

Chapter 25

FLAWED CONCEPTS OF SIMULTANEITY & COMMON TIME

Einstein's contrived concepts of 'simultaneity,' 'common time' and 'proper time' were based upon his concept of a 'synchronous mathematical time for each inertial system,' which empirically does not exist. Thus, Einstein's 'common time' and 'proper time,' artificially results in the same time for all spatially separated events and observers with synchronized clocks situated at different locations on an inertial system of coordinates or frame of reference. These spurious concepts were applied by Einstein to distort measurements throughout his Special Theory in order to artificially eliminate time intervals, space intervals and relative motions, all in a failed attempt to achieve his primary relativistic goal of velocity dependent co-variant magnitudes for all physical phenomena, including the velocity of light at c .

During the middle of May 1905, Einstein had a long discussion with his friend and colleague, Michele Besso, about the 'difficulties' surrounding the velocity of light.¹ (Folsing, p. 155) The next day Einstein stated to Besso concerning such discussion:

“Thank you. I've completely solved the problem. An analysis of the concept of time was my solution. Time cannot be absolutely defined, and there is an inseparable relation between time and [the] signal velocity.”² (*Id.*)

Six weeks after his meeting with Besso, Einstein finished writing his Special Theory treatise and it was received by the publisher on June 30, 1905. (*Id.*, p. 156)

During such long discussion with Besso, Einstein must have come to grips with the fact that the real culprit that was causing the 'difficulties' of $c + v$ and $c - v$ was the relative motion between the stationary embankment and the carriage moving linearly away at v . The evening after such discussion Einstein must have realized that if he could

¹ Seventeen years later, Einstein recalled that: “we discussed every aspect of the problem.” (Folsing, p. 155) Of course, we now know from Chapters 21 and 22 that there were no real empirical difficulties concerning the velocity of light.

² Here Einstein meant that distant simultaneity cannot be absolutely defined by a human observer, because “there is an inseparable relation between time and [light] signal velocity.” And he was right. However, later he contradicted himself and asserted that there was an ‘absolute mathematical distant simultaneity’ for all observers with synchronized clocks on an inertial reference frame. We will explain what all of this means later in this chapter.

mathematically negate the time interval (t') and the space interval (vt) described by the Galilean transformations, then he could eliminate the relative motion between the two inertial reference frames and with it the troublesome classical addition of velocities ($c \pm v$) would also be eliminated. This scenario could provide a solution for Einstein's mathematical 'difficulties,' because then the velocity of light could algebraically remain a constant magnitude of c for all inertial frames and observers on such frame. It turns out that his Special Theory, which he wrote during the next six weeks, mathematically accomplished this artificial solution, as we shall soon see in Chapters 25 through 29.

Section 1 of Einstein's 1905 Special Theory was primarily devoted to: 1) his definition of a synchronous mathematical time on a stationary system of Cartesian coordinates (frame of reference), and 2) his description of the constant velocity of light at c on such finite stationary system. In the process, Einstein defined an absolute 'common time' for all spatially separated observers with synchronous clocks situated on every inertial frame of reference. By this method, Einstein artificially did away with time intervals between events and coordinate measurers (inertial observers) on such frame. These spurious concepts of time would later distort all of Einstein's coordinate measurements, because such distortions (i.e. contractions of distance and expansions of time) were necessary in order to construct his relativistic concepts and for his Special Theory as a whole to appear plausible.

A. Time and Simultaneity

What do we normally mean by the word 'time?' According to the writings of Ernst Mach in the late 19th century, 'time' as an independent reality does not exist. In other words, any concept of time is only an arbitrary convention or definition of

convenience that serves to relate a sequence of events for an observer. Poincaré agreed in 1898. (Jammer, 2006, pp. 96, 100, 101)

The normal concept of ‘time’ has at least three distinct meanings: ‘instant,’ ‘interval’ and ‘eternity:’

1. An ‘instant’ can be defined as the moment in the ‘eternity’ of the universe that any light ray is emitted anywhere in the universe (a ‘light event’), or the moment that such light event is later perceived by a distant human observer.³
2. An ‘interval’ of time can then be defined as the duration between two light events or two instants.
3. We define ‘eternity’ as the infinite duration and continuance of existence of things in the universe.

A clock is merely a convenient convention which humans use to identify an ‘instant,’ or to measure an ‘interval’ of time. The algebraic symbol (t) can either be used to mean an instant (t) or an interval (such as ct or vt), but $t_2 - t_1$ only algebraically describes an interval. (see Dingle, 1972, pp. 133 – 134) An ‘event’ is mathematically defined as “a point in space and a point in time together.”⁴ (Rohrlich, p. 5)

As we proceed through this and other chapters, it is important to distinguish the concepts of ‘simultaneity,’ ‘sequence’ and ‘causality’ (cause and effect) from the above concepts of ‘time.’ ‘Simultaneous’ normally means ‘at the same time’⁵ (Goldberg, p.

³ It follows that any moment in the eternity of the universe is simultaneous for every observer located anywhere in the infinite universe. But these simultaneous events that occur at such moment and at different places throughout the infinite universe are not perceived by spatially separated human observers to be simultaneous, because of the distance/time interval delay of each light signal that propagates from such distant light event through empty space at the finite velocity of c to the eye of the local human observer.

⁴ “The eruption of a volcano is specified as an event when not only the location of the volcano is given but also the exact time of the eruption.” (Rohrlich, p. 65)

⁵ This definition of course begs the question: what do we mean by ‘time’? For example: is it an empirically observed time or a mathematical time in the abstract?

113), or as Poincaré defined it: when the order of two events may be interchanged.⁶ (Poincaré, *Measurement of Time*, 1898 [Miller, p. 174]) “As long as the two events [occur] at the same place there is no problem.” (Goldberg, p. 110) But when “two physical [events occur] far from one another,” the simultaneity of their times and the order (‘sequence’) of their causation or occurrence may not be obvious, and it may require considerable analysis and explanation.⁷ (see Poincaré, 1898 [Miller, p. 174])

It is also very important to realize and remember that everything we discuss in this chapter (including Einstein’s definitions of ‘simultaneity’ and ‘time’) relates to Einstein’s contrived system of measurement. He needed his specific system of measurement (with its specific, arbitrary and artificial definitions) in order to construct his Special Theory, its strange relativistic concepts and its bizarre mathematical consequences. All of this for one primary, unnecessary and impossible purpose: to mathematically require that the velocity of light is *measured* by coordinates to be c simultaneously by every inertial observer in every inertial frame of reference. (Chapters 21E, 21F and 24C)

In 1905, in Section 1 of his Special Theory, Einstein attempted to define ‘time’ in terms of ‘simultaneity.’ However, in the process he defined, illustrated and commingled several very different concepts, including the following:

1. ‘Actual Observed Distant Simultaneity’ is the perception that two light events occurred at the same instant by a human observer who is at the position of the two light events or who is equidistant from them.⁸ (see Figure 25.1A)
2. ‘Apparent Distant Simultaneity’ occurs where two distant light events occur at

⁶ As we shall soon see, Einstein would give many different, strange, and non-intuitive meanings to the word ‘simultaneous,’ in order to construct his Special Theory.

