deliberately covered up a cyclic effect which would have been apparent in the raw data.

Another experiment will show why the CIK experiment does not rule out an ether drift. The experiment of Turner and Hill (1964) is significant. The first impression of the Turner and Hill experiment is that it is little different from the other ether-drift experiments. In fact, as far as the instrumentation is concerned, it is not significantly different.

The distinguishing feature of the Turner and Hill experiment is that the authors attempted to detect a physically different effect. If there is an ether drift, Turner and Hill reasoned that the proper time of clocks (and gamma rays) would be affected by their velocity through the ether. Since the velocity on the edge of a spinning disk is the combination of its spin velocity and the ether-drift velocity, a cyclic variation in the proper time and in the emitted frequency of gamma rays should result. The center frequency of the absorber (located at the center of the spinning disk) for gamma rays is affected only by the ether-drift velocity. Giving the equation for the absorber first:

$$f' = \Delta f + f = f\left(1 - \left(\frac{v}{c}\right)^2\right)^{1/2} = f\left(1 - \beta_v^2\right)^{1/2} \qquad (10.2)$$

or:

$$\frac{\Delta f}{f} \approx -\frac{\beta_v^2}{2} \qquad (10.3)$$

For the source of the gamma rays, the spin of the disk must be considered as well as the ether-drift velocity. The frequency of the source gamma rays is given by:

$$f' = \Delta f + f = f(1 - (v - u) \cdot (v - u)/c^2)^{1/2} \tag{10.4}$$

The combined velocity of interest is the difference between the two velocities rather than the sum, because of the definition of the ether-drift velocity above. The combined velocity is the total velocity with respect to the isotropic speed-of-light frame. In the case of the ether gauge theory, the gravity field defines that frame. Simplifying equation (10.4) above gives:

$$\frac{\Delta f}{f} = -\frac{\beta_v^2}{2} + \beta_v \cdot \beta_u - \frac{\beta_u^2}{2} \tag{10.5}$$

The effect of the first term in this equation of the source frequency is canceled by the ether-drift effect on the absorber given by equation (10.3). The second term gives a first-order cyclic effect in the spin velocity, and the last term gives a constant second-order effect in the spin velocity. (The last term is also canceled if the absorber is also at the edge of the spinning disk.) I will refer to the combined effect as the "proper time" effect, even though in the ether gauge theory it is a clock effect, not an intrinsic time effect.

Like the other ether drift experiments, Turner and Hill did not detect any first-order cyclic effects. They conclude that no significant ether drift is present. Also, like the others, they concentrate on showing that no galactic or earth orbital effects are present.

The observant reader will have noted that the transit time mechanism, first proposed by Ruderfer, is distinctly different from the proper time mechanism. Furthermore, the transit time effect, given in equation (10.1) is opposite in sign but identical in magnitude with the second term of equation (10.5), which arises from the proper time effect.

The obvious conclusion is that both mechanisms are valid and that the two first-order cyclic effects cancel each other.

In fact, Ruderfer (1961) published an erratum to his first paper. In that erratum he described the proper time effect and indicated that it would cancel the transit time effect—at least for the specific variation of the FitzGerald-Lorentz contraction theory which he was considering. Yet Champeney, Isaak and Khan (CIK) cited the Ruderfer erratum in their references but ignored the proper time effect. In another example, Jackson (1975, 645) describes the transit time effect but does not mention the proper time effect. It seems to be acceptable to ignore effects in order to prove that no ether drift exists.

Ruderfer's conclusion in his erratum was that the results (no first-order cyclic effect) were consistent with both the special theory and the ether theory. Because the two effects cancel, it is clear that the experimental data does agree with the ether gauge theory. But, unlike Ruderfer, I believe the experimental data disagrees with the special theory. Why?

I will present two arguments which will show that the special theory requires that the time dilation of the source gamma rays be described by equation (10.5), just as the ether gauge theory does. But, since the special theory does not allow an ether drift, the first-order cyclic variation of frequency given in equation (10.5) is not canceled by a counteracting transit time correction from equation (10.3). Since the experimental data does not demonstrate a first-order cyclic effect, it follows that the special theory must be incorrect.

The argument that the Mossbauer experiments are explained by the special theory depends on the observer being located at the center of the spinning disk. The alternative argument from the general theory and the equivalence principle depends on the "pseudopotential," i.e. the centripetal acceleration is used to map the spin velocity (around the center of the disk) into an equivalent gravitational potential.

The first argument which shows that the special theory must yield the same time dilation effect as the ether gauge theory depends upon the choice of frame. In Chapter 4, it was argued that one does not have free choice of observer frame. And there is direct experimental evidence that clock rates on the surface of the earth fit the special theory only if the observer frame is chosen as the earth-centered inertial (earth's gravity field) frame.

Hafele and Keating (1972a and 1972b) claimed that their around-the-world clock experiments had convincingly put the twin paradox to bed. While I claimed in Chapter 1 that their experimental data proved no such thing, their experiment was still significant. It convincingly showed that the proper time of clocks on the surface of the earth agrees with the special theory only if the observer is assumed (contrary to the actual facts) to be in the earth-centered inertial frame. This observer frame is the only frame which is consistent with the observations, in spite of the fact that each clock was actually observed in its own moving frame. Thus, clocks which move westward on the surface of the earth run faster than clocks which move eastward with the same surface velocity. The earth-centered inertial frame is the only frame which can be chosen so that the Hafele and Keating experimental data agrees with the special theory.

The clocks at the ground tracking stations of the Global Positioning System (GPS) also show that an earth-centered observer frame is required for agreement with the special theory. The general theory requires that clocks run faster as the gravitational potential is increased. But the spin of the earth causes a centrifugal force which distorts the spherical shape of the earth and raises the gravitational potential of positions near the equator. Thus, the spin of the earth by distorting the shape causes clocks to run faster per the general theory. But, in spite of this general theory effect, the observed behavior of clocks is that all clocks at mean sea level run at the same rate. The only way that this observed clock behavior can be reconciled with the special theory is that the spin velocity of the earth causes clocks to run slower—exactly counteracting the general theory effect. But, only if the observer frame is chosen to be the earth-centered inertial frame, do the two effects cancel, in conformity with observed clock behavior.

It is unreasonable to assume that gamma ray clocks do not behave similar to the macroscopic clocks involved in the above experiments. Thus, the clocks in the Mossbauer experiments should also behave as if the observer is located at the center of the earth. But the special theory, in an earth-centered inertial frame, combines the earth-spin velocity with the disk-spin velocity, so that the proper time effects are as given in equation (10.5). Thus, according to the special theory, a cyclic effect should be observed—contrary to the experimental evidence.

It is often claimed that the Mossbauer experiments can be explained on the basis of the "pseudopotential." But this proof also depends on an implicit choice of frame. As was argued in Chapter 2, the equivalence principle implicitly requires that velocities employed in the special theory be with respect to the gravity field. The integrated centripetal acceleration is always equivalent to the integrated gravitational acceleration only if the velocities are always measured with respect to the gravity field. The integrated centripetal acceleration has an indeterminate constant of integration associated with the velocity of the center of rotation. Clearly, different constants of integration yield different results. And, as was shown in Chapter 2, the experimental evidence indicates that only if the velocity is measured with respect to the gravity field will the equivalence principle hold.

The proper application of a "pseudopotential" thus leads to the same prediction. Specifically, a clock on the edge of the spinning disk which is located on a spinning earth will exhibit a cyclical rate per equation (10.5). The absence of such an effect in the observational data indicates that the special theory is wrong. However, in the new ether gauge theory, the transit time effect of equation (10.1) cancels the proper time effect and gives results which agree with the observational data.

(2) Jupiter decametric radiation

In Chapter 7, it was mentioned that the Maxwell electromagnetic equations would have terms related to the time rate of change of gravitational and kinetic fields. Such added terms could explain how unusual electromagnetic effects can arise in large-scale gravitokinetic interactions. It is clear from a cursory consideration of planetary gravitokinetic interactions that electromagnetic phenomena will be induced. The compaction of ether in front of a moving mass is equivalent to the development of a positive charge (inward moving compression) in front of the mass. Similarly, a negative charge will be induced in the rear where the ether is expanding. Perhaps even more significant is that the differential change in the kinetic lines of force which occur in three-body interactions can induce magnetic monopole effects.

A prime example of electromagnetic phenomena which appear to arise from large-scale gravitokinetic effects is the unexplained electrical discharge between Jupiter and its satellite Io. A gigantic discharge of electricity between Jupiter and Io was photographed by the Voyager flyby of Jupiter (Moore, Patrick and Hunt, 1983) in 1979. The induced charges mentioned above, together with the changing kinetic lines of force, seem to offer a likely mechanism for explaining the effect. If such is the case, rather than a constant loop of electric current, as some have supposed, it is more likely that the current is a function of where Io is in relationship to Jupiter and the sun. The electrostatic potential would appear to be greatest when Io is directly in front or directly behind Jupiter in its orbit. In addition, if it is the induced magnetic monopole which causes the current to flow in the loop out of the orbital plane, it is probably not a loop of current; but, instead, the current probably flows in the same direction (outward or inward) in both halves of the loop.

The above hypothesis is strongly supported by the intermittent decameter radiation from Jupiter (Douglas, 1964), which is probably stimulated by the electric discharge between Jupiter and Io. Bigg (1964) has shown that the decameter radiation is very directional and is correlated with both Io's orbital position around Jupiter and the surface longitude of Jupiter. In addition, he shows that the characteristic radiation frequency patterns are reversed, depending on whether Io is ahead of Jupiter (in Jupiter's orbit around the sun) or behind.

The Jupiter-Io phenomenon lends some credence to, and the new ether theory suggests, a mechanism for some of the interplanetary phenomena which Velikovski claimed to find buried in earth history. It suggests that, perhaps, the magnetic reversals on the earth may have been stimulated by interplanetary bodies of some sort. The lunar effect on the earth's magnetic field is further evidence of the same sort.

