Time, Motion and Relativity

Accurate measurements of *time* and *length* are of crucial importance in science; yet, tragically, confusion over the fundamentals of *time* has been common among physicists since Albert Einstein made the *observer* a factor in a measurement of a process rate; *i.e.,* the velocity of light.

"Although everyone has a general understanding of the phenomenon of time, it has—in fact—never been precisely, scientifically defined…. In a general sense, the passage of time is perceived as the relationship which exists in the sequence of occurrence of events; and, for reasons which have never been clearly understood, common sense seems to indicate that the passage of time should be uniform throughout the universe. Even Sir Isaac Newton believed this to be the case. However, although this elementary concept of time is understood by almost everyone, it is not universally accepted within the scientific community. Due primarily to the influence of relativity, it has recently become acceptable to consider the passage of time as a variable."[1]

What is Time? *Time* is best defined as the rate of a fundamental natural process; but *time* is best understood as the duration or interval between events. Probably, the most fundamental natural process is Faraday's *law of magnetic induction.* This law specifies that a certain amount of electrical force is the result of the change of magnetic flux per unit of **time**.

Some things seem obvious….

"Life can only be understood backwards, but it must be lived forwards."

—*Anonymous,* Little Bits from the Heart, published by Heartland Samplers, Inc., 1991.

Scientific studies show how *time* operates in natural processes at work in the universe. In all processes (dynamic situations where something is not stationary) scientists must use some definition of time to specify rates of process; *i.e.,* how fast something occurs and how long it takes for something to change. While all scientists agree that *time* must somehow be defined in order to quantify the rate of a natural process or the interval between events, scientists disagree on the nature of *time*. The most highly respected scientists dealt with this fundamental issue. Newton believed in "absolute time" where time flows constantly and without dependence upon any other factor.

Measuring Distance. For as long as history informs us, distance has been measured in a straightforward way specified formally by Euclidean Geometry. The distance between any two objects is measured and quantified by the number of times a standard unit of length, such as the king's foot or a specific rod of platinum, can be placed end-to-end between the two objects. The rod is considered to have a constant length that does not vary with temperature, age or any other factor. Any deviation from this assumption affects the accuracy of the measurement. But few believed that the space between the objects being measured was actually changing in length. The common idea existed that space itself did not consist of anything physical that was being measured. Nearly everyone believed an axiom called the *Principle of Relativity* (PR) where the distance between two stationary objects was fixed by the two objects themselves without influence of a third object or environmental conditions.

Measuring Time Intervals. Until 1905, almost everyone thought that time could be measured like distance, using a clock of some type to measure an interval of time. Of course, certain errors of measurement would occur without the perfect clock, but it was assumed that the time elapsed between two events was a certain value that did not vary due to any other influence, say a third event or the *location* of the clock.

Physicists recognized certain difficulties in making a measurement of elapsed time when the two events occurred at separate locations, but nevertheless assumed that this was a matter of synchronizing two clocks which would continue running at close to the same rate. Hardly anyone thought that the *problem of synchronization* of clocks could not be handled by a signal from one clock resetting a second clock with an appropriate time interval added to account for signal propagation time. For example, NASA employs this method to synchronize clocks in satellites moving with high velocity.

Einstein's Theory of Time. In 1905, Albert Einstein presented his (Special) Theory of Relativity (SRT) where time slows down for an object moving with high velocity. In SRT, simultaneity does not exist, and the instant when any event occurs is not the same for everyone, but depends upon the environment and his location in the universe. (See textbox on time, p. 7.) This conclusion stems from a postulate that all observers measure the same velocity of incoming light, no matter what velocity that observer has in the universe. Below, we will explain how this leads to notions of "curved space" and time dilation that logical thinkers reject.

Clocks versus Time. In the traditional view, a time interval is measured by the use of some clock. Care is taken to distinguish between absolute time and its measure by the use of a clock. Robert Henderson provides us with a simple example to illustrate that the passage of time is the same for everyone without regard to one's motion or location (sometimes called a *frame of reference*).

Does Time Slow Down? "As universally understood, the passage of time referred to as a 'year' is defined as being the interval required for the earth to travel one revolution around the sun. Let us now consider the tenet of SRT that the passage of time is a variable, with its passage being slower in any reference frame in direct proportion to that reference frame's relative velocity with respect to any other reference frame (that is, the greater the relative velocity the slower the passage of time."

"Let us next assume we launch a manned rocket ship from the earth at a very high rate of speed into

Time: Relative or Absolute?