⁷ In the “analysis of two widely separated physical facts, the notion of causality, simultaneity and time [can sometimes become] intermingled.” (Miller, p. 174)

⁸ Any form of ‘actual simultaneity’ could also be characterized as ‘absolute simultaneity.’

different instants, but they are perceived by a local human observer to have occurred simultaneously.⁹ (see Figure 25.1B)

3. ‘Absolute Mathematical Distant Simultaneity’ is Einstein’s absolute and generally meaningless definition for the coordinate measurement of the same instant that two or more light events occur at different places (usually on a single frame of reference), where synchronized “clocks at the respective places record the same time for [such events].”¹⁰ (Resnick, 1968, p. 52; see Figure 25.1C)

In 1898, Poincaré referred to the concept of ‘actual observed distant simultaneity’ as the psychological or ‘conscious’ simultaneity of a human observer. (Jammer, 2006, p. 100) On the other hand, Einstein’s definition of ‘absolute mathematical distant simultaneity’ had nothing to do with conscious or actual perceived simultaneity. It only dealt with light events that abstractly occur at the same instant anywhere in the Cosmos, synchronized clocks at such events, inertial reference frames, coordinates and coordinate measurers (mis-characterized as ‘observers’). (see Figure 25.1C) In other words, Einstein’s coordinate definition of ‘absolute mathematical distant simultaneity’ only deals with the same time or instant in the abstract, rather than the normal concept of the instant of visual perception by a human observer.¹¹

Very importantly, it must be realized by the reader at this early juncture that Einstein’s various misleading concepts of simultaneity, of synchronization of clocks, and of time, only served to help him mathematically construct his contrived Special Theory, and to sufficiently confuse the reader into believing that his relativistic concepts might

⁹ This concept has also been mischaracterized as ‘relative simultaneity,’ because the perceived actual simultaneity of such events is relative to the distance/time interval delay of c between the distant position of light emission and the local position of its perception by a local observer.

¹⁰ This concept has also been characterized as ‘coordinate time.’ (see Jammer, 2006, p. 111) Resnick concluded that: “Events occurring at two different places in that frame must be called *simultaneous*.” (Resnick, 1968, p.52) Later in this chapter we will demonstrate why this mathematical conclusion by Resnick is empirically invalid and generally meaningless for a human observer.

¹¹ Even though three distant light events in Figure 25.1C are actually simultaneous or mathematically simultaneous, they could not be perceived by a distant human observer to be simultaneous, and such actual ‘apparent distant non-simultaneity’ would have no meaning for a human observer.

have some empirical merit. However, such concepts have no real meaning for a human observer nor for empirical physics.

Let us now begin to discuss: 1) whether any concept of simultaneity is a reasonable definition of ‘time’ or even a logical or necessary benchmark from which to determine a sequence of events; 2) whether any form of simultaneity has any meaning for a human observer; and 3) why Einstein needed his mathematical or coordinate definition of simultaneity in order to construct his Special Theory.

B. Apparent Distant Simultaneity and Actual Observed Distant Simultaneity

By 1905, Einstein and the entire scientific community knew that there was a distance/time interval delay for the light signal transmitting at the finite velocity of 300,000 km/s (c) from the distant position of emission of a light ray to the position of a local observer’s perception of such light ray. This had been demonstrated by Römer in 1676 and confirmed by Bradley in 1728.¹² (see Figures 6.5, 6.6 and 7.5B) Based upon this fact, Einstein is reputed to have stated in early 1905: “Time cannot be absolutely defined, and there is an inseparable relation between time and the light signal.”¹³ (see Einstein, Kyoto, 1922 [Physics Today, August 1982, p. 46]; Folsing, p. 155) In effect, Einstein was asserting that the instant of occurrence of a distant light event empirically varies for all observers in the Universe, depending upon the distance/time interval delay of the light signal from the distant light event to each observer’s eyes, and such local

¹² This distance/time interval delay of c for a distant light event in the Solar System, and the instant of its perception by an observer on Earth, was implicit in Römer’s 1676 deductions concerning the finite velocity of light, and his delayed perceptions on Earth of the eclipses of Jupiter’s moon, Io. (Figure 6.5)

¹³ This statement and others like it are often asserted as Einstein’s challenge to the validity of Newton’s 1687 concept of absolute time, when the light signal was believed by most people to be instantaneous. On the contrary, by 1687 Newton knew of Römer’s observations and theory (see Chapter 6C), but he refrained from including Römer’s theory in the *Principia* because Bradley did not empirically confirm it until 1728 (the year after Newton’s death). Nevertheless, Einstein was correct when he asserted that, “there is no universal ‘now’ as there was with Newton’s absolute time” in 1687. (Hoffmann, 1983, p. 101)

observer's understanding of the instant that such distant light event actually occurred (as related to his local Earth time).

For example, each morning sunrise is an empirical light event for every observer on Earth. But it takes a time interval of 8-1/3 minutes for light emitted by the Sun to propagate the 93 million miles of distance from the Sun to the Earth at c (300,000 km/s).¹⁴ So the Sun physically rises well above the horizon of the Earth 8-1/3 minutes before the light emitted by the Sun begins to reach our eyes and we on Earth begin to observe the light event of sunrise. (Figure 25.2A) Thus, no local Earth time can be assigned by an observer on Earth to such sunrise event, nor to the instant of such distant emission of light by the Sun, until after this distance/time interval of delay is factored into such computation.¹⁵ Not until well after this 8-1/3 minute distance/time interval delay of c transpires, can we fully perceive and understand the sunrise event.¹⁶ (Figure 25.2B)

It is obvious from the above example that the observer on Earth who is watching the event of a sunrise does not observe the light emitted by the Sun simultaneously with its actual emission 93 million miles away. Nevertheless, such observer perceives and usually intuitively assumes that such distant light emission and his local observation thereof are simultaneous events. This is a good example of 'apparent distant simultaneity.' (Figure 25.1B)

Early in Section 1 of his Special Theory, Einstein correctly described this universal misperception of 'apparent distant simultaneity,' with the following example:

¹⁴ We shall refer to this delay phenomenon of the light signal as the "distance/time interval delay of c ."

¹⁵ Likewise, each individual observer cannot determine, relate and assign a local Earth time to the instant that light was emitted by a distant light event vis., an exploding star: i) until the light signal from such event, transmitting at the constant finite speed of 300,000 km/s, reaches such observer's eye so that she can perceive it; and ii) unless and until the distance interval and/or the time interval from such observer to such distant light event is determined and factored into the computation.

¹⁶ Rocket scientists, astronomers and mathematicians must consider these delayed perceptions when they compute a trajectory to a distant planet.

“We have to take into account that all our judgments in which time plays a part are always judgments of simultaneous events.¹⁷ If, for instance, I say, ‘That train arrives here at 7 o’clock,’ I mean something like this: ‘The pointing of the small hand of my watch to 7 and the arrival of the train are simultaneous events.’”¹⁸ (Einstein, 1905d [Dover, 1952, p. 39])

Thus where Einstein and his watch are in the immediate vicinity of a light event (the arrival of the train) so that the time indicated by the positions of the hands of his watch and the slightly distant light event (the arrival of the train) are capable of almost simultaneous observation,¹⁹ and all objects and observers are stationary (relatively at rest), then Einstein would assert that both events (the positions of the hands on his watch striking seven and the train’s arrival) are almost actually observed simultaneous events for the observer with the watch.²⁰ (see Figures 25.1A and 25.3A) In Special Relativity the above scenario (observing two events at the same instant) is sometimes referred to as ‘local simultaneity.’ (see Jammer, 2006, p. 120)

But, actually, the above events only occurred at approximately the same instant in time as perceived and evaluated by each human observer. In a footnote, Einstein acknowledged that he chose to ignore the “inexactitude that lurks in the concept of simultaneity of two events at approximately the same place.” (Einstein, 1905d [Dover,

¹⁷ This is not really a correct statement. In reality, our judgments normally concern apparently simultaneous distant events, such as an automobile passing us on the other side of the freeway or a distant jetliner entering a cloud.