(3) Lunar-induced magnetic variations in the earth's field

A second, more mundane example of possible gravitokinetic-induced electromagnetic phenomena is the variation in the magnetic field of the earth as a function of lunar position. I have found no explanation of the effect which does not have serious conceptual problems. Tidal effects are the most commonly suggested explanation (Merrill and McElhinny, 1983). It is claimed that the lunar gravitational tides are similar to the solar-induced thermal tide in inducing the magnetic variations by causing horizontal air currents in the ionosphere which induce electric currents because of the presence of the magnetic field. These induced currents are then held to be the source of the added solar and lunar effects.

The explanation has some merit as an explanation of the solar-induced effects. The induced-current loops which are called upon to give the required magnetic intensity are at a maximum where the horizontal flow of the atmosphere might be expected to be at a maximum. But, as an explanation of the lunar effect, it is highly unlikely. The magnetic effects induced by the moon have a 12-hour cycle (Matsushita and Maeda, 1965) rather than the solar 24-hour cycle. Furthermore, the lunar effect is at a minimum at lunar noon, while the solar effect is at a maximum at solar noon.

I believe a more logical explanation of the lunar effect is that it arises from a small kinetic field which results from the earth's motion through the lunar component of the gravity field (rotation of the earth-moon system around the combined center of mass). This would give rise to a maximum lunar-induced kinetic field of one polarity at lunar noon and a maximum of the opposite polarity at lunar midnight. The rotation of the earth would cause the laboratory observer to see a changing kinetic field which cannot be distinguished from a magnetic field. The nulls at lunar noon and lunar midnight would be caused by the rate of change of the kinetic field becoming zero at the extremum of the induced kinetic field. The null at lunar midnight would be much broader because the center of mass of the earth-moon system is biased a substantial portion of an earth radius toward the moon and away from the center of spin (mass) of the earth. The model fits the data. It lends support to the link between the gravitational and the electromagnetic phenomena described in Chapter 3.

(4) The Sagnac effect

The Sagnac effect was already considered in some detail in Chapter 6. In that chapter, the incompatibility of the Sagnac effect with the Thomas precession effect was considered at length. At this point, a review, together with a brief look at specific experiments, is presented.

The original Sagnac experiment was performed in 1913. The experiment was similar in many ways to the Michelson-Morley experiment. Sagnac, after separating a monochromatic source into two beams, sent them around an enclosed area in opposite directions before recombining them into a single beam to look for interference effects. He found that, when the entire experiment was rotated, a fringe shift took place which was a function of the enclosed area and of the speed of rotation.

As indicated in Chapter 6, the simplest explanation is that the velocity of light is dependent on the medium (ether) and is not affected by the mechanical rotation of the experimental apparatus. But such an explanation is at odds with the special theory.

Several more recent Sagnac experiments are described by Ashby and Allan (1979). These experiments included, among others, the Hafele and Keating experiment referred to in Chapter 1, the Vessot gravitational redshift rocket probe (also known as Gravity Probe A), and a 1977 U.S. Naval Observatory portable-clock experiment. While not specifically pointing out that it is a Sagnac effect, Ashby and Allan state:

> It is probably worth restating at this point that the size of the correction due to earth rotation which is required to generate coordinate time for a clock returning to its point of departure is proportional to the projection on the equatorial plane of the circumnavigated area, using the usual geocentric coordinate. The proportionality coefficient is 1.6227×10^{-6} ns/km, and the sign of the correction is positive (negative) when the area is circumscribed clockwise (counterclockwise) as viewed from the south pole.

The final Sagnac experiment to be considered was described by Allan and Ashby, together with eleven other authors (Allan et al., 1985). The experiment involved the around-the-world transfer of time via the GPS satellites. The time-transfer method involves the use of a satellite in common view whose one-way transit signal time to each ground station is measured. This measured one-way time is differenced with the theoretical transit time to obtain a residual at each ground site. The difference in the residuals is treated as a direct measure of the difference in the respective clocks. (The differencing of common-view data causes many error sources to be canceled or greatly diminished.) The following quote describes the results of the experiment:

> The total magnitude of the Sagnac correction varies from about 230 to 350 ns depending upon which satellites are employed. Since the Sagnac effect is accounted for in the software of each receiver the residuals should add to zero. The frequency residuals are about an order of magnitude better than the clocks involved. The net result of the experiment is that we have validated the around-the-world Sagnac effect with an uncertainty which is about 2 percent of the total effect.

I have ignored the everyday use of the Sagnac effect in modern gyrocompass instruments. The concentration on global examples of the Sagnac effect is intended to leave no doubt that such an effect is real and needs to be considered in laboratory-based instruments. Thus, it is quite puzzling that many of the experiments in the preceding chapter mentioned "spurious signals" associated with ether-drift signals. The Sagnac effect clearly applies to speed-of-light effects and clock effects on a rotating earth. The effects are straightforward and understandable even in the special theory, if the reference frame is the earth-centered non-rotating frame.

The Sagnac effect in a laboratory-based rotating frame is equivalent to modifying the speed of light with an ether drift. Thus, the Sagnac effect modifies the special theory so that it agrees with the new ether gauge theory. The problem with the Sagnac effect is that, if it is valid, it ought equally well to apply to the earth's orbital motion. But applying it to orbital motion leads to a contradiction with the Michelson-Morley experiment and all its modern verifications. The ether gauge theory, by contrast, agrees with the Michelson-Morley type experiments, because they are not moving in the preferred frame.

(5) The Michelson-Gale Experiment

The Michelson-Gale experiment (1925) is actually nothing more than a grandiose Sagnac experiment which uses the earth rotation itself as the rotating platform. However, it is significant in that it shows the effect extends to the scale of the earth. It is significant to the ether gauge theory in that it shows that the gravity field does not rotate with the earth.

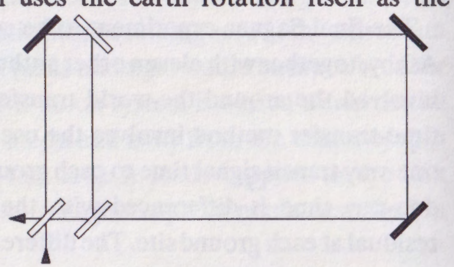


Figure 10.3
Michelson-Gale Experiment

Figure 10.3 is a schematic of the Michelson-Gale experiment. The fully-silvered mirrors are shown as solid objects, while the half-silvered mirrors are shown as open objects. The short light path was constructed as a calibration loop (the rotation could not be stopped to measure the difference). The size of the loop was approximately 340 by 610 meters. The entire light path was enclosed in 30 centimeter diameter water pipe which was evacuated so that air currents would not disturb the experiment.

A fringe shift of 0.3 wavelength was measured, which was within a few percent of the expected value computed via the Sagnac effect using the earth's rotation rate. The result is generally considered to be consistent with the special theory of relativity because it is simply another manifestation of the Sagnac effect. But, since the special theory cannot give a coherent explanation of the Sagnac effect, it cannot explain the Michelson-Gale experiment. The new ether gauge theory explains the effect by noting that the earth's gravity field does not rotate with the earth.

(6) The Edwards effect

The Edwards effect was considered at the end of Chapter 5. It is briefly reviewed because it is in the same category as the other experiments contained in this section. Specifically, the special theory and classical electromagnetic theory offer no explanation of the phenomenon. On the other hand, the new ether gauge theory offers a simple and clear explanation.

The Edwards effect can be explained as the increase of charge with velocity, as expected in the new theory. Edwards, Kenyon and Lemon (1976) studied the anomalous negative potential which developed outside a superconductor as a result of an electric current through the conductor. They found that the potential varied proportional to the square of the current. They ran a wide variety of tests to show that the anomalous effect could not be explained by any known mechanism. They state in their conclusions:

> None of the proposed explanations are in reasonable agreement with the observed signal in any of the experimental variations. For every experimental variation the magnitudes of every proposed effect is too low. In addition, the functional relationships with current and other parameters are wrong in most cases. ...
>
> The intent of the experiments has been to check Maxwell's equations for I^2 electric-field effects in the experimental situation where the circuit is at rest and the charge-carrier speed is constant. The expected field is zero. Yet, the results of all experiments indicate a non-zero field with an I^2 dependence. ... No other function appears to agree with the observations.

It is clear that classical electrodynamics and the special theory have no explanation for the Edwards effect. On the other hand, the explanation of the new ether gauge theory is simple and straightforward.

(7) The Venus radar data

The first material which I encountered that suggested there might be a problem with the Venus radar data was a brief report by Wallace (1990) in *Galilean Electrodynamics*. As a result of that report, I obtained some of the referenced material and investigated some of Wallace's claims.

While there is indeed some evidence of systematic problems, I do not believe that Wallace's (1969) proposed solution is an improvement. He claims that the solution is the emission theory of light—that its velocity is given by the sum of the normal speed of light and the velocity of the source. As far as I am concerned, there is ample evidence that such is not the case. The GPS system and its use of one-way range measurements has already been cited as evidence against any unusual light-velocity theories.

But it is clear that, in the early radar data of Venus, there were systematic error sources. One of these was the presence of a large 30-day variation in the ranges that corresponded to the phase of the moon (Pettengill et al., 1962). Data collected following the first batch of data showed only about one-sixth as large an effect. A study (Ash, Shipiro and Smith, 1967) combining radar and optical data into a least-squares analysis showed that the smaller effect could be accounted for "mostly" by a smaller lunar-to-earth mass ratio than had been used in the first analysis.

Still, even after adjustments in the processing, strange systematic effects seemed to remain. Perhaps most significant was the unusually large and systematic negative residuals from the USSR radar data compared to the Lincoln Laboratory and Arecibo data. The authors of the report state:

> This incompatibility cannot be removed by assuming simply that different units of time were used by the different observatories. The apparent discrepancy of up to five times the quoted measurement error thus remains unexplained.

Two other evidences of systematic problems exist. First, a quantitative goodness-of-fit was assigned to two separately constructed solutions to the data, one with the Einstein relativity assumptions and one with Newtonian assumptions. The goodness-of-fit value would be hard pressed to pick one solution over the other. Second, a projection of the solution forward by four

to six weeks was compared with later measurements not included in the analysis. The residuals for these later measurements were clearly excessive.

How would the data agree with the new gauge theory? Without actually performing an extensive least-squares analysis on a par with the original study, no conclusive answer can be given. However, there is evidence that the results would be improved.