"So we see that we cannot attach any *absolute* significance to the concept of simultaneity, but that two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relatively to that system."

—*Albert Einstein* (1905). The Principle of Relativity, pp. 42-43, Dover Publications, Inc.

the outer regions of space, whereupon the ship turns around and returns to the earth. Let us further assume that the period of time required for the ship to complete its round trip—as measured by residents on the earth—is one year. Let us also assume the velocity of the rocket ship with respect to the earth—is so great that time passes only half as fast on the ship as it does on the earth, in keeping with the concepts of SRT. Now, when the ship returns from its voyage, the earth will have made one complete circuit around the sun as noted by residents on the earth. However, to those passengers on the rocket ship—who are now again residing on the earth—the earth will have traveled only half-way around the sun: an obviously impossible condition.

"This simple example—using nothing other than common sense—clearly shows that the passage of time cannot be made to vary due to a reference frame's relative velocity. In addition, the absurdity of the condition brought about by this example is also encountered when the passage of time is assumed to vary *for any other reason.* For example, an outgrowth of SRT is the assumption that the passage of time is also a variable depending on the mass of a reference frame: the greater the mass the slower the passage of time is assumed to be in the vicinity of that mass. Now, if this were in truth the case, then the passage of time on the sun would be slower than its passage on the earth due to the greater mass of the sun."[2]

The Twin Paradox. A situation similar to the thought experiment just given has been described to illustrate the time dilation of SRT. One of identical twins stays on earth while his twin brother takes a trip, traveling at high velocities somewhere in space before returning to earth. Upon his return the traveling twin is supposed to be much younger biologically than the stay-at-home twin who did not experience time dilation.

This illustration reveals two errors in logic embedded in SRT. First, since SRT (as formulated by Einstein in 1905, or by Minkowski in 1908) relates the passage of time only to velocity *and not to acceleration,* either twin can be considered as the one with the greater velocity and the least aged during the interval they are apart. So application of SRT to the situation of the twins leads to a contradiction in finding that first one, and then the other twin, is the younger.

Second, the view of Einstein that time slows down with velocity (as in SRT) or with gravitational mass (as in General Relativity Theory) is quite illogical, because it is based on *shifting definitions* of the unit of length and the unit of time interval. The latter becomes immediately apparent in the Twin Paradox when it is remembered that each twin can count the same number of revolutions made by the earth about the sun during the period when they are separated.

We now quote an objection to the preceding analysis along with our defense:

> *Objection:* "When you say that 'each twin can count the same number of revolutions made by the earth about the sun,' it is as if you suggested to solve the problem of synchronization at a distance by means of a BIG clock, that every observer can "see!"

Defense: It's not a question of being able to "see" the sun. A space vehicle could travel very far and fast and still be able to "see" the sun and earth in order to count earth orbits. Besides, the count of years could be delayed until both twins are back on earth in the same frame of reference where there can be no disagreement about the elapsed time. Also, synchronization of separated clocks can be accomplished as described above and proven by NASA engineers.

Physics of Time. Of the three fundamental laws that govern forces, *time* is a factor only in Faraday's Law—where electric and magnetic energy are exchanged in proportion to the relative motion of two devices. For this reason, time should be defined in terms of Faraday's *law of magnetic induction.*

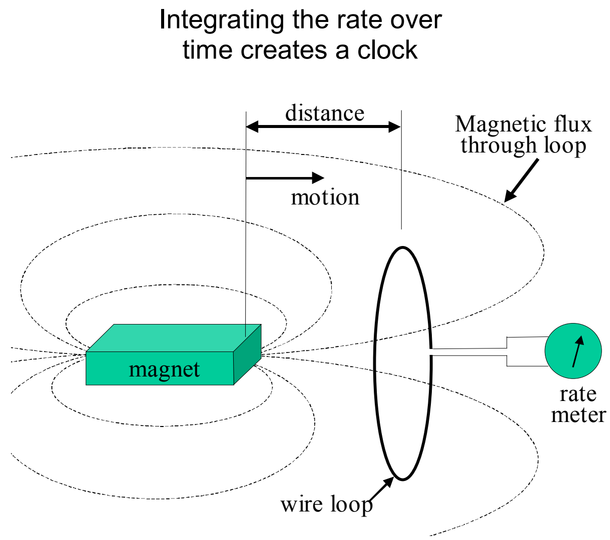
Measuring Time and Distance. It is important to know the process which is the most fundamental, because clocks based on less fundamental processes will speed up and slow down under various conditions. As the fundamental natural process, magnetic induction establishes time as rate-of-change. From this time rate-of-change, intervals of time are established, *e.g.* days, hours or years, by integrating the rate over time. Some natural clocks, such as atomic clocks, undoubtedly operate by magnetic induction. We can construct clocks to "tell time" and measure intervals of elapsed time, but we err if we assume that time is established by the indication or movements of any clock.