¹⁸ The ‘stationary system’ on the Earth (the train station) in Einstein’s example was, of course, an inertial system in uniform rectilinear motion through space, where the observers, clocks and events all share the common motion of the Earth and are in somewhat close proximity to one another. In effect, Einstein was describing the motions and the approximate common times of an observer and two events on an inertial reference frame (the Earth) in Galileo’s Relativity.

¹⁹ Later Einstein would assert that the simultaneous observation by two distant observers of the hands of two different synchronous clocks pointing to the same clock number is what he meant by a ‘simultaneous time’ and ‘simultaneous events;’ not that one observer would judge such distant events to occur at the same instant. (see Einstein, *Relativity*, pp. 27 – 28) Mathematically Einstein was correct, but empirically he was not correct. (see Figure 25.1)

²⁰ “[I]n the remainder of the relativity paper Einstein used the term event to mean an occurrence at a particular position, measured relative to an inertial reference system by a rigid measuring rod, and whose time [proper time] was registered by a clock at that point.” (Miller, p. 182) This may be a ‘mathematical event,’ but it is not an empirical event.

1952, p. 39, footnote]) This inexactitude occurs because of the distance/time interval delay of the light signal with a finite speed of c (300,000 km/s) from the position of the waiting observer (Einstein) and his clock relative to the position of the slightly distant arriving train.²¹ (see Figure 25.3A) The fact that the clock of the waiting observer on the platform and the clock of the engineer on the train may be synchronized to exactly the same mathematical time does not make the train's arrival and the passenger's clock pointing to seven empirically or consciously simultaneous events for either observer.

From the above discussion, one begins to realize that Einstein was going to co-mingle several very different concepts of simultaneity in his Special Theory.²² For example, the 'mathematical absolute simultaneity' of any two distant light events only refers to the abstract instant of their occurrence, regardless of any observation by a human observer. Whereas, the empirical evaluation by a human observer as to whether two distant light events are actually or absolutely simultaneous must also consider the time interval from each distant occurrence to such observer's eyes. On the other hand, an observer's evaluation that a nearby light event and a distant light event are actually simultaneous events is only an illusory misassumption of 'apparent distant simultaneity' that fails to consider the time interval for light to propagate from each light event to such observer's eyes.²³

²¹ Of course, such events are not rigorously or exactly simultaneous; they are only perceived to be simultaneous by the observer. Even where two observers are standing one behind the other near to the arriving train, their perceptions of the time of arrival of the train are not exactly simultaneous, because of the slight difference in distance from each observer's eyes to the train, and because of the slight difference in the distance/time interval delay of c relative to each pair of eyes. On the other hand, such perception would be empirically simultaneous if such two observers were exactly equidistant from the train.

²² Some of these concepts of simultaneity would be empirical with a human observer, some of these concepts would be mathematical with coordinates and/or a theoretical measurer, and some of these concepts would be totally false.

²³ Even where two observers are equidistant from a light event, they still may not evaluate such light event to be simultaneous. This difference in evaluation can result from the relative linear motion of either the

Uncountable light events occur every day at the same instant on Earth and throughout the universe. Such absolute simultaneity can have meaning where two human observers are in very close proximity, such as where they simultaneously kiss each other or shake hands. But for the most part there is no meaning for any human observer with respect to such absolute distant simultaneity. In the real world, it is rare for observed distant events to occur simultaneously with any meaning for human observers. It is even more unusual for distant simultaneous events (that could have meaning for humans) to have their actual distant simultaneity measured with precision by any human observer. For example, it is rare indeed for a horse race to end in a dead heat as measured by a judge at the finish line, or for two equidistant supernovae to be observed and measured to have occurred at exactly the same instant.²⁴ Except for timed events and certain laboratory or technical experiments, the concept of absolute simultaneity (in any form) is hardly a useful concept for physics, or a reliable benchmark from which to judge the local time for the instant of a distant light event or the sequence of any light events.²⁵

Why then did Einstein choose the symmetrical concept of ‘simultaneous events’ as the benchmark for his definition of ‘time’?²⁶ Resnick claimed that Einstein was attempting to create an unambiguous universal time scale, because the illusion of apparent distant simultaneity resulted in an invalid absolute time scale ($t = t'$) for the

light event or the observer during the propagation of the light. (see Figure 25.3B) Our contrived example is similar to the contrived example that Einstein used to demonstrate his Relativity of Simultaneity concept. (see Figure 26.3)

²⁴ Most likely such a simultaneous supernovae event has never been witnessed, nor may it ever be. The only way that an observer could ever know whether such supernovae were actually simultaneous would be to empirically determine the exact distance/time interval delay of c from each distant supernova to his eye.

²⁵ If one uses the concept of the distance/time interval delay of c for the determination of the local instant of perception of distant light events and current technology to measure the distance, then any concept of simultaneity becomes superfluous even as a benchmark for such determination of time or sequence.

²⁶ One reason, of course, was simply because it was symmetrical. (see Jammer, 2006, pp. 115, 120, 125, 139, 201 – 219)

measurement of all events. In other words: “That the same time scale [$t' = t$] applied to all inertial frames of reference was a basic [false] premise of Newtonian mechanics.”²⁷ (Resnick, 1968, p. 50) Resnick also inferred that Einstein synchronized the clocks in a single frame of reference so that he could create an unambiguous time scale in that frame.²⁸ (*Id.*) In addition, Resnick implied that Einstein “set up a universal time scale”²⁹ (*Id.*, p. 50), because actual simultaneity was a relative concept.³⁰ (*Id.*, pp. 53, 55)

Contrary to Resnick’s dubious rationalizations and attempted justifications, the real reasons that Einstein chose simultaneity as the basis for his definition of time and for his synchronization of clocks on each inertial reference frame had nothing to do with simultaneity *per se* and very little to do with any time scale. In reality, Einstein needed his concept of ‘absolute mathematical distant simultaneity’ in order to theoretically create an artificial ‘common time’ or a ‘simultaneous mathematical time’ for all spatially separated coordinate points or coordinate measurers with synchronized clocks on any inertial frame, for two basic reasons that were fundamental to his Special Theory. 1) In order to artificially eliminate time intervals on every inertial coordinate system (reference frame) moving at v so that he could claim that the velocity of light had the same temporal

²⁷ Therefore, asserted Resnick, the time measurements for events in Newtonian mechanics were inaccurate, and “we certainly shall not have a universal time scale if different inertial observers disagree as to whether two events are simultaneous.” (Resnick, 1968, p. 50)

²⁸ “We certainly cannot have observers in the same reference frame disagree on whether clocks are synchronized or not.” (Resnick, 1968, p. 51) “Then we can set up time scales in exactly the same way in all inertial frames and compare what different observers have to say about the sequence of two events, A and B.” (*Id.*, p. 51)

²⁹ This velocity dependent universal time scale was the Lorentz transformation equation for ‘local time:’ $t' = t - v/c^2 \cdot x / \sqrt{1 - v^2/c^2}$. (see Einstein, *Relativity*, p. 37)

³⁰ Neffe in effect refuted all of the above dubious characterizations and rationalizations by Resnick by asserting that such ambiguities and differences in time and time scales “had been standard knowledge in physics for a long time prior to Einstein.” (Neffe, p. 129) Miller went even further and stated that such known differences in the time of distant events were intentionally ignored by Poincaré and other mathematicians so that the definition of physical time in physics could “be expressed in a convenient and simple form,” i.e. the equation $t' = t$ contained in the Galilean transformations. (Miller, p. 176) Thus, Einstein’s criticism of the inexactitude of distant times contained in the Galilean transformation equation for time ($t' = t$) was not the great revelation for physics that Einstein and his followers claim it to be.

coordinate measurement of c for every spatially separated observer on each inertial reference frame (instead of $c - v$ or $c + v$);³¹ and 2) as a stationary benchmark for time on one inertial reference frame so that observers with differently synchronized clocks on different inertial reference frames (coordinate systems) with different relative velocities would have asymmetrical and ‘non-simultaneous’ coordinate measurements for the time of a light event, and out-of-sync and ‘non-simultaneous’ coordinate measurements for the distance (length) of an object, when measured between such reference frames.