In Chapter 3, it was argued that the kinetic-field effect cannot arise unless a compression of the ether in front and an expansion of the ether behind a moving mass occurs. This was illustrated in Figure 3.2. This first-order distortion of the ether density with velocity is counteracted by the first-order effect of the relative velocity of the speed of light. However, distance measurements, as well as aberration effects, will still remain as first-order effects. The aberration of light is enhanced by this longitudinal compression and expansion with velocity. The distance effects should show up without attenuation in the radar measurements.

As the earth rotates around the earth-moon center of mass, a first-order velocity effect on the measured distance would arise due to the ether distortion with velocity. This varying path distance would obviously be phased with the moon's position. But such an effect would be small, and it is hard to believe it would not alias easily into the value obtained for the earth-moon mass ratio. A similar small diurnal effect would also be present.

The systematic residuals of the USSR station look like they could qualitatively be explained by the new ether gauge theory. Any distances measured through the expanded or contracted portions of the ether will be modified because they must traverse more or less ether. Even though the transverse distances would not be modified, any component of longitudinal velocity would traverse more ether in the direction of its velocity through the ether and would traverse less ether in the direction opposite its velocity through the ether. It is this last effect which could explain the negative residuals of the USSR data compared to the US data. The USSR station, when observing Venus at the same time as the US, is always farther ahead of the US station in the earth's orbit. It, therefore, looks through an ether which is compressed somewhat more than the ether through which the US station looks. Since the residuals are computed as the observed minus the measured, the residuals of the USSR observations will be more negative because of the longer ranges measured.

In summary, while a convincing case cannot be made on the basis of a quick analysis, the data definitely suggest that the new ether theory might very well agree with the Venus data better than any other theory .

(8) The Pioneer 10 experiment

Consider the Pioneer 10 spacecraft and an experiment performed by JPL personnel, Anderson, Armstrong and Lau (1989). They searched for gravity waves using NASA's Deep Space Network (DSN) of tracking stations and the Pioneer 10 spacecraft. Ironically, this attempted test of the general theory of relativity provides an unacknowledged and unannounced refutation of the special theory of relativity.

However, before exploring the details of the Pioneer 10 experiment, I want to set the stage by returning to the twin paradox discussion of the first chapter.

The twins and a mirror

In the first chapter, two solutions to the twin paradox (TIC-TOC version) compatible with the special theory were proposed. In each of the solutions, a small portion of the signal energy was lost in space-time due to the non-simultaneity of time. Thus, each twin sees the other's time running slower than his own time and a few cycles of the transmitted frequency are, at least temporarily, lost into space-time. The lower frequency and longer wavelengths of the incoming signals are a result of the energy loss.

The two solutions of the twin paradox were distinguished only by what happens when one of the two twins turns around. Ohanian (1988) claimed that the signal energy missing because of the slower time rate was only temporarily lost in space-time and would be recovered when the moving twin decelerated at the end of the outward portion of the journey. Lucas and Hodgeson (1990), by contrast, claimed that the missing signal energy was permanently lost. (Admittedly, they put their arguments in terms of time and not energy. But the cycles that are lost in the transmitted frequency correspond to the lost energy. Likewise, the longer observed wavelength corresponds to "photons" of lower energy. Conservation of cycles is simply conservation of energy in another guise.)

It is apparent that both solutions (and as far as I can determine, all solutions) of the twin paradox compatible with the special theory require that signal energy is lost while unaccelerated relative motion is occurring. Therefore, an experiment which can confirm or deny this energy loss during unaccelerated motion is capable of confirming or denying the special theory itself.

Let me then propose an experiment involving the twins with significant relative motion. Assume Terrance is on earth and Stella is either in orbit around the earth or around the sun. Now compare the predicted results, using both the special theory and the new ether gauge theory. First, in Figure 10.4 a split view of the frequencies transmitted and received by the twins, Terrance

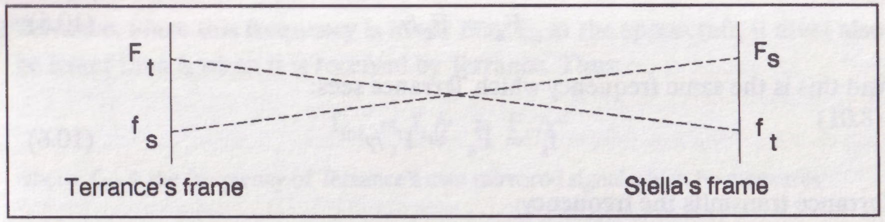


Figure 10.4 Special Theory View of Two Frames

and Stella, is shown. Assume they each had clocks running at the same frequency. Thus:

$$F_t = F_s \tag{10.2}$$

where: F_t is the frequency Terrance transmits
F_s is the frequency Stella transmits

(Note that all classical doppler and gravitational potential effects are assumed removed, so that only the transverse doppler or time non-simultaneity effect from the special theory remains.) Now, from the special theory, each will see the other's clock running slow, so that Terrance sees Stella's clock running slow and Stella sees Terrance's clock running slow. Thus:

$$f_s = F_s/\gamma = F_t/\gamma \tag{10.3}$$
$$f_t = F_t/\gamma = F_s/\gamma \tag{10.4}$$

where: f_s is Terrance's measurement of the frequency he receives from Stella
f_t is Stella's measurement of the frequency she receives from Terrance
γ is the now familar velocity gauge scale factor

Since a lower frequency is received (fewer cycles) than was broadcast, it is obvious that some energy is being continuously lost in space-time.

In Figure 10.5 the ether gauge situation is characterized. In this case, no energy is lost into space-time. Instead, the gauge or scale of Stella's time (and energy) is reduced due to her motion through the earth's (or sun's) gravity field. Thus, Stella transmits the frequency:

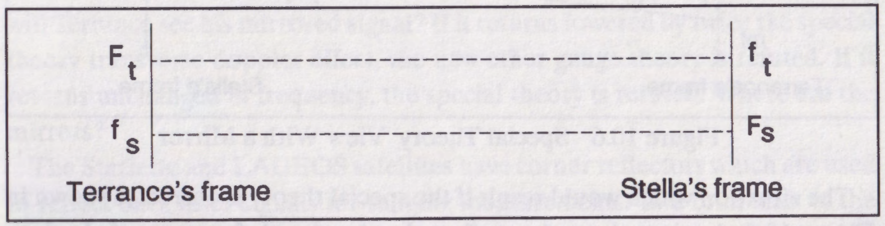


Figure 10.5 Ether Gauge Theory View of Two Frames

$$F_s = F_t/\gamma \tag{10.5}$$

And this is the same frequency which Terrance sees:

$$f_s = F_s = F_t/\gamma \tag{10.6}$$

Terrance transmits the frequency:

$$F_t = \gamma F_s \tag{10.7}$$

And this is the same frequency which Stella sees:

$$f_t = F_t = \gamma F_s \tag{10.8}$$

Now a careful look at Figures 10.4 and 10.5 or at equations (10.3) and (10.6) shows that Terrance's perception of the relationship between his transmitted frequency, F_t and his measurement of Stella's frequency, f_s, is the same in the special theory and the ether gauge theory. Terrance compares his own clock with that received from Stella, and it is not apparent to him whether Stella's time is running slow per the special theory or whether Stella's clock is simply running slow per the new ether gauge theory. Thus, Terrance, who sits in the general role of the laboratory observer, is unable to distinguish between the two theories.

But Stella's view of the two theories is dramatically different. Thus, by asking Stella, we should be able to learn that one of the two theories is wrong. However, it is not easy to accelerate humans to high relative velocities, and a simpler solution is possible. If a mirror or transponder is put on the spacecraft rather than Stella, it should be possible to deduce what Stella would have seen from the reflected signal.

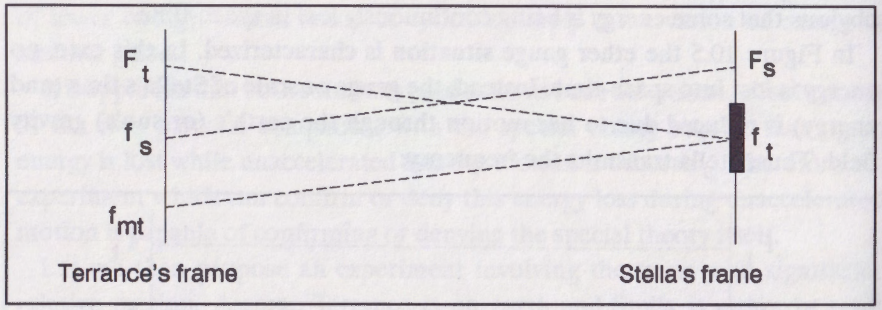


Figure 10.6 Special Theory View With a Mirror

The situation which would result if the special theory is correct is shown in Figure 10.6. A mirror is used to reflect the signal with frequency, f_t, back to

Terrance. Since this frequency is lower than F_s at the spacecraft, it must also be lower than f_s when it is received by Terrance. Thus:

$$f_{mt} = f_t/\gamma = F_t/\gamma^2 \tag{10.8}$$

where: f_{mt} is the frequency of Terrance's own mirrored signal which he measures

This equation tells us that Terrance's signal loses energy and the perceived frequency is lowered during both legs of the signal round trip.

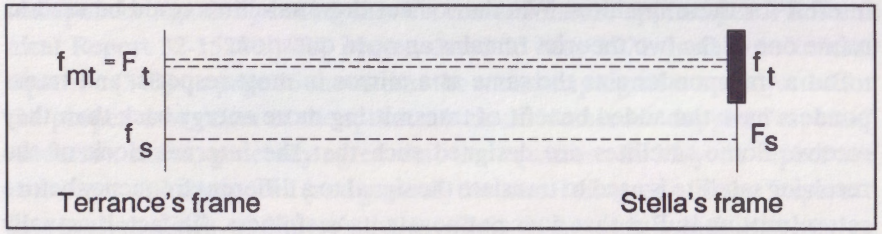


Figure 10.7 Ether Gauge Theory View With a Mirror

Finally, in Figure 10.7, the analogous situation for the ether gauge theory is illustrated. But no frequency changes occur due to the signal path, so the frequency must remain unchanged. (The path followed is raised slightly in Figure 10.7 simply to make it visible.) This gives:

$$f_{mt} = f_t = F_t \tag{10.9}$$

Where the special theory predicts the mirrored signal will be lower than Stella's direct signal and lower than Terrance's own clock, the new ether gauge theory predicts that the mirrored signal will be higher than Stella's own signal and equal in frequency to Terrance's clock. Thus, by sending up a mirror or corner reflector, it should be possible to refute one of the two theories from ground observations.