The Scientific Method employs standard units of measurements for distance and an interval of time in order to make accurate observations. Measuring rods such as a ruler or a bar of platinum are used to define a unit of length.

Clocks are used to measure an interval of time. Typically, each interval of time is quantified by the number of repetition cycles of some nature process such as the daily cycle of light and darkness, tides, the monthly cycle of new and full moons, or the annual cycle of the seasons.

Michael Faraday discovered, in 1831, that a *changing* magnetic field induces an electric current. This relationship eluded other researchers who did not anticipate the *dynamics* of energy exchange between electric and magnetic devices and were looking only for a static relationship. Time and process rate are intimately related in the electromagnetic relationship.

Faraday's Law used to measure velocity



Magnetic induction is the term used to describe how a changing magnetic field creates an electric field. Since two devices are exchanging energy by induction, two devices can be employed to demonstrate the effect. The figure illustrates one device as an electric circuit consisting of a single loop of wire and detecting meter. The second device is any source of magnetism and can be a permanent magnet (shown) or an electromagnet.

When the distance between the magnet and wire loop is not changed, the meter showing electrical activity (voltage or current) reads zero, indicating zero activity. But if the magnet is moved toward the wire loop, the meter detects electricity. The quantity of electricity is proportional to the velocity and motion of the magnet. The same amount of electrical activity from magnetic induction occurs when the wire loop is moved toward the magnet, showing a certain symmetry of motions in space.

Advantages of a Clock Based the Law of Magnetic Induction. A clock that measures the rate of magnetic induction has the advantage of greater accuracy to the degree that its design removes the influence of other mechanisms for energy exchange. Such a clock also has the advantage of being accurate anywhere in the universe since Faraday's law does not vary with location.

Principle of Relativity. Having defined distance and time by PR (not to be confused with Einstein's Theory of Relativity), as discussed earlier, the Scientific Method and rules of logic do not permit any deviation from the definitions in the development of a scientific theory. Following the axiomatic approach of science, *velocity* V was defined in terms of distance and time. In mathematical notation,

$$V = D / T$$

where D represents the distance between two points and T is the time interval between two events. PR places no minimum or maximum limit, nor any requirement of a constant or variable quantity on distance, time period or velocity; and a parameter is defined by the difference between its starting and ending quantity. For example, PR defines how to specify the movement of a ray of light over any distance, over any period, and with any velocity. The parameter under consideration is measured at the starting point a and the ending point b along the path. Thus, for positions d, times t, and velocities v, the path of a ray of light is described as

$$D = d_b - d_a$$

$$T = t_b - t_a$$

$$V = (d_b - d_a) / (t_b - t_a)$$

By PR, the last equation becomes

$$V = v_b - v_a$$

In this way, "relative" quantities are defined by the differences between a source and detector. PR follows *the law of cause and effect* by making the source of a light ray a factor in the velocity of the emitted light.

Applying the Principle of Relativity. Einstein began well enough, with a discussion of magnetic induction, using the same devices shown in the figure which he called a "conductor" and a "magnet." Then he discussed the "electrodynamics action" of these devices as a result of their relative motion to show that magnetic induction follows PR. He endorsed this principle and wrote that "the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good" [3, pp. 36-37] and, more formally as follows: "The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of coordinates in uniform translatory motion." While this definition of the principle is rather intimidating, the weak form (limited to distance and time) expressed earlier is included and adequate for our present discussion.

Principle of Constancy. By his failure to follow the simple approach of PR*,* Einstein committed an error in logic at the beginning of his famous paper that developed SRT.[3, 4] Having introduced the first principle of relativity, Einstein "introduce[d] another postulate…, namely that light is always propagated in empty space with a definite velocity *c* which is independent of the state of motion of the emitting body." [3, p. 38] Stated formally, "Any ray of light moves in the "stationary" system of co-ordinates with the determined velocity *c,* whether the ray be emitted by a stationary or by a moving body. Hence

$$\text{velocity} = \frac{\text{light path}}{\text{time interval}}$$

where time interval is to be taken in the sense of the definition in §1." [3, p. 41] The term "light path" is used in accordance with units of length, *i.e.,* the distance traveled by a ray of light.