These distorted coordinate measurements between different reference frames were necessary for Einstein’s asymmetrical concepts of the ‘Relativity of Simultaneity’ and the ‘Relativity of Length.’ (see Chapter 26) These two asymmetrical and distorted concepts would then become the justification for Einstein’s adoption of the meaningless Lorentz transformation equations, which were the heart of his Special Theory. (see Chapter 27) The Lorentz transformations in turn mathematically eliminated time intervals (t') and space intervals (vt) of different inertial reference frames, and thus their relative motions, so that the velocity of light could be simultaneously and algebraically covariant (a constant c) for all inertial observers.

If Einstein had applied the normal empirical process for determining the local time of a distant light event for a local human observer, which we have previously described,³² there would have been: 1) no need for Einstein’s concepts of simultaneity, synchronous clocks, or common time, 2) no coordinate distortions between reference

³¹ Without time intervals between coordinate points, the results of these artificial measurements would be the same as if time was $t' = t$ and the velocity of light was instantaneous rather than finite. (see Chapter 21.E) We will explain these distorted time measurements for the velocity of light in detail later in this chapter.

³² This normal process involves the empirical determination of the distance/time interval delay of velocity c from the position and instant of a distant light emission (event) to the eyes of the local human observer at the instant of his perception.

frames, 3) no concepts of the ‘Relativity of Simultaneity’ or the ‘Relativity of Distance,’ 4) no Lorentz transformation equations, 5) no absolute (co-variant) propagation velocity of a light ray at c simultaneously for all inertial observers, and thus 6) no Special Theory of Relativity.’ It is just that simple.

It should begin to become obvious to the reader that Einstein’s strategy for his Special Theory was to assert one dubious concept (absolute mathematical distant simultaneity), that would rationalize a second artificial concept (mathematical distant simultaneity of synchronized clocks), that would support another invalid *ad hoc* concept (the Relativity of Simultaneity), that would justify another meaningless *ad hoc* concept (Lorentz transformations), that would mathematically confirm another impossible *ad hoc* concept (his absolute and simultaneous co-variant propagation velocity of light at c for all inertial observers), that would ...well you get the idea. However, since this relativistic ‘house of cards’ (see Figure 1.1) was not only based on many false premises and other illogical false assertions, but was also *ad hoc* and unnecessary, it was inevitable that it would ultimately fall.³³

C. How did Einstein contrive his artificial and absolute coordinate definitions of absolute mathematical distant simultaneity, synchronous or simultaneous mathematical time, and the common time or the proper time of an inertial reference frame?

First let us examine how Einstein constructed his mathematical ‘Definition of Simultaneity’ in § 1 of his 1905 Special Theory.³⁴ Einstein initially referred to an inertial frame of reference as a “system of coordinates in which the equations of Newtonian

³³ Despite the many attempted rationalizations, misanalyses, conjectures, false confirmations, etc., of Einstein’s followers.

³⁴ In 1916, Einstein also contrived a somewhat different mathematical ‘definition of simultaneity,’ which we shall discuss later in this chapter and in detail in Chapter 26.

mechanics hold good...to the first approximation.”³⁵ (Einstein, 1905d [Dover, 1952, p. 38]) Einstein called this reference frame the ‘stationary system’ or the ‘system at rest.’ It was where observers (measurers), their clocks, and the body or point to be measured by Euclidean geometry, Cartesian coordinates and rigid rods were all relatively stationary in the same inertial frame of reference.³⁶ (*Id.*) Einstein then stated:

“If we wish to describe the *motion* of a material point, we give the values of its co-ordinates as functions of the time.”³⁷ (*Id.*, pp. 38 – 39)

Thereafter Einstein defined “a time exclusively for the place where [a clock] is located.”³⁸ (*Id.*, p. 39) For example, if a light event (such as a flash of lightening) occurs at exactly the same location as observer A and her clock, then Einstein asserted that the time of the light event for observer A was indicated by the observed positions of the hands on her clock. That is to say, the clock time indicated by the hands of her clock and the flash of lightning were locally observed to be simultaneous events for observer A.³⁹ (see Figure 25.4A) But, asked Einstein, what if observer A had “to evaluate the times of events occurring at places remote from [her clock]?” (*Id.*) For example: What if observer A had to evaluate the time of a different lightning flash which occurred at the distant location of observer B and his clock? (see Figure 25.4B)

When the local observer has “to evaluate the times of events occurring at places

³⁵ It was “a coordinate system in which Newton’s First Law, the law of inertia, holds true.” (Jammer, 2006, p. 140) Jammer also points out that Einstein’s 1905 paper “contains a logical paradoxism, for it starts with the premise of the validity of Newtonian mechanics and concludes with a refutation of it.” (*Id.*, p. 141) The footnote (“to the first approximation”) was added in 1923, because in Special Relativity the Galilean transformations are only considered to be a first approximation of the relativistic Lorentz transformations at low velocities. (*Id.*, pp. 141, 142)

³⁶ Resnick illustrated a framework of measuring rods and clocks that an observer (such as Einstein) might have used to determine the space-time coordinates of an event. (see Figure 25.5B)

³⁷ Einstein did the same thing when he wished to mathematically describe the propagation of a light ray.

³⁸ Remember that Einstein’s example of this ‘proper time’ concept was where the hands of his watch pointing to 7 o’clock and the arrival of the train in the station were observed to be simultaneous events.

³⁹ This concept is what Einstein and his followers would later call a ‘proper time.’

remote from” his or her clock, then the distance/time interval delay of c becomes a factor in relating a local time of observation to the instant that such distant light event occurred. As Einstein then pointed out, where lightning strikes at two distant locations (A and B) on a stationary railway embankment, we can establish an “A time” and a “B time” by the above method (vis. proximity of each lightning strike to each observer, the time indicated by the hands of each observer’s clock, and the local observations of the instant of such light events by observers located at A and at B). But, cautioned Einstein, “we have not defined a common ‘time’ for A and B.”⁴⁰ (Einstein, 1905d [Dover, 1952, pp. 39, 40])

Why did Einstein even want to define a common time for A and B? This common or synchronous time for two spatially separated human observers would be the same as the common or synchronous time contained in the Galilean transformation equations ($t' = t$). It would be meaningless for either human observer as an empirical method to determine the local time for a distant light event on the other frame. It would also result in the same concept as the universal absolute ‘now’ time contained in Newton’s ‘absolute time,’ which Einstein correctly asserted was invalid for precise measurements.