Note before proceeding: All acknowledge that Terrance sees Stella's signal decreased in frequency or "photon" energy per the left-hand side of Figures 10.4 and 10.5. So the only question is: At what frequency or "photon" energy will Terrance see his mirrored signal? If it returns lowered by twice the special theory transverse doppler effect, the new ether gauge theory is refuted. If it returns unchanged in frequency, the special theory is refuted. Where are the mirrors?

The Starlette and LAGEOS satellites have corner reflectors which are used to reflect back laser signals for ranging measurements. In a brief scan of the literature, I have not found any references to the return frequencies. Clearly,

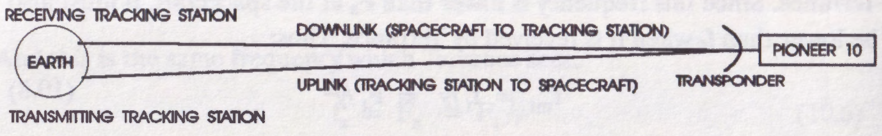


Figure 10.8 Pioneer 10 Gravity Wave Experiment

the pulse travel time or two-way range measurement is the parameter of interest for these satellites. Whether or not these satellites could be used to refute one of the two theories remains an open question.

But a transponder acts the same as a mirror in most respects, and transponders have the added benefit of transmitting more energy back than they receive. Some satellites are designed such that the internal clock of the receiving satellite is used to translate the signal to a different frequency before retransmitting it. But that does not negate its usefulness. (In fact, it actually enhances the usefulness.)

Pioneer 10 gravity wave experiment

It is time to look at the Pioneer 10 spacecraft and the experiment of Anderson, Armstrong and Lau (1989) in more detail.

A microwave link with a frequency of 2.3 GHz was established, using one DSN tracking station on the uplink and a second DSN tracking station on the downlink (see Figure 10.8). Hydrogen-maser clocks were used at each ground station, and a transponder on the spacecraft was used to mirror the signal received at the spacecraft back to the receiving ground station. Data were taken in December 1988, when Pioneer 10 was more than 44 astronomical units distant and near solar opposition.

The round-trip signal received at the tracking station was beat against a local replica of the transmitted signal and integrated to get a precise measure of the change in the range (integrated doppler count). One-minute differences of the integrated doppler were formed to give a doppler frequency record. Next, the relative motions of spacecraft and tracking stations were subtracted from the measurements to remove the classical doppler effects. In addition, the gravitational adjustment for clock rates was made per the general theory, and the proper-time clock rates were adjusted to match a clock at rest in the sun-centered reference frame. Following these corrections, the effects of ionospheric and tropospheric refraction were removed. The final result was frequency residuals with RMS noise of about 2 milliHertz. Thus, the received frequency

was within one part in 10^{12} of the transmitted frequency. The Allan variance computed for averaging times greater than 200 seconds was about 3×10^{-13}.

It is my claim that this gravity-wave experiment refutes the special theory by showing that the return transponder signal corresponds to Figure 10.7 and disagrees with Figure 10.6. But, to be sure that the test results refute the special theory, more details of the proper-time clock-rate adjustments are needed.

Anderson (1991), one of the authors of the gravity wave study cited above, has responded to the question as to what corrections were made to the transponder signals by stating that the corrections are applied per JPL Technical Report 32-1527 by T.J. Moyer, dated 15 May 1971. In that document, equation (343) on page 56 shows that the round-trip signal is not adjusted for the proper-time offset of the spacecraft clock. Numerous doppler "experts," Anderson states, generally agree that the equations in Moyer's report are consistent with the special (and general) theories. I disagree with the "experts." In equation (343) of Moyer's report there is no term which involves an adjustment for the spacecraft's proper time. Proper-time adjustments are only made for the DSN ground-station clocks. Thus, JPL assumes that the transponder works in the time frame of the observer.

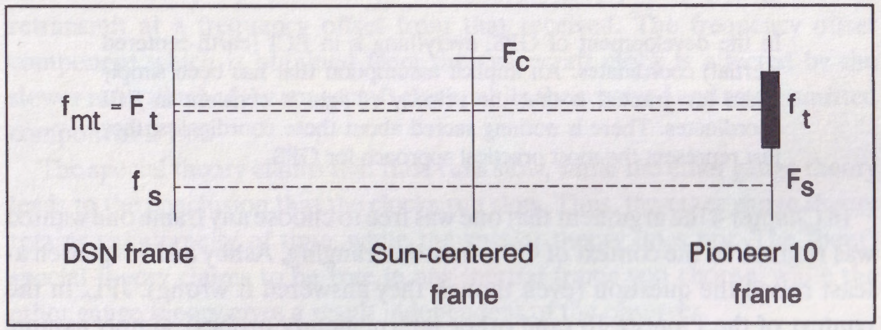


Figure 10.9 View per Moyer's Equations (343) and (344)

A question of frame

The adjustments to frequency which Moyer gives are precisely what is predicted by the ether gauge theory. Dropping the general theory and classical doppler terms leaves only an adjustment for the DSN tracking-station clock in the round-trip signal as seen in a sun-centered inertial frame. The one-way (spacecraft to DSN tracking station) signal given by Moyer in his equation (344) does include an adjustment for the spacecraft proper time. The special theory clock effects in Moyer's equations (343) and (344) are illustrated in Figure 10.9.

Figure 10.9 is identical with Figure 10.7 with the addition of a sun-centered frame and an appropriate relationship between the clock rate (or time) in that frame with the other two frames. Specifically, if we assume the clocks originally had the same frequency in the sun-centered frame:

$$F_t = F_c/\gamma_t \tag{10.10}$$
$$F_s = F_c/\gamma_s \tag{10.11}$$

where: γ_t is the frequency scale factor due to the DSN velocity
γ_s is the frequency scale factor due to the spacecraft velocity

As stated above, Moyer's equations (343) and (344) are in perfect agreement with the new ether gauge theory. Then how can the "experts" think they are in agreement with the special theory? Two significant distortions to the special theory are required in order to force it to agree with the experimental results. These distortions are: (1) the free choice of the observer frame, and (2) the requirement that the mirror must work in the time frame of the chosen observer.

The free choice of the observer frame has already been addressed in Chapter 4. Jorgensen (1988) claimed:

> In the development of GPS, everything is in ECI (earth-centered inertial) coordinates. An implicit assumption that has been simply taken for granted is that the velocity of light is constant in ECI coordinates. There is nothing sacred about these coordinates; they just represent the most practical approach for GPS.

In Chapter 4 the argument that one was free to choose any frame one wanted was refuted. In the context of GPS crosslink ranging, Ashby and Jorgensen at least raised the question (even though they answered it wrong). JPL, in the context of the Pioneer 10 (and other interplanetary probes), simply assume that the sun-centered frame can be chosen with no attempt to justify its choice.

As stated earlier, if any frame can be chosen, let the special theory advocates show that the experimental results can be reconciled with the results of at least one frame that is not coincident with the gravity field in which the experiment is performed.

The assumption that the mirror or transponder works in the chosen observer's frame is such a severe bending of the special theory that it is a wonder it did not break. In fact, such an assumption is strong support for Kuhn's (1970) claim that theories are not rejected because they do not match the data. Instead, only when an alternate theory is available which fits the data better, is a particular theory rejected. The ether gauge theory now provides that alternate to the special theory.

Actually, JPL simply assumes that the mirror works in the sun-centered frame. They do not indicate whether they expect the mirror will always work in the sun-centered frame or work in whatever frame is chosen for the observer. Since to assume the mirror would always work in the sun-centered frame is clearly incompatible with the special theory, I assume they would argue that the mirror always works in the inertial frame of the chosen observer.

But, if a mirror or transponder always works in the frame of the observer, the simultaneity of time can be immediately deduced. For there is then no difference between the behavior of a moving transponder and a stationary transponder under such an assumption. Thus, the moving and stationary transponders each receive and retransmit the same frequency (ignoring classical doppler effects). If the clocks in the spacecrafts associated with the moving and stationary transponders run at different rates, it is a clock-rate effect, not a time-rate effect. (Thus, a better term than "proper time" would be the use of the term "proper clock.")

A one-to-one mapping between the clock associated with the transponder and the clock of the observer is clearly available for transponders which retransmit at a frequency offset from that received. The frequency offset component which is obtained from the spacecraft clock is affected by the slower rate (time) of the spacecraft clock, while the received and retransmitted component is not.

The special theory claims that time runs slow, while the ether gauge theory leads to the conclusion that the clocks run slow. Thus, the ether gauge theory retains simultaneity of time, while the special theory does not. The "bent" special theory claims to be true in any inertial frame you choose, while the ether gauge theory gives a result independent of the observer.

Yet, while the Pioneer 10 measurements were made in the moving frame of the tracking stations, the relative rates of proper time fit the sun-centered frame! This contradicts the special theory and supports the ether gauge theory. The ether gauge theory also explains why the earth-centered frame is the only frame which works for GPS and other systems which remain within the gravity field of the earth. The ether gauge theory requires that all velocities be measured with respect to the encompassing gravity field and demands that the reference frame be that same gravity field. This latter demand fits the observed data. Systems which reside within the gravity field of the earth work only in an earth-centered frame, while systems which reside primarily within the sun's gravity field work only within a sun-centered frame.