While the preceding equation is written in accordance with velocity as *a dependent variable* as defined by PR*,* Einstein uses the equation as defined by the *Principle of Constancy* where light has a "determined velocity *c* [with respect to the observer]." By the Principle of Constancy, the velocity of light becomes $v = c$ for all velocities of all observers. Thus, with light velocity changed to a constant (with respect to the observer instead of the source), then the light path and measuring rod must change, along with the time interval, in order to accommodate the equation and new definition of velocity. If this is not yet obvious, the reader can study Mitsopoulis' excellent paper to see how the "relativistic" equations can be derived from PR without the conflicting postulate of the *Principle of Constancy.*[5]

Einstein seems to have been aware that the two principles were inconsistent, for he wrote about the second postulate, stating that it "is only apparently irreconcilable with the former" [3, p. 38] or, as another translation puts it, "the further assumption, —an assumption which is, at first sight quite irreconcilable with the former one…."[4] Despite this lapse in logic that eroded commitment to the Scientific Method, Einstein implied that he had reconciled the two principles that he combined to create SRT when he stated: "These two assumptions [or postulates] are quite sufficient to give us a simple and consistent theory of electrodynamics of moving bodies on the basis of the Maxwellian theory for bodies at rest. [4, p. 2]

Velocity of Light. So, we see that SRT became flawed in logic by incorporating the Principle of Constancy—the error being not the velocity of light or its constant rate, but rather the specification that light velocity depends upon the observer, quite independent of its source or, perhaps, a space medium through which the light travels. Many modern physicists insist that the Principle of Constancy is well-established by empirical evidence. But, Fox[6] and Alväger*, et. al,*[7] questioned the validity of measurements on the velocity of light by noting that the best laboratory vacuums left particles to absorb and emit light in its path to a detector. Curt Renshaw has challenged the claims that observations of light from binary stars can only be interpreted by the Principle of Constancy.[8] And other researchers have developed electrodynamics theory consistent with all known experiments, data, measurements and observations based on the Galilean Transformation instead of SRT.[9,10,11]

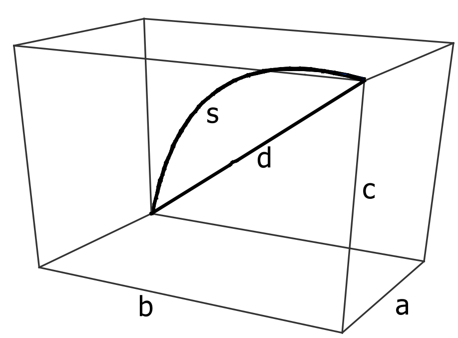
Fundamental Defects in SRT.
Einstein's Theory of Relativity has significant defects and is not a valid scientific model of physical reality. The principal reasons for this assessment of SRT are:

- An assumed interdependence of space and time (and the equivalence of "curved space").
- A non-causal assumption (regarding the velocity of light) that is unrelated to first principles.
- A point-particle assumption that eliminates self-charge effects in elementary particles.

Interdependence of Space and Time. Einstein claimed that space and time are related entities, and he added a fourth dimension in his "space-time continuum:"

> One spoke of points of space, as of instants of time, as if they were absolute realities. It was not observed that the true element of the space-time specification was the event specified by four numbers x_1, x_2, x_3, t.... Upon giving up the hypothesis of the absolute character of time, particularly that of simultaneity, the four-dimensionality of the time-space concept was immediately recognized. [12, p. 30]

Illustration of a path in "curved space" that is longer than a straight line in Euclidean space. Einstein disregarded the Theorem of Pythagoras. His SRT attempts to make s^2 equivalent to $d^2 = a^2 + b^2 + c^2$. The figure illustrates a case of "curved space" with a longer path when $\Delta s^2 > 0$. The interdependence of space and time is equivalent to a "curvature of space" that defines the path where events occur in space and the time when events occur. The "curved space" concept of SRT was developed by Minkowski (1908) in non-Euclidean geometry, but the "curved space" of Einstein's General Theory of Relativity (GTR) was developed in Riemann's non-Euclidean geometry. [13, p. 20] Later, Einstein acknowledged that