Nevertheless, Einstein then attempted to define a ‘common time’ for spatially separated observers A and B in such ‘stationary system.’ But first, asserted Einstein, we must “establish by definition that the ‘time’ required by light to travel from A to B equals the ‘time’ it requires to travel from B to A.” (*Id.*, p. 40) “By definition,” Einstein meant

⁴⁰ In 1898, Poincaré had already anticipated and discussed in detail the problems of determining ‘simultaneity’ and a ‘common time’ for distant observers. In 1898, Poincaré pointed out in his treatise on the *Measurement of Time*: “Not only do we have no direct experience of the equality of two times, but we do not even have one for the simultaneity of two events occurring in different places.” (Folsing, p. 175; Jammer, 2006, p. 100) It is obvious that Einstein got the idea to define ‘time’ in terms of ‘simultaneity’ from Poincaré’s earlier writings.

that he would have to assume: 1) that space was isotropic and homogeneous (vis., the same in all directions and everywhere), 2) that the velocity of light was constant in all directions, and 3) that the geometry of space was Euclidean.⁴¹ (see Miller, pp. 181, 183 – 184)

Einstein then theoretically sent a light ray emitted from A at clock time t_A which propagated towards B and then reflected from B at clock time t_B and propagated back towards A and arrived at A again at clock time t'_A . (see Figure 25.5A) In Einstein's own words:

“Let a ray of light start at the time ‘A time’ t_A from A towards B, let it at the ‘B time’ t_B be reflected at B in the direction of A, and arrive again at A at the time ‘A time’ t'_A .” (Einstein, 1905d [Dover, 1952, p. 40])

Einstein then claimed that (in accordance with his definitions) “the two clocks synchronize if $t_B - t_A = t'_A - t_B$.”⁴² (*Id.*) This equation, which describes the equivalent measurement of two time intervals by propagating light signals, is sometimes described as Einstein's ‘synchrony equation.’⁴³ (see Jammer, 2006, p. 118) Einstein also assumed that “this definition of synchronism is free from contradictions, and possible for any number of points.”⁴⁴ (*Id.*)

⁴¹ These were substantially the same assumptions or conventions that Poincaré used for the same reasons in 1898. (Miller, pp. 175 – 176, 181) Poincaré had adopted such conventions in order to avoid the vicious circle of defining the ‘velocity of light’ with ‘time,’ and defining ‘time’ with the ‘velocity of light.’ (Jammer, 2006, pp. 101, 102) It turns out that such time/space assumptions were also consequences of Einstein's two fundamental postulates for Special Relativity. (Miller, pp. 183 - 184) What a coincidence?

⁴² Einstein was correct, where the distance to and fro is the same finite distance in a stationary system. In this context, ‘time’ means reading the ‘instant’ of a light event (such as emission) as shown by the hands of both synchronized clocks, the clock at A and the clock at B. (Jammer, 2006, p. 111) Einstein's method of synchronizing clocks by light signals had also been previously anticipated, devised and published by Poincaré. (Folsing, p. 175; see Jammer, 2006, pp. 104, 108)

⁴³ Einstein's ‘synchrony equation’ was necessary for his Special Theory as a stationary algebraic benchmark for one reference frame, from which to compare two different algebraic time intervals for a relatively stationary inertial reference frame and a relatively moving inertial reference frame in his concept of the Relativity of Simultaneity. (see Chapter 26A)

⁴⁴ Einstein then described how his definition of synchronism could be “possible for any number of points.” “1. If the clock at B synchronizes with the clock at A, the clock at A synchronizes with the clock at B. 2.

According to Resnick, Einstein's 1905 procedure for synchronizing distant clocks depended upon the following additional requirements:

1. There must be a "measured distance $[L]$ between the clocks..."
2. There must be an agreed upon procedure between observers "that A will turn on his light source when his clock reads $t = 0$ and observer B will set his clock to $t = L/c$ the instant he receives the signal."⁴⁵ (Resnick, 1968, p. 52)

Neither Einstein's synchrony equations nor his equation in § 1 for the to and fro velocity of light at c in a stationary system ($2AB/t'_A - t_A = c$) tells us the value of c nor the distance of A to B.⁴⁶ (see Figure 25.5A) However, we can now precisely measure these values, i.e. by laser beams sent from the Earth to the Moon and back, even without a clock and a man on the Moon to help us.

Why did Einstein define the synchronization of two spatially separated identical clocks by an algebraic equation, where the clock time t_B minus the clock time t_A (one time interval of light propagation) equals the clock time t'_A minus the clock time t_B (another time interval of light propagation)? He had already established by definition that such two time intervals were equal. Also, why did he define equal time intervals in terms of a synchronous clock time at each point (light event)? The answer is because Einstein needed to define time intervals in this abstract and imprecise manner in order to attempt to demonstrate his concept of the 'Relativity of Simultaneity' in Section 2 of his

If the clock at A synchronizes with the clock at B and also with the clock at C, the clocks at B and C also synchronize with each other." (Einstein, 1905d [Dover, 1952, p. 40]) In effect, Einstein's definition and examples of synchronism were nothing more than spatially separated clock times in his concept of 'absolute mathematical distant simultaneity.' (see Figure 25.1C) They are meaningless for a human observer.

⁴⁵ But, practically, how would the distance between clocks be precisely measured in 1905, especially in empty space? Realistically, how long would it take for A to react, then for B to react and then for A to react? Unless such reactions were instantaneous the results would be distorted or merely approximations.

⁴⁶ Einstein's equation ($2AB/t'_A - t_A = c$) was also necessary as a benchmark from which to compare two different theoretical algebraic velocities for light in Einstein's so-called proof of the Relativity of Simultaneity. (see Chapter 26A)

Special Theory. (see our Chapter 26A)

Toward the end of § 1, Einstein claimed that each distant light event (at A or at B) was now “simultaneous or synchronous” for both spatially separated observers (A and B) who shared a common synchronous time on the same frame of reference. In Einstein’s own words:

“Thus with the help of certain imaginary physical experiments we have settled what is to be understood by synchronous stationary clocks located at different places, and have evidently obtained a definition of ‘simultaneous,’ or ‘synchronous,’ and of ‘time.’ The ‘time’ of an event is that which is given simultaneously with the event by a stationary clock located at the place of the event,⁴⁷ this clock being synchronous, and indeed synchronous for all time determinations, with a specified stationary clock.”⁴⁸ (Einstein, 1905d [Dover, 1952, p. 40])

But we must ask: How can the ‘time’ of each sequential light event (emission, reflection and receipt) in Einstein’s above thought experiment (where $t_B - t_A = t'_A - t_B$) be both synchronous and/or simultaneous for each observer, A and B?⁴⁹ We only discover the answer to this clever paradox when we read Einstein’s 1916 book, *Relativity*. By a ‘simultaneous’ time of two distant sequential events, Einstein meant that the ‘position of the pointers’ (hands) of each clock (A and B) are simultaneously pointing to the same number on the face of each spatially separated clock when the instant of each spatially separated event is determined.⁵⁰ (see Einstein, *Relativity*, p. 28) He did not mean that the instant of occurrence of such spatially separated events was judged to be simultaneous by a distant observer. Now we begin to understand why Einstein chose the

⁴⁷ This axiom is the basis for Einstein’s concept of ‘proper time,’ which we will discuss in detail in Chapter 25D.

⁴⁸ This axiom is the original basis for Einstein’s concept of the ‘common proper time of all events on an inertial system.’