In Chapter 4, the claim that the ratio between the transmitted and received frequencies was independent of frame was found to be true. Our argument was not with the proof which Jorgensen and Ashby gave but with the implications which they made from that proof. But, by assuming that the mirror works in the observer time frame, even the limited proof which Jorgensen and Ashby gave is unavailable to the JPL experimenters. With a two-way link, the proof (which Jorgensen gave for the frequency ratio being independent of observer frame) can only hold if the mirror is assumed to work in the spacecraft frame. But that assumption would lead to equation (10.8) and is inconsistent with the actual measurements obtained. Hence, the special theory was "bent" to force agreement with experiment.

The claims that systems can be made to work in different inertial frames remain empty claims. No one has ever demonstrated such an alternative solution. It is no coincidence that the inertial frames used are either earth-centered or sun-centered. Furthermore, the measured one-to-one relationships between proper time of the tracking station and proper time of the spacecraft demand a unique reference frame. The special theory is contradicted by these measurements, since the measurements demand simultaneity of time and a unique frame of reference.

Conclusion

In the first section of this chapter, two experiments which disagree with the new theory were considered. The two experiments also disagree with the special theory. The two experiments were not really taken seriously. They simply disagree with too much other experimental evidence which appears to be completely equivalent in technique.

In the second section of the chapter, experimental data which favors the new theory were considered. Some of the experiments are hardly convincing, on their own. However, when taken together, they present a powerful argument. The Mossbauer experiments, the Sagnac effect, the Edwards effect, and the Pioneer 10 experiment are powerful arguments in favor of the new theory even when considered individually. The prior explanations of the Sagnac effect are ad hoc and contrary to all the normal special theory characteristics. The Edwards effect has simply not been explained at all using the special theory. The Pioneer 10 experiment performed by JPL is catastrophic to the special theory. It tests the claims of reciprocity of the Lorentz transformation directly and finds them faulty. The results of all the experiments are in complete agreement with the new ether gauge theory.

11

CLASSICAL PROOFS OF THE GENERAL THEORY

Evident Evidence?

> The experimental evidence for the general theory will be considered in this chapter. The same evidence supports the new ether gauge theory.

Einstein, at the time he published the general theory, proposed three tests of the theory. They were: (1) the gravitational redshift, (2) the deflection of starlight by the sun, and (3) the precession of the perihelion of the planet Mercury. Even if the Shapiro time-delay effect (the increase in the transit times of radar signals reflected from planets as they are eclipsed by the sun) is included as an additional test, the statement made by Everitt (1988) is still true:

> Even today, ... general relativity lacks a secure experimental foundation. Einstein advanced a theory of great conceptual elegance, radically different from Newtonian theory, with few testable consequences.

As Everitt goes on to say, there have been a multitude of rival theories which can meet the above experimental tests. It is for this reason that new tests (which are to be considered in the next chapter) are being avidly pursued in spite of huge costs.

Considering the above, it is not surprising that the new ether gauge theory can easily be used to explain the classical tests. Two, more unusual, tests are described which favor the new theory.

The Gravitational Redshift

The gravitational redshift predicted by the general theory has been measured very precisely. Pound and Rebka (1960), and later Pound and Snider (1965), used the Mossbauer effect to measure the relative absorption of 14.4 keV gamma rays in a 22.5 meter vertical shaft at Harvard University. By varying the velocity of the source, the Doppler effect could be used to determine the precise point at which the absorption was maximized. Very precise results were obtained. The results were in excellent agreement with the predicted value. The same results are predicted by the new theory.

The ether gauge theory explains the redshift of light, as it escapes from a gravitational body, simply and directly. It is the result of the three-dimensional expansion in the length scale as the gravitational gauge changes. Lengths increase; and, thus, the wavelength of radiated energy is shifted to longer wavelengths. The longer wavelengths correspond to lower frequencies—for light, this is a redshift in the frequency spectrum. Little more can be said regarding the mechanism. It is direct. There are no subtle effects to consider.

The Deflection of Starlight by the Sun

The deflection of starlight by the sun has generally been considered as a fairly decisive test of the general theory. One reason for this is that the effect predicted by Newtonian physics is only one half as large. In addition, when Einstein in 1911 computed an effect using the special theory and the equivalence principle, he also obtained a value only one half the effect predicted by the general theory.

Schiff (1960) showed that Einstein, while properly considering the special theory effect of time dilation on the deflection, failed to consider the special theory effect of FitzGerald contraction. When the radial contraction of distance toward the sun is considered, the special theory and the equivalence principle do predict the same effect obtained by the general theory. Thus, Schiff argued that the bending of light rays in a gravity field was not a very decisive test of the general theory.

Decisive or not, all the early data were obtained by careful observations of stars in the vicinity of the sun during a total eclipse. These observations varied

widely but, on balance, supported the general theory. More recent data, measuring the deflection of radio waves from a quasar using radio interferometers, have yielded much more precise results which agree very well with the general theory predictions.

The new ether gauge theory shows that light slows down and is, therefore, deflected by both the time dilation and the three-dimensional contraction of distances. The two effects are of equal magnitude, and both are due to the change of gauge with gravitational potential. Again, the effects are direct and simple.

The Precession of the Perihelion of Mercury

The precession of Mercury's perihelion is a valid test of the general theory. It has always been faced with some uncertainty because the effect could also be caused by an oblateness in the shape of the sun. As above, the most accurate results have been obtained recently via the use of radar data (Shapiro et al., 1972). The data currently agree very well with the general theory.

The new ether gauge theory predicts the same effect as the general theory. The difference is primarily in nomenclature. Rather than space curvature causing the effect, it is caused by ether compression. The ether is more dense and the distance scale is shorter when Mercury is at perihelion. This changed distance scale causes the precession of the orbit because of the greater distances involved (shorter scale) in the more compact ether near perihelion.

The Shapiro Time-Delay Effect

Shapiro (1968) first measured a time-delay effect, predicted by the general theory, by determining the extra time delay of radar signals reflected from the surfaces of Venus and Mercury when they were in the vicinity of the sun. The measurements were in reasonable agreement with the general theory, and later results were in very precise agreement with the expected effect.

The Shapiro effect is also straightforward and easily explained by the new ether gauge theory. It is the direct result of the extra distance which the light path must traverse and of the time change which results from the change in the gravity gauge. (The speed of light is affected by both the distance gauge and the time gauge.) It is given directly by the scale factor of length and time associated with the gravity gauge in Chapter 2. There is nothing mystical about the effect.

The Expansion of the Universe

As is well known, the general theory predicts the expansion of the universe, a predicted effect which Einstein attempted to overcome by adding an extra fudge factor (cosmological constant) to the theory. The later observation by Hubble that the universe was expanding led Einstein to refer to the addition of the cosmological constant as the biggest blunder of his life.

In any case, the general theory predicts an expansion. But it predicts that the expansion will slow and, if there is enough mass present in the universe, to eventually start contracting again. At present, it appears that there is only about 1/100 of the mass needed to stop the expansion. More important, though, the rate of expansion should have slowed long ago. There is evidence that this has not occurred. Adler et al.(1965) used the measured redshift of light from distant galaxies, along with other simplifying assumptions, to compute the apparent relationship between matter density and pressure of expansion. The relationship they found was not characteristic of matter-energy driving the expansion—instead it was characteristic of electromagnetic radiation. They state:

> Thus the molecules which comprise the "gas" of this universe would move at the speed of light and must therefore be photons (or neutrinos). However, we know that the density of electromagnetic energy in the universe is a small fraction of the total energy, while, on the other hand, we know almost nothing about the energy density due to neutrinos. We therefore cannot decide as yet whether the model corresponding to the law of expansion ... has a chance of having a reasonable physical significance or not.

In the new ether gauge theory, the internal compressive force within the ether will always cause expansion. This is independent of the relative mass content of the universe. It is simply caused by the internal compressive energy of the ether itself. This also removes a problem with recent observations of the galactic distribution of matter and the "Big Bang" model. The uniformity of the background microwave radiation and the observed distribution of matter in clumps cannot be explained by the general theory. In the ether gauge theory, the distribution of matter has only a minor affect on the expansion of the universe.

Naked Singularities

Computational simulations of the general theory equations have recently revealed a severe problem with the general theory. Shapiro and Teukolsky (1991) have shown via simulations that with particular three-dimensional distributions of matter the general theory equations lead to the formation of a "naked singularity." A gravitational singularity can result from the non-linearity of the general theory equations because it leads to gravity creating gravity. The gravitational force becomes infinite at a point of singularity. In the past such singularities have always been surrounded by a black hole; and, since nothing inside a black hole can affect anything outside the black hole, such singularities could be ignored. But, if the Shapiro-Teukolsky results are verified, something must be wrong with the general theory equations. A naked singularity, i.e. one not shielded by a black hole, implies an infinite gravitational force, which clearly violates fundamental concepts of physics.

The ether gauge theory would not suffer a similar fate, since it is a linear theory rather than a non-linear theory. Furthermore, the distribution of matter does not affect the fundamental nature of the ether. In other words, the ether compression caused by matter is due to the exclusion of the ether from the space occupied by the particles (standing waves) of matter. The non-linearity of the general theory results from the concept that any form of energy creates curvature of space. Thus, gravity creates gravity. But in the new ether gauge theory gravity is caused by the gradient of ether density. Thus, homogenous energy such as is resident in the vacuum or ether does not itself cause more gravity.

Conclusion

The classical proofs of the general theory have been considered. There are not a lot of them. As expected, they agree with the new ether gauge theory. That the tests agree with the new theory is obvious. The situation is parallel to the special theory situation. The new theory seems to explain the classical tests more easily than the old theory.

The observed evidence from the redshift of distant galaxies favors the expansion model of the new theory over that of the general theory. The new computational tests of the general theory equations reveal a significant problem with the general theory. This problem does not arise with the new ether gauge theory.

12

NEW GRAVITATIONAL EXPERIMENTS

Probing Probabilities

> The classical gravitational tests are not capable of distinguishing between the new ether gauge theory and general relativity. However, it has been recognized for some time that the classical tests are not very discriminating. New tests are already planned which are capable of distinguishing between the general theory and the new ether gauge theory. The proposed tests explore areas where the two theories predict different results.