Minkowski's space "is a four dimensional, quasieuclidian [sic] space, with the line element [Δs^2], (the distance between two neighboring events)" given as [12, pp. 32, 39]

$$\Delta s^2 = \Delta x_1^2 + \Delta x_2^2 + \Delta x_3^2 + \Delta x_4^2 \qquad (1)$$

where x_1, x_2, and x_3 are the three position coordinates of space and $x_4 = ict$ is the "imaginary time variable." When $\Delta s^2 > 0$, the Minkowski formulation of SRT gives the displacement of a particle as[14]

$$\frac{d^2 s}{c^2} \equiv dt^2 \left[1 - \frac{v^2}{c^2}\right], \quad \mathrm{v} = \frac{d\mathbf{x}}{dt} \qquad (2)$$

Einstein developed the implications of equation (2); he claimed that time slows down, length contracts, and mass increases with velocity in accordance with equation (2). Einstein claimed that the same results are obtained in the original formulation of SRT by himself in 1905[3,4] and the later formulation by Minkowski in 1908.[14]

The Minkowski formulation of SRT in 1908 is based on equation (1) and "curved space." Kanarev shows the correspondence of Einstein's SRT with Minkowski's geometry by his analysis of the theorem of Pythagoras. [13, p. 10] Late in the nineteenth century, the theoretical mathematicians Riemann and Lobachevsky invented geometries different from Euclid's. Such geometries are called "non-Euclidean" or "pseudo-Euclidean." In Euclid's geometry all sides of a right triangle are straight lines, and its included angles add up to 180 degrees. In the geometries of Riemann and Lobachevsky, all sides of triangles are curved, and their included angles add up to more or less than 180 degrees. In the observable world, such geometries exist only on curved surfaces; therefore they are associated with concept of "curved space."

When Einstein and Minkowski chose $\Delta s^2 \neq 0$ in equation (1), the result was a disregard for Pythagoras' Theorem with great impact on physical theory:

- Interdependence of space and time
- Curvature of space
- Physics based on four dimensions instead of three
- "Relativistic effects" of mass, length, and time varying in accordance with velocity

Non-causal assumption. Minkowski's "curved space" coordinate system is equivalent to the non-causal premises of the Special Theory of Relativity concerning (1) postulated constant velocity of light relative to all observers and (2) interdependence of time and length dimensions.

Summary. *Time* flows at a constant rate. In science, *time* should be defined in terms of a natural process, although human *perceptions* of process rates seem to be derived from the period between an ordered sequence of two events. A consistent application of defined units of length, Newton's "absolute time," and Faraday's law of magnetic induction establish a basis in electromagnetics for descriptions of static and dynamic forces and structure in nature. These goals of physics are being fulfilled using Maxwell's concept of electromagnetic fields with the Principle of Relativity—by application of the Galilean Transformation and consistent definitions of time and length to the fundamental laws of Coulomb, Ampere, and Faraday.

References.

1. R. L. Henderson, “Time Defined,” Reality and Meaning #36 (May/June 1999).

2. R. L. Henderson, “Adversaries: The Aether Versus Relativity,” Reality and Meaning #34 (Jan/Feb 1999).

3. Albert Einstein, “On the Electrodynamics of Moving Bodies,” The Principle of Relativity, pp. 37-65, Dover Pub., (1923 & 1952).

4. A. Einstein, “On the Electrodynamics of Moving Bodies,” The Principle of Relativity, p. 2, pub. by the University of Calcutta (1920)]

5. T. D. Mitsopoulis, The Disproof of the Special Theory of Relativity, 23 Monis Kyccou st., Papagou, Athens, Greece (1989).

6. J. G. Fox, “Constancy of Velocity of Light, J. Opt. Soc. **57** (7) 967.

7. T. Alväger*, et. al,* “Test of the Second Postulate,” Physics Letters **12** (3) 260.

8. C. Renshaw, “The Extinction Length for Distant Sources and Its effect on Measured Period of Binary Stars,” 680 America’s Cup Cove, Alpharetta, GA 30202.

9. T. G. Barnes, “A Classical Foundation for Electrodynamics,” CSS paper **CR1**.

10. C. W. Lucas, Jr., “Electrodynamics of Real Particles vs. Maxwell’s Equations, CSS paper **TC3**.

11. D. L. Bergman, “Theory of Forces,” CSS paper **LN1**.

12. A. Einstein, The Meaning of Relativity, Princeton University Press, Princeton, NJ (1953).

13. P. M. Kanarev, The Crisis of Theoretical Physics, 11 Pushkin Street, #19, 350063, Krasnodar, Russia (1997).

14. H. M. Schwartz, “Relativity, Minkowski Formulation,” McGraw-Hill Encyclopedia of Science & Technology, 7th ed., McGraw-Hill, Inc., NY, NY, **15,** 286 (1992).