⁴⁹ The concepts of ‘synchrony’ and ‘simultaneity’ may both be symmetric, but they are certainly not identical. (see Jammer, 2006, p. 115)

⁵⁰ In other words, all that Einstein was really claiming was that such spatially separated clocks showed a synchronous time. Was not this clever and misleading definition also devious?

reading of clock times as his definition or convention for the determination of the ‘time’ (instant) of an event.⁵¹ Einstein’s rationale for the reading of the positions of hands of a clock was: “in this manner a time-value is associated with every event which is essentially capable of observation.” (*Id.*)

Jammer further explained the above ambiguous quotation by Einstein concerning a ‘synchronous time’ and a ‘simultaneous time’:

“The notions of simultaneity and of clock synchronization are intimately related, because spatially separated events are defined as simultaneous if and only if synchronized clocks at the locations of these events indicate the same readings when the events occur. Hence every definition of clock synchronization is a definition of simultaneity and vice versa.” (Jammer, 2006, p. 120)

What Einstein really defined and settled with his definition of simultaneous and synchronism is that in his theoretical system of measurement every spatially separated measurer at every point on a coordinate system (inertial reference frame) measures with his synchronous clock the same mathematical ‘synchronous time,’ ‘simultaneous time’ and ‘common time’ for every spatially separated event on such frame.⁵² Einstein made these facts very clear when (at the end of Section 1) he referred to these times as the “time of the [entire] stationary system” (frame of reference). (Einstein, 1905d [Dover, 1952, p. 40]) Einstein also reiterated this concept in 1916:

“It is clear that this definition [of ‘simultaneity’] can be used to give an exact meaning not only to two events, but to as many events as we care to choose, and independently of the positions of the scenes of the events with respect to the body

⁵¹ In *Relativity*, we also discover another artificial meaning for simultaneous time: two light rays that require “the same time [interval] to traverse” equal distances may be considered to do so in simultaneous times. (see Einstein, *Relativity*, p. 27) Here ‘simultaneous’ means ‘equal.’ In this regard, Einstein stated: “There is only one demand to be made of the definition of simultaneity, namely, that in every real case it must supply us with an empirical decision as to whether or not the conception that has to be defined is fulfilled.” (*Id.*) In effect, ‘the end justifies the means.’

⁵² Any of these times are substantially identical to the impossible absolute time ($t' = t$) described by the Galilean transformations where the light signal must have an instantaneous or infinite speed.

of reference (here the railway embankment).⁵³ We are thus led also to a definition of ‘time’ in physics.”⁵⁴ (Einstein, *Relativity*, p. 27)

When we strip away all of Einstein’s “imaginary physical experiments,” his arbitrary and misleading definitions, axioms, and conventions, and his dubious analogies and rationalizations, we discover that he has invented at least five more dubious variations of his ‘absolute mathematical distant simultaneity’ concept. Such variations may be described as follows:

1. Synchronous clocks that simultaneously show the same clock time at spatially separated coordinate points.⁵⁵
2. The ‘common coordinate time’ or ‘mathematical time’ for all spatially separated points on a coordinate system (frame of reference).
3. The ‘common proper time’ for all events occurring on an inertial reference frame as indicated by any observer’s synchronous clock time.
4. A ‘coordinate time interval’ as indicated by different coordinate clock times of spatially separated synchronous clocks, and algebraically described as $t_2 - t_1$.⁵⁶
5. The equivalence of the terms ‘synchronous’ and ‘simultaneous.’

All of the above concepts and their variations may be meaningful for mathematicians, but they are completely meaningless for human observers and for empirical physics. For example:

- A. The absolute mathematical simultaneity of distant light events has no meaning for a human observer, unless he can perceive such distant occurrences and

⁵³ This is Einstein’s 1916 restatement of his axiom for the ‘common proper time of events on an inertial system.’ This concept means that the clock time for one event is also the clock time for all events that occur on the same frame at the same instant, even if such events are spatially distant from a synchronized clock. But if the clocks of all spatially separated observers are synchronized to show exactly the same clock time, how can any one human observer know or understand from such synchronized clocks the instant that any distant event empirically occurred? She cannot.

⁵⁴ For all of the reasons set forth in this chapter, Einstein’s ‘definition of time in physics’ is meaningless for a human observer and also probably for physics.

⁵⁵ This concept is basically the same as the 24 ‘time zones’ that the Earth is currently divided into, where each time zone has the same synchronous time for all observers and events.

⁵⁶ Einstein needed a coordinate time interval to be described imprecisely by algebraic clock times (i.e. $t_2 - t_1$) rather than precisely by empirically elapsed time intervals, in order to confuse and mislead his readers and to construct his other relativistic concepts. (for example, see Chapter 26)

understand the significance of their local times. Remember our examples of the dead heat horse race and the simultaneous supernovae.

B. Synchronous clocks cannot help a human observer to understand the local time of a distant light event, nor the time interval of light propagation involved. Rather they actually confuse and distort such understanding.

C. Just because clocks located at spatially separated points A and B on an inertial frame are defined to be simultaneous and are synchronized to show the same clock time, this does not mean that distant light events on such inertial frame are perceived to be simultaneous by each spatially separated human observer.⁵⁷ (see Figures 25.1C and 25.3A) It is important to remember throughout this remainder of this treatise that whenever Einstein (or any of his followers) refers to simultaneity or simultaneous events, he may just be referring to events that are arbitrarily considered to be simultaneous or which are mathematically simultaneous as measured by synchronous clocks.

D. Einstein's other mathematical concepts, such as 'common coordinate time' and 'common proper time,' are equally meaningless for human observers for similar reasons.

By this juncture, the reader must realize how artificial and contrived Einstein's various definitions and examples of simultaneity, synchrony and common time really were. One minute Einstein would talk about the empirical observations of a human observer, and the next minute he would talk about the coordinate measurements of a mathematical measurer...as if they were the same concepts. This commingling of completely different concepts must also be extremely confusing for any reader.⁵⁸

⁵⁷ The clocks of an observer in Boston, MA, and an observer in Pittsburgh, PA, are both synchronized to Eastern Daylight Time, but each observer on the inertial Earth (in Boston and Pittsburgh) does not perceive the light event of sunrise 'simultaneously.' The Pittsburgh observer (being much farther west) perceives the sunrise event about 40 minutes after the Boston observer; some mathematicians might say one nanosecond later. In any event, such physical events and their perceptions are not simultaneous, even though their clocks are synchronous.

⁵⁸ Section 1 of Einstein's 1905 treatise is perhaps the most misleading, confusing and contrived section of his entire Special Theory.

D. Why did Einstein need his definitions and concepts of simultaneity, synchrony and common time?⁵⁹

There is one very obvious reason: coordinates and clocks. Einstein needed his definitions, concepts and algebraic examples of simultaneity, synchronous clock time, common time, and velocity c to be ‘properly’ measured by coordinates and clocks in one inertial reference frame theoretically at rest, as benchmarks for comparison with different ‘non-proper’ coordinate and clock measurements of the same phenomena between two relatively moving inertial reference frames.⁶⁰ The primary reason for these comparisons of proper and non-proper coordinate and clock measurements was to illustrate Einstein’s twin concepts of the Relativity of Simultaneity (time) and the Relativity of Distance (length) in the next step of his Special Theory.⁶¹ (see Chapter 26)

What do we mean by ‘proper’ and ‘non-proper’ measurements? In Special Relativity, either reference frame may be called the ‘rest frame.’ This definition (rest frame) means that the thing to be measured by coordinates, and by the coordinate measurer (observer) with her rigid measuring rod and synchronized clock, are all relatively stationary with one another. All clock and coordinate measurements made in a rest frame are by relativistic convention called ‘proper.’ (see French, pp. 105 – 106) The length of a rigid rod “as measured [by coordinates] in its rest frame is called its proper

⁵⁹ Many writers suggest various reasons, but everyone seems to be confused. For example, Miller suggests that Einstein “declared the definition of simultaneity to be identical with clock synchronization.” (Miller, p. 183) Einstein did, but that is not an answer for why. (also see Jammer, 2006, p. 110; Resnick, 1968, p. 52)