To identify those tests of most interest, note the following two facts: (1) the new gauge theory yields gravitokinetic equations which are completely parallel to the electromagnetic equations; (2) the general theory, by contrast, yields gravitoelectric and gravitomagnetic equations which are not completely parallel. Thus, gravitational tests of most interest would be those where the general theory anomalous terms could be expected to contribute. Two types of tests meet these requirements: tests of the gravitational radiation and tests of the kinetic or gravitomagnetic interactions.

Before addressing these two types of tests, the field equations obtained from the general theory in a weak field environment are compared with the new gauge theory equations.

Thorne (1988) gives the weak field Einstein equations. First, he defines the potentials in terms of the standard Einstein metric components:

$$\mathbf{g} = -\nabla\Phi \quad \text{with} \quad \Phi = -(g_{oo} + 1)\, c^2/2 \tag{12.1}$$

$$\mathbf{H} = \nabla \times \gamma \quad \text{with} \quad \gamma_j = g_{oj} \quad (j=1,..,3) \tag{12.2}$$

where: g_{oo} and g_{oj} are the metric components

The first equation gives the gravitoelectric field, g, in terms of the gravitational potential; and the second gives the gravitomagnetic field, H, in terms of the vector potential.

Thorne then gives the Maxwell equivalent field equations as:

$$\nabla \mathbf{H} = 0 \tag{12.3}$$

$$\nabla \times \mathbf{g} = 0 \tag{12.4}$$

$$\nabla \cdot \mathbf{g} = -4\pi G\rho \tag{12.5}$$

$$\nabla \times \mathbf{H} = 4\,[-\frac{4\pi}{c} G\rho\mathbf{v} + \frac{1}{c}\frac{\partial \mathbf{g}}{\partial t}] \tag{12.6}$$

where: G is Newton's gravitational constant
ρ is the mass density
v is the velocity of the mass

The equivalent of the Lorentz force equation is given by Thorne as:

$$\frac{d\mathbf{v}}{dt} = \mathbf{g} + (\frac{\mathbf{v}}{c}) \times \mathbf{H} \tag{12.7}$$

The gravitational equivalent of the Maxwell field equations in the new ether gauge theory was given in Chapter 3. The equations are repeated here and then compared with the equations given by Thorne:

$$\nabla \cdot \mathbf{k} = 0 \tag{12.8}$$

$$\nabla \times \mathbf{g} = \frac{1}{c}\frac{\partial \mathbf{k}}{\partial t} \tag{12.9}$$

$$\nabla \cdot g = -4\pi\rho \tag{12.10}$$

$$\nabla \times \mathbf{k} = -\frac{4\pi}{c}\mathbf{J} + \frac{1}{c}\frac{\partial \mathbf{g}}{\partial t} \tag{12.11}$$

The differences in the Thorne field equations and these equations are now addressed individually. Equations (12.3) and (12.8) differ only in nomenclature. Rather than use the term gravitomagnetic field and identify it with the magnetic equivalent symbol, H, I have identified the field with the kinetic inertial force and used the symbol, k.

Equations (12.4) and (12.9) differ by the presence of the derivative of the kinetic field. Thorne has left this term out because it is of second order in the velocity ratio (v/c). He indicates that, if it is included, there are many more second-order terms which should be included as well. As stated in Chapter 3 but not developed from first principles, I do not believe the same is true of the new gauge theory. The equations are, I believe, gauge invariant. Einstein's general theory equations ascribe space curvature to the presence of energy, and the three-dimensional stress is a result of this curvature. In the ether gauge equations, the cause and effect are reversed. The presence of energy causes compression of the ether, and the gradient of the compression or stress causes the equivalent of curvature. This explains the reason the new gauge theory does not have the same problem as the general theory with the energy in the background vacuum (ether) fluctuations. Although the energy is huge, its gradient is not. Therefore, it does not result in curvature of space (gradient in the ether density).

Equations (12.5) and (12.10) are identical, though it is not obvious. As shown in Chapter 3, the ether gauge equations incorporated Newton's gravitational constant within the definition of the mass density, ρ. Equation (12.11) also has the gravitational constant incorporated in the definition of the mass velocity, J. But it is not identical with equation (12.6) because an extra factor of four is found on the left-hand side of equation (12.6). Thorne says that "presumably" this anomalous factor of four arises from the fact that gravity waves are associated with spin-2 fields while electromagnetic waves are associated with spin-1 fields. The spin is defined by the symmetry properties of the radiation. The gravitational radiation is quadrupolar. If it is rotated through 360 degrees, it will go through two indistinguishable patterns—hence, it is called spin-2.

The above presumption is, I think, nonsense. Electromagnetic radiation can also be caused to radiate in a quadrupolar fashion. This does not make it four times stronger. Instead, I believe, the factor of four arises from the fact that kinetic (gravitomagnetic) energy in the Einstein theory is a factor of two too small. It does not account for the extra energy in the kinetic field which is obtained from the gauge change of velocity (reduced rest mass). The squaring of the factor of two is a result of the normal presence of the square of the velocity in the actual effects of the kinetic field. For example, Thorne's equation (12.6) for the gravitomagnetic (kinetic) field has a velocity term in it, and then the Lorentz force equation multiplies the field by another velocity-dependent term. Proper recognition that the kinetic field has twice the energy of the classical kinetic energy causes the factor of four to drop out of equation (12.6). This is reflected in the gauge field equation (12.11).

Specific proposed tests of the general theory can now be considered. The above background provides a means to contrast the new gauge theory predictions with the general theory predictions.

Gravitational Radiation

The first order of business regarding gravity waves is to see what the general theory has predicted regarding them. A comprehensive and yet easy to read description of gravity waves is given in a book by Davies (1980). Some of his introductory and concluding statements regarding gravity waves are of particular interest.

In his introduction, Davies (1980, vii) tells us that:

> Few physicists seriously doubt that waves in the gravitational field, analogous to waves in the electromagnetic field, really exist.

and

> ... the establishment of a new branch of astronomy, using gravity wave detectors as 'gravity telescopes', is on the horizon. With such a facility we could 'see' into the dense hearts of quasars and neutron stars, probe to the very edges of black holes and maybe eventually listen to the rumble of the primordial big bang itself.

The strong advantage of gravity waves over electromagnetic waves is, according to Davies, their penetration of matter. In his concluding statements, Davies (1980, 128) tells us:

> Like neutrinos, gravitons can easily pass through vast quantities of ultra-dense matter without being stopped, and can erupt out of the centres of stars, neutron stars and quasars, and from the very edges of black holes. Gravity waves can rumble across the Universe from the first conceivable moment of the big bang, and carry information about epochs that are more than fifty powers of ten earlier than the corresponding electromagnetic signals. Using gravity wave telescopes, astronomers could follow the tortured destruction of whole stars, the titanic explosions of quasars and the awesome collisions of black holes. They could 'see' the violent gyrations of nascent neutron stars, the turbulence of a supernova and the gentle but inexorable collapse of star clusters and galaxies. These details may be a long way off, but it is hard to see how science can shrink from the new Maxwell-Hertz path laid before us by Einstein.

This is an eloquent picture of what some physicists see for the future of gravity waves.

Before considering the state of the art in gravity-wave detection, it should be stated that most physicists believe that gravity fields, like electromagnetic fields, need to be quantized. This is not a conclusion of the general theory. The general theory says nothing about quantization; and, in fact, efforts to develop a quantum theory of gravity have so far been fruitless. Nevertheless, in the words of Davies (1980, 129) again:

> If it is believed that the quantum theory must be applied consistently to all of physics (which is a virtually unanimous assumption) then gravity waves must also be quantized as gravitons.

The search for gravity waves involves an attempt to detect extremely small amounts of energy. The first experimental attempts were undertaken by Joseph Weber of the University of Maryland in the late 1960s and early 1970s. He constructed what has become known as a bar detector. Weber's detector was a huge cylindrical bar of aluminum which was expected to resonate with gravity waves of the right frequency which approached the bar from the correct direction. He actually observed what appeared to be gravitational waves. In order to ensure the energy being detected was not of local origin, he set up a second detector near Chicago. He still detected coincident events on the order of once per day. Several checks which he made seemed to corroborate the conclusion that they were the result of gravity waves. Most significant, they seemed to arrive from the center of the galaxy. A severe problem existed, however. No one could predict events as energetic as what Weber was detecting at anywhere near the frequency that he observed.

Perhaps the best that can be said of the Weber "events" is that they captured the attention of others. As a result, many other gravity-wave detectors were constructed with increasing sensitivity. No one else has ever clearly detected an event which can be identified exclusively as a gravity wave.

In addition to resonant bar detectors, there are now a number of detectors known as LIGOs. The mnemonic stands for Laser Interferometer Gravity-wave Observatories. These detectors use interferometric means to detect tiny variations in distance between mirrors which are mounted on masses separated in orthogonal directions from a common coherent source of light. Presumably, gravity waves would cause the masses on which the mirrors are mounted to move by tiny amounts. This movement would be detected by a change in the interference pattern of the beams which are brought back together. The sensitivity of these detectors is, among other parameters, a function of the separation distance of the mirrors. A number of detectors with separation distances in the tens of meters have been constructed. Currently

planned are two huge detectors with separation distances of four kilometers. The two detectors are to be operated by Cal Tech on the west coast of the US and by MIT on the east coast. The projected cost is on the order of 200 million dollars.

The funding of such costly experiments is clear evidence that many believe that gravity-wave detection is simply a matter of building more sensitive detectors. This is also evidenced by a bet which Dr. Kip Thorne (1987) has made with Dr. Jeremiah Ostriker. In their bet they state: (1) that both believe that Einstein's equations are valid; (2) that both are convinced that the equations predict gravity waves; (3) that both are confident that Nature will provide what the physical laws predict; and (4) both have faith that scientists can ultimately observe what Nature does supply. But they go on to state that they differ on the likely strengths of the natural sources of gravity waves and the probability of verifiable detection of gravity waves in the near future. Dr. Thorne bet a case of good California red wine that at least two experimental groups would observe phenomena which they agree are gravity waves before 1 January 2000. Dr. Ostriker bet a case of good French red wine that the above would not happen within the time limit. The bet was made in May of 1981.

I believe that Dr. Thorne will lose his bet. I also believe the huge amounts of money being spent on gravity-wave detectors are being wasted. Why? The new gauge theory predicts effects which are almost in complete disagreement with the above expectations.

First, as described in Chapter 3, the new gauge theory indicates that gravity waves will indeed be generated. But they are exactly the same thing as electromagnetic waves. In fact, it would actually be more appropriate to call electromagnetic waves by the term gravitokinetic waves. This has a number of implications. First and foremost, it means that gravity waves will not penetrate through matter. Gravity waves will be absorbed and attenuated exactly like the commonplace electromagnetic waves. The expected benefit described above by Davies, therefore, will not be attained.

A second prediction of the new gauge theory is also in complete disagreement with the expectations. Again, as indicated in Chapter 3, the electromagnetic radiation was observed to be quantized only because of the quantization of the standing-wave energy of the electron and the other fundamental particles. Thus, it was quantized in absorption and emission but not as radiation. Since mass is not similarly quantized, it is clear that gravitational radiation is not quantized; and there is no such thing as a graviton. This position is strengthened by the twenty years of fruitless effort in attempting to combine the quantum theory with a gravitational theory.

Because the gravity-wave detectors are designed to detect a wave which is not strongly absorbed by matter, they appear to be doomed to failure.

The natural objection to the above predictions is to point out that there is already observational evidence of gravitational radiation. What about the evidence of Taylor and Weisberg (1982)? They show that the binary pulsar PSR 1913+16, originally discovered by Hulse and Taylor, loses energy at a rate which is consistent with the quadrupolar gravity-wave predictions of the general theory. Is that energy loss also consistent with the new gauge theory?

The gauge theory does predict energy loss from mass motion; only the energy is radiated as "electromagnetic" energy rather than as gravity waves. There is an apparent problem, though. Meisner, Thorne and Wheeler (1973, 975) claim quadrupolar gravitational radiation is four times stronger than the equivalent quadrupolar electromagnetic radiation. I believe that this is the same extra factor of four discussed above which Thorne (1988) gets for the gravitomagnetic (my kinetic) field strength. If I'm right, the quadrupolar energy loss from gravitational radiation should be decreased by a factor of four and be equivalent to the electromagnetic equation. But this loss of a factor of four is exactly counteracted by a gain of a factor of four when it is observed that the radiation is proportional to the square of the kinetic energy and the true kinetic energy is twice as large as is classically assumed. Thus, the energy loss predicted by the new theory is exactly that predicted by the quadrupolar formula obtained from Einstein. Of course, the actual radiation is quadrupolar electromagnetic radiation rather than gravity waves.

In fact, the new gauge theory agrees better with Taylor's data than does the general theory. The general theory is non-linear; and, according to Damour (1983), the quadrupolar radiation formula has not been shown to apply for strong gravity fields. In fact, the non-linear effects appear to result in greater radiation. By contrast, in the new gauge theory, gravitational and electromagnetic field equations are gauge invariant and do not change with an increased ether gradient of compression (Einstein's curvature of space); and, hence, the gravitational radiation would still obey the linear law. This means that the quadrupolar radiation formula applies directly to the binary pulsar.

The new ether gauge theory does agree with the binary pulsar data. The conclusion is that gravity-wave detectors will be constructed in vain. The gravity radiation will be absorbed by matter, just as any other form of electromagnetic radiation is absorbed.

Gravitokinetic Interactions—Gravity Probe B

Within the next decade, a crucial test of Einstein's theory is planned. It is known as Gravity Probe B, or the Stanford Gyroscope Experiment (Everitt, 1988). What does the new gauge theory predict regarding this experiment? How do the predictions compare to the general theory predictions?

The planned experiment involves placing an ultra-precise gyroscope in a polar orbit of about 500 kilometers altitude. The gyroscope will have its spin axis aligned in the plane of the orbit. Two different types of precession are expected and will be measured. The larger of the two precessions is an "in plane" precession. It is generally referred to as "geodetic" precession. It is also referred to by some authors as "motional" precession. The smaller of the two precession components is the "out of plane" or orthogonal precession. It is variously referred to as "frame dragging," Lens-Thirring (after the first people to predict the effect), and the spin-spin precession effect. The geodetic precession can be subdivided into additional components. The two components obtained from the general theory are the space-curvature precession and the spin-orbit precession effect.

Thorne (1988) derives expressions for each of the separate precession effects mentioned above. The frame-dragging or Lens-Thirring effect, which, for clarity, I prefer to call a spin-spin precession effect, is considered first. Thorne gives an equation for the gravitomagnetic dipole field caused by the earth's spin. This corresponds in the new ether gauge theory to the dipole kinetic field. Thorne's equation is:

$$\mathbf{H} = \frac{2G}{c}[\mathbf{S} - 3(\mathbf{S}\cdot\mathbf{n})\mathbf{n}]/r^3 \tag{12.12}$$

where: **S** is the spin angular momentum
n is a unit vector in the radial direction

The only problem with this equation is that, by the new gauge theory, it is four times too big. This factor of four derives directly from the anomalous factor of four in equation (12.6), which has already been discussed. The net result is that the new gauge theory obtains a kinetic dipole field which is one-fourth as big as that of the general theory.

The instantaneous field given by equation (12.12) causes a torque on the spin dipole field generated by the gyrocompass itself. (This explains the spin-spin terminology.) Thorne gives for the dipole moment of the gravitomagnetic or kinetic field the expression:

$$\mu = \frac{s}{2c} \qquad (12.13)$$

where: s is the spin angular momentum of the gyrocompass

This equation is in complete agreement with the electromagnetic equivalent. But the velocity gauge relationships for the internal and external gauge developed in Chapter 5 show that the mass difference between the internal and external gauge is twice (the square of the gauge scale factor) that of the charge difference. I believe this means the kinetic field is twice that of the equivalent magnetic field. Thus, the ether gauge theory will give a kinetic moment twice that given by the general theory in equation (12.13).

The spin-spin final effect is the orbital average of the cross-product of the gyroscope's kinetic field given by equation (12.13) with the earth's kinetic field given by equation (12.12). For Gravity Probe B this gives:

$$\Omega_{ss} = \frac{GS}{2c^2r^3} \approx .05 \text{ arc-seconds per year} \qquad (12.14)$$

The value given is that obtained using the general theory. The new ether gauge theory gives exactly one-half the same numerical value. The field from the earth's spin is only one-fourth as large as the general theory, but the dipole moment of the gyrocompass is twice as big. The net result is a prediction from the new theory that only one half the spin-spin effect predicted by the general theory will be seen.

Thorne also gives the equations for computing the components of the geodetic precession. The first of these is the spin-orbit coupling. As above, the dipole moment of the gyrocompass is needed. Thus, equation (12.13) is used. (Remember that the new ether gauge theory gives twice the value for this equation.) This dipole is acted upon by an induced gravitomagnetic (kinetic) field obtained from the motion of the gyrocompass through the gravitoelectric (gravity) field. The equation for the induced field is:

$$\mathbf{H} = -\frac{\mathbf{v}}{c} \times \mathbf{g} \qquad (12.15)$$

This equation is identical in the two theories. The cross-product of equations (12.13) and (12.15) gives the resultant spin-orbit precession. Thorne gives for the general theory the result:

$$\Omega_{so} = \left[\frac{r_g}{2r}\right]^{5/2} \frac{c}{r_g}\mathbf{n} \approx 2.3 \text{ arc-seconds per year} \qquad (12.16)$$

where: r_g is the gravitational radius of the earth and is given by $2GM/c^2$
$\mathbf{n}$ is the unit vector normal to the orbital plane

The predicted effect of the new gauge theory is twice as big, since the dipole moment of the gyrocompass is twice that of the general theory.

The second component of the geodetic effect is the space-curvature effect in the general theory (the gradient of compaction of the ether in the ether gauge theory). Thorne gets for this a value which is exactly twice as big as he gets for the spin orbital effect:

$$\Omega_{sc} = 2\Omega_{so} \approx 4.6 \text{ arc-seconds per year} \qquad (12.17)$$

The value obtained in the new ether gauge theory is the same. Thus, the spin-orbit and space-curvature effects are equal to each other in the ether gauge theory and the total of 9.2 arc-seconds per year is equal to four-thirds of the general theory total of 6.9 arc-seconds per year.

But the Thomas precession effect has not yet been considered. Thorne specifically indicates that, in the general theory, the Thomas precession makes no contribution to the geodetic precession. The reason is simple. The Thomas precession arises in the special theory as a direct result of accelerations. But an object in orbit around the earth is in free-fall; and, in the general theory, free-fall is treated as unaccelerated motion. No acceleration means no Thomas precession. Thus, the combined geodetic precession predicted by the general theory is a total of 6.9 arc-seconds per year; and it arises from the spin-orbit and space-curvature effects.

In the new ether gauge theory, the Thomas precession arises from an entirely different mechanism. Specifically, it is the analogue of the space-curvature effect. In the new ether gauge theory, the space-curvature precession of the general theory is replaced by the precession from the gradient of ether compaction due to gravity. The Thomas precession is similarly replaced by the precession from the gradient of ether compaction due to velocity. Thus, the Thomas precession still exists in the new ether gauge theory, even for an object in free-fall. However, it occurs only within the gravity field of the orbiting object, since there is obviously no gradient of ether compaction outside its gravity field. But, unlike a point-source electron, Gravity Probe B is very large compared to its own gravity field. Thus, for entirely different reasons the general theory and the ether gauge theory predict no Thomas precession effects for gyrocompasses in orbit.

The final combined geodetic precession from the new ether gauge theory is predicted to be 9.2 arc-seconds per year. It arises from the space-curvature and spin-orbit combined effects. This is precisely four-thirds the 6.9 arc-second-per-year effect predicted by the general theory.

I believe that Gravity Probe B will measure one-half the frame-dragging effect and four-thirds the geodetic effect predicted by the general theory. A value of .025 arc-seconds per year is predicted by the ether gauge theory for the frame-dragging effect and a value of 9.2 arc-seconds per year is predicted for the geodetic effect.