⁶⁰ For this reason, at the end of Section 1 of his 1905 Special Theory, Einstein stated: “It is essential to have time defined by means of stationary clocks in the stationary system...” (Einstein, 1905d [Dover, 1952, p. 40])

⁶¹ Unfortunately, the reader cannot fully understand why such ‘proper’ measurements made in a rest frame and ‘non-proper’ measurements made between relatively moving frames were so critical to Einstein’s Special Theory, until we discuss such artificial measurements in detail in Chapters 26 and 28. Suffice it to say at this point that if Einstein had not invented ‘proper’ measurements and used coordinates and clock times to make his measurements, there would be no Special Theory. Modern technological methods of measurements would not have worked for Einstein’s Special Theory.

length...,” which is designated by l_0 .⁶² (*Id.*, p. 106) Similarly, the time of a clock and an event as observed and measured in its rest frame is called its ‘proper time,’ and is designated by t_0 . (*Id.*)

In order to construct his Special Theory, Einstein decreed that the ‘proper time’ of an event is the ‘clock time of a stationary clock with an observer at the place of the event.’ (Einstein, 1905 [Dover, 1952, p. 40]) Thus, a ‘proper time’ can only be measured in one frame of reference by one clock. (see Goldberg, pp. 77 – 78, 464, and French, p. 106) All other measurements of time in Special Relativity are considered to be ‘non-proper.’⁶³ Therefore, the measurement of clock time between two reference frames is non-proper because it requires two clocks, and the measurement of a time interval between two events on the same reference frame is non-proper if such measurement requires more than one clock. (*Id.*) Of course, “a time interval measured by two different clocks at two different places” would also be non-proper. (see Resnick, 1965, p. 64)

There are also other proper quantities or measurements in Special Relativity, such as ‘proper mass.’ (*Id.*, p. 117) All of the above ‘proper’ quantities or measurements “represent invariant quantities in relativity theory.”⁶⁴ (*Id.*, p. 64) It follows that (in relativity theory) all non-proper measurements and quantities are not invariant (they do not have the same magnitude or value in all inertial reference frames). Why? Because, according to Einstein’s method of measurement, coordinate measurements between

⁶² “Any other measurement of length is called non-proper, and...yields a value less than l_0 by a factor corresponding to the Lorentz transformation.” (French, p. 106) The reason for this will become apparent in Chapters 27 and 28.

⁶³ Non-proper time measurements are considered to be slower than t_0 by a factor corresponding to the Lorentz transformation. The reason for this will become apparent in Chapters 27 and 28.

⁶⁴ In other words, they have the same value in all inertial reference frames.

different inertial reference frames are distorted as are time measurements because relatively moving clocks run slow.⁶⁵ (see Chapter 28)

All of the above axioms or conventions concerning proper and non-proper coordinate measurements of length and clock times of events were, of course, completely *ad hoc*.⁶⁶ There is no physical or empirical reason that would make their existence necessary. Unfortunately, it is not until we read Chapters 26 and 28 that we can fully understand why Einstein needed to invent these arbitrary conventions, why they were essential to his artificial relativistic concepts and his Special Theory in general, and why such conventions and their measurements were so absurd.

A second reason why Einstein needed his definition of simultaneity and the same synchronous clock time as shown on all spatially separated clocks of all observers in an inertial reference frame...is not so obvious. It was in order to theoretically and artificially eliminate all time intervals between coordinate points on every inertial reference frame,⁶⁷ so that Einstein and his followers could claim that the velocity of a light ray propagating through such frame would always be covariantly and simultaneously measured with coordinates and clocks to be c (rather than $c \pm v$) by all inertial observers on every inertial reference frame in the Cosmos.⁶⁸ (see Chapter 24C)

Let us now discuss and describe how Einstein may have rationalized these contrived and artificial results.

⁶⁵ Do any of Einstein's contrived methods of measurement make any empirical sense? Of course not.

⁶⁶ They are all very similar to the *ad hoc* conventions that Lorentz invented for his April 1904 transformation treatise. (see Chapter 16; Goldberg, pp. 98 – 102)

⁶⁷ This is a result that Einstein would later accomplish mathematically with his Lorentz transformations. (see Chapter 27)

⁶⁸ Why do we come to these conclusions? Because $c + v$ and $c - v$ basically describe a relative velocity, a relative velocity cannot exist between reference frames without a time interval, and there is no time interval between reference frames for a covariant algebraic magnitude, no matter now it is accomplished. (see Einstein, *Relativity*, pp. 47 – 48)

Remember that early in Section 1 of his 1905 treatise, Einstein stated the way that mathematicians describe the motion of a material point: “We give the values of its coordinates as functions of the time” interval of its motion. (see Einstein, 1905d [Dover, 1952, pp. 38 – 39]) This is why the factor vt describes the distance moved by a material point in the Galilean transformations in order to determine its relative position or distance traveled. It follows that if these coordinates all have the same value for time there will be no time interval and thus no motion of the material point that can be mathematically described. This is what Einstein theoretically accomplished with his synchronous common time for each coordinate point (measurer with a synchronous clock) on an inertial reference frame.

This scenario would equally apply to the propagation of a light ray. If the coordinates of the light ray all have the same synchronous common time, then there will be no time interval and thus no motion (propagation) of the light ray that can be mathematically described.⁶⁹ Because every inertial observer on an inertial reference frame theoretically measures a ray of light passing through the frame as a function of coordinate time, and all clocks at all coordinate points on such frame are synchronized to the same coordinate time, therefore Einstein and his followers could claim that the velocity of light was simultaneously a constant c relative to all inertial observers at all coordinate points, not $c \pm v$.⁷⁰ (see Chapter 24C)

For example, if Einstein theoretically sent a light ray at velocity c toward a

⁶⁹ In other words, it would be as if $t' = t$; a light ray would theoretically and mathematically propagate instantaneously from one point to another without any time interval for such propagation.

⁷⁰ Restated in different words: if Einstein stipulated that the tip of a ray of light always propagates through empty space with the absolute constant velocity c , and that clocks at all coordinate points in an inertial frame are synchronized to show the same coordinate time, and if the velocity of a light ray passing through an inertial frame is measured as a function of coordinate time, then he could assert that a light ray measured with the same coordinate time at all points has the same velocity c for all inertial observers, rather than $c + v$ or $c - v$.

linearly moving reference frame, the light ray's velocity relative to any point on such moving frame, as measured by the same synchronous coordinate time value for all of its coordinate points, would mathematically be c (not $c - v$ or $c + v$) regardless of the linear velocity of the observer at v relative to such light ray. Why? Because all of such equal coordinate time values would not permit the mathematical coordinate description of any motion or propagation.⁷¹

Perhaps this scenario is what prompted Dingle to write: Einstein's "theory forbids us to form a picture of *any motion at all*." (Dingle, 1961, p. 21)

"We must content ourselves with stating the result of an experimental measure of the velocity of any beam of light with respect to any body at all. The theory therefore demands that we give up the attempt to picture, not merely what it is that moves, but the process of motion itself, the passage from point to point as time goes on. That requires us to express in a formula the velocity of light with respect to two relatively moving bodies in such a way that the value c results for both."⁷² (*Id.*, p. 20)

Later, Einstein artificially and mathematically accomplished this same result with his Lorentz transformation equations for time. (see Chapter 27) When the Lorentz transformations translated the velocity c of a light ray from one reference frame to another, it artificially eliminated the relative velocity v in the factors $x \pm vt$ and $t \pm vx/c^2$ so that there was no relative velocity that could mathematically be described and thus there was no mathematical time interval between the two reference frames.