Conclusion

In summary, very expensive new tests of the general theory are planned. Tests of gravitational radiation are predicted by the new theory to be fruitless. The search for gravity waves is expected to yield no positive results. However, because the signals are expected to be so small, null results will not be particularly decisive. By contrast, Gravity Probe B is expected to be a crucial test. The new theory predicts the spin-spin (frame dragging) precession to be only one-half that predicted by the general theory. The new theory predicts the much larger geodetic precession to be greater by one-third than that predicted by the general theory.

13

HIGHLIGHTS, CONCLUSIONS, ACTION

Recusant Recapitulation

There are three objectives in mind for this final chapter. They are: (1) a summary of the preceding chapters; (2) a presentation of the most significant implications and conclusions; and (3) a list of actions required to put the new theory on an even firmer foundation.

Highlights

The intent of the first chapter was to show that reasonable doubt was justified regarding the special theory. The twin paradox was considered in detail. The normal resolution of the twin paradox is to wave the hand and state that the acceleration of one of the twins removes the symmetry and solves the problem. A careful analysis shows that consideration of the acceleration still leaves the paradox intact.

There is a large amount of empiricism in science. This, together with the old adage, "If it ain't broke, don't fix it," goes a long way toward explaining why scientists are so extremely resistant to questioning the special theory. The special theory has served them well for eighty-five years. But a theory which agrees with experiment just as well as the special theory, if not better, and which is free of logical paradoxes, ought to be readily received by the scientific establishment.

The first chapter questioned the old. The second chapter lays the theoretical groundwork for the new. If the scale or gauge of physics is changed by a change in gravitational potential or by the square of velocity through the gravity field, the general experimental environment which created and sustained the Einstein theories is satisfied by the new theory.

The electron is pictured as a quantized standing-wave structure which acts back upon itself. This picture allows one to obtain the scale or gauge change with velocity without the paradox-producing Lorentz transformation. This is very significant. Even those radicals who have questioned the special theory seem all too willing to accept the Lorentz transformation, which is the source of the symmetry problem.

The equivalence principle is employed in the second chapter. The equivalence principle is a strange unexplained phenomenon of the special and general theories, but it arises from common physical effects in the new theory.

In addition to the above, the second chapter presents the solution to the historic problem of the missing longitudinal wave in the ether. The solution involves a modified MacCallaugh ether with a Poisson ratio of zero. Not only does this ether model explain why there is no longitudinal wave, it also shows why the Poynting vector, which is related to the phase relationship between the electric and magnetic fields, controls the flow of electromagnetic energy.

The third chapter shows that the ether gauge theory, together with the standing-wave model of the electron, provides a radical but exciting new unification of gravity with electromagnetism. This unification has a number of implications. Among these implications are: (1) electromagnetic radiation is quantized on emission and absorption but not as radiation; (2) the background ether fluctuation, which gives rise to the uncertainty of quantum phenomena and to the spontaneous appearance and disappearance of particle/anti-particle pairs, is just the electromagnetic radiation below the quantum threshold of absorption; (3) electromagnetic radiation is the same as gravitokinetic radiation; and (4) the gravitokinetic field equations are parallel to the Maxwell electromagnetic equations.

Theoretical details of the new theory are explored in the next five chapters—Chapter 4 through Chapter 8. In Chapter 4 the topics of doppler shift and aberration are pursued. The claim of Jorgensen and Ashby, that one is free to choose the observer frame in the Global Positioning System, is contested. Finally, a simple aberration experiment is proposed which it is claimed will clearly refute either the special theory or the new ether gauge theory.

In Chapter 5 the subject of force and motion is explored. The longitudinal magnetic force is considered. It is found to be described by the Gauss-Riemann-Whittaker (GRW) force equation. The external velocity gauge is developed and shows that the charge of the electron increases with velocity. This result is reconciled with the classical charge-to-mass experiments. Finally, the increased charge with velocity is used to explain the Edwards effect. The Edwards effect has not been explained by use of classical electromagnetic theory or by the special theory. A simple, direct explanation of the Edwards effect is given by the new ether gauge theory.

Rotational motion is considered in Chapter 6. Rotational motion presents a clear problem to the special theory—and an opportunity to show why the new theory is so much better. The Sagnac effect cannot be explained by the special theory—without some ad hoc changes described by Post. But, even with these changes, problems remain. If the Sagnac changes are incorporated, the Thomas precession is not explained. Even more critical, if the Post explanation of the Sagnac effect is used, orbital motion of the earth should result in a contradiction of the Michelson-Morley experiment.

The new ether gauge theory explains each of the experiments without conflict. The Sagnac effect arises because of the apparent ether drift induced by the earth's rotation with respect to the preferred frame of reference (the non-rotating gravity field). The Thomas precession is shown to result directly from the compression of the ether with velocity—equivalent to the gravitational potential compression. The Michelson-Morley experiment presents no problem because: (1) it was not sensitive enough to measure the spin velocity of the earth, and (2) the orbital velocity carries the preferred frame of reference along with the earth.

Chapter 7 uses the ether gauge theory to construct models of elementary particles. This modeling exercise is not critical, but it appears fruitful. It is capable of adding intuitive understanding to concepts which arose mathematically from the quantum theory. The electron's anomalous g-factor of two is an excellent example of a characteristic which is explained in an intuitive sense by the new model of the electron.

The impact of the new ether gauge theory on quantum mechanics is explored in Chapter 8. It is clear that both negative and positive effects will be felt. The removal of the requirement of Lorentz covariance is clearly positive. Most of the important characteristics which are obtained by the imposition of Lorentz covariance can be obtained by the less restrictive gauge invariance.

The experimental evidence for and against the new ether gauge theory is explored in Chapters 9 through 12. Experiments which are generally regarded as proofs of the special theory are considered in Chapter 9. The same experiments are analyzed in terms of the new ether gauge theory. The conclusion of this chapter is that the evidence on balance favors the new theory over the old.

In Chapter 10 two experiments which cannot be explained using the new theory are considered. These two experiments also disagree with the special theory. The conclusion is that the two experiments are faulty.

In the latter half of the chapter, the experiments which present significant difficulties to the special theory are examined. The new ether gauge theory clearly solves some of these experiments and provides clues to the possible solution of the others. The Pioneer 10 experiment described at the end of the chapter is in clear disagreement with the special theory. It strongly supports the new ether gauge theory.

The proofs of the general theory of relativity are the subject of Chapter 11. Historically, the general theory proofs are rather limited. The new ether gauge theory easily satisfies the historical tests. Two more recent tests which favor the new theory are presented at the close of the chapter.

More significant and crucial tests of the general theory are planned for the future. These tests are the subject of Chapter 12. Gravitational radiation and Gravity Probe B (Stanford Gyroscope Experiment) are considered in some detail. The new ether gauge theory predicts effects different from the general theory. These predictions provide the means for decisively distinguishing the new theory from the old.

Conclusions

There are a number of significant conclusions which can be made regarding the new ether gauge theory. If it is true, it is a major step forward in understanding the physical universe. A list of some of the more significant accomplishments of the new theory is given below.

It replaces the Einstein special theory with a gauge theory of velocity. This gauge theory is significant in that: (1) it restores time simultaneity; (2) it eliminates the twin paradox by removing the Lorentz transformation symmetry; and (3) it directly explains Newton's first law as the result of energy conservation during a change of gauge with velocity.

It replaces the Einstein general theory, as well as the special theory. The two theories are replaced by one coherent theory. With regard to the general theory, the new ether gauge theory is significant in that: (1) the potential energy of the gravity field is simply the energy made available as a result of the gauge change with ether density; (2) the gravitational force is a result of the gradient of ether density; and (3) the gravity waves predicted by the general theory are replaced by electromagnetic (gravitokinetic) waves in the new theory.

Other interesting characteristics of the new ether gauge theory are: (1) the true kinetic energy which generates a kinetic twist field in the ether is actually twice as big as is classically assigned to it (the gauge change with velocity releases rest-mass energy which is used, together with the external energy, to generate the kinetic field); (2) electromagnetic waves generated by normal electromagnetic means are quantized on emission and absorption but not as radiation; (3) the equivalence of inertial and gravitational mass are explained as a direct result of the parallel gauge change effects; (4) the structural glue (gravity) which holds the electron together is explained for the first time; (5) with the gravitational and electromagnetic forces clearly linked together, the unification of all forces appears possible; and (6) the unquantized background radiation is the common source of electromagnetic, gravitational and geometric quantum fluctuations.

The list of significant characteristics would not be complete without mentioning the experimental evidence which already favors the new theory over the old. These include: (1) a simple physical mechanism which explains the equivalence principle; (2) a coherent explanation which agrees with the Sagnac effect, the Thomas precession and the Michelson-Morley experiment all at the same time; (3) an explanation for the Edwards effect; and (4) indications that more unusual phenomena, such as the biased residuals in the USSR radar data, will be eliminated using the new theory. But, since it only takes one experiment to prove a theory is wrong, the most significant experiment is the Pioneer 10 experiment described in Chapter 10. It completely refutes the special theory and is in complete agreement with the ether gauge theory.

On balance, the evidence is strong enough in favor of the new theory to strongly recommend further experimental action.

Action

As detailed in Chapter 12, the new ether gauge theory predicts results from Gravity Probe B, or, as otherwise known, the Stanford Relativity Experiment, which are clearly distinguishable from the results predicted by the general theory. It is expected that this experiment will go forward without any new call for action. In addition, the search for gravity waves will undoubtedly continue, though it is a search which, I believe, is futile.

The call for action which I would like to make involves much less expensive experiments than these huge projects. The simplest new experiments which are apt to contradict the special theory are those which detect the ether drift caused by the earth's spin. Of these experiments those which detect aberration appear to be the simplest.

The speckle interferometry test described in Chapter 4 is very attractive. If the aberration caused by the earth's rotational velocity can be detected, it provides evidence of the strongest type that the special theory is wrong. The special theory predicts an aberration effect only when relative motion is involved. The new ether gauge theory predicts an aberration effect from the earth's spin velocity even when there is no motion between the source and the detector. The significance of such tests is large. The cost of such tests should be relatively modest.

A new theory has been proposed. It has significant implications. It should be reasonably easy to test. It predicts results clearly distinguishable from the special and general theories. *May the theory which corresponds to reality win.*

I believe we shall soon *escape from Einstein.*

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