The final reason why Einstein needed his concepts of simultaneity and synchrony was in order to remain consistent with his absolute, co-variant and impossible law for the

⁷¹ Imagine that a light ray was propagating from Boston to Miami in the Eastern Time zone, which has identical coordinate values for time. There would be no coordinate time intervals measured by clock times for such propagation, so the light could be interpreted as having the velocity c relative to every linearly moving observer along the way (instead of $c - v$ or $c + v$).

⁷² This is also what Einstein mathematically accomplished with his relativistic formula for the composition of velocities. (see Chapter 29)

constant propagation velocity of light at c relative to any inertial reference frame in the Cosmos at any instant. In this regard, Einstein stated:

“We suppose further, that, when three events A , B and C occur in different places in such a manner that A is simultaneous with B , and B is simultaneous with C (simultaneous in the sense of the above definition),⁷³ then the criterion for the simultaneity of the pair of events A , C is also satisfied.⁷⁴ This assumption is a physical hypothesis about the law of propagation of light; it must certainly be fulfilled if we are to maintain the law of the constancy of the velocity of light *in vacuo*.” (Einstein, *Relativity*, p. 27, F.N.)

However, Einstein’s above contrived example was a non sequitur. A light ray may take the same time interval to propagate to and fro between events A and B , and the same time interval to propagate to and fro between events B and C , but this does not mean that all of such events occur simultaneously at the same instant. The reason why such example was (for Einstein) “a physical hypotheses about the law of propagation of light” *en vacuo* was so that such velocity of light could theoretically and mathematically always be a constant and co-variant magnitude of c simultaneously (in the above nonsense) with respect to A , B and C , and regardless of their linear velocities (or empirical time intervals) relative to the light ray.⁷⁵

In 1914, Einstein asserted that his concept of simultaneity was “the most important, and also the most controversial theorem of the new theory of relativity.”

(Einstein, 1914 [Collected Papers, Vol. 6, p. 4]) And for good reason!

E. Is the common time of an inertial reference frame a meaningful concept?

Where did Einstein’s concept of the ‘common time of an entire inertial frame’

⁷³ Very importantly, here the nonsense of Einstein’s definition of simultaneity was that light takes the same time interval to travel a certain distance in two opposite directions.

⁷⁴ Einstein’s criteria for the simultaneity of events A and C is that light takes the same time interval to propagate between $A - B$ and then between $B - C$; not that events A and C occurred simultaneously at the same instant as perceived by a human observer.

⁷⁵ It becomes obvious that for Einstein ‘simultaneity’ and ‘synchronous clocks’ were a form of symmetry.

really come from? In Lorentz's April 1904 treatise, he asserted that each inertial reference frame in his contraction theory had its own unique "local-time." (Lorentz, 1904 [Dover, 1952, pp. 15, 17, 19, 25, 26, 28]; also see Miller, p. 177) In 1905, Einstein copied Lorentz's April 1904 concept of 'local time'⁷⁶ and ultimately changed its name to the 'common time' or 'proper time' of an inertial reference frame. How do we know this? Because, as Einstein explained in his 1907 Jahrbuch article:

"One had only to realize that an auxiliary quantity introduced by H. A. Lorentz and named by him 'local time' could be defined as 'time in general. If one adheres to this definition of time, the basic equations of Lorentz's theory correspond to the principle of relativity, provided that the [Galilean] transformation equations are replaced by ones [vis. the Lorentz transformations] that correspond to the new conception of time."⁷⁷ (Einstein, 1907 [Collected Papers, Vol. 2, p. 253])

Pais paraphrased the above quotation⁷⁸ and also pointed out that in Special Relativity "there are as many times as there are inertial frames." (Pais, p. 141) Born also confirmed these facts, as follows:

"The time as read from a clock in the [inertial] system of reference in which it is at rest is [in Einstein's Special Theory] called the proper time of the system. This is identical with the 'local time' of Lorentz."⁷⁹ (Born, p. 250)

Is Einstein's 'synchronous common time' for A and B, his common 'time of the stationary system,' his common 'proper time for all events occurring on an inertial

⁷⁶ As we pointed out in Chapters 16 and 24, Lorentz's 'local time' in April 1904 was not the same as his much more limited concept of 'local time' in his 1895 treatise. Lorentz's 1895 local time ($t' = t + vx/c^2$) was merely an arbitrary measurement from true time that was invented to algebraically remove the factor v from the results of first order light experiments. However Lorentz's 'modified local time' of April 1904, which added $\sqrt{1 - v^2/c^2}$ as a denominator, theoretically resulted in an entirely different and unique time for each inertial reference system. (see Goldberg, pp. 94 – 100) It was Lorentz's April 1904 'modified local time' that Einstein adopted for his Special Theory.

⁷⁷ Poincaré also based his synchronization procedure for clocks on Lorentz's April 1904 'modified local time' before Einstein did. (see Jammer, 2006, p. 104)

⁷⁸ "All that was needed was the insight that an auxiliary quantity introduced by H.A. Lorentz and denoted by him as 'local time' can be defined as 'time' pure and simple." (Pais, p. 141) But since Lorentz's April 1904 modified concept of 'local time' was based on the 'true time' of ether, it is meaningless. Therefore, Einstein's 'common time,' 'proper time' and time (pure and simple) based on such modified 'local time' is also meaningless.

⁷⁹ In Special Relativity, every inertial system has a unique common local time, regardless of its size.

system,' and Lorentz's April 1904 'modified local time' for every inertial reference frame, all the same basic concept? This would appear to be a correct analysis. It thus becomes obvious that Einstein's Special Theory incorrectly equated the instant of each human observer's perception of the occurrence of a distant light event with the common inertial motions of all observers with synchronized clocks (common time) on the same inertial body. But one might ask: what relevance do common inertial motions and synchronized clocks have with respect to each spatially separated human observer's perception and evaluation of the instant that a distant light event occurs? The answer is: none.

Einstein's mathematical concepts of a 'synchronous common time' and a 'proper time of the system' implies that there is a 'common local time of perception' for all human observers situated at different locations on an inertial system. (Figure 25.6A) But, on the contrary, since each human observer in the Cosmos occupies a unique position, and since there is a unique distance/time interval delay of c from a distant light event to each observer's unique position, it follows that there is a unique 'local time' of perception of any distant light event for each human observer in the Cosmos. (Figure 25.6B) The state of motion (common, inertial, accelerated, or otherwise) of the observer and his frame, and the synchronization of his clock (or not), is irrelevant to such unique local time of perception by each human observer.

Of course, Einstein should have defined 'local time' and 'proper time' in terms of the unique position of each human observer at the instant of his perception of a distant light event and the unique distance/time interval delay of c from such distant light event to such observer's unique position...regardless of any common motion or synchronized

clocks on an inertial system (frame of reference). But that would not have furthered Einstein's relativistic agenda, for the reasons previously set forth in this chapter.

Einstein's synchronized 'common time' for each observer, and his arbitrary 'proper time' for an entire inertial system, are only rough approximations of the local time of a distant event for each human observer located at a different position on an inertial system.⁸⁰ Such concepts might have some semblance or reasonable approximation of validity in Einstein's above example, where a man in a railway station looking at the small hand of his watch pointing to seven and the arrival of the train at the same station, are located in the same general vicinity. But even with this example of an inertial observer in close proximity to two different light events (sometimes mischaracterized as 'local simultaneity'), Einstein acknowledged "the inexactitude which lurks in the concept of simultaneity of two events at approximately the same place..."⁸¹

However, not considered nor acknowledged by Einstein in his Special Theory was the scale of the inertial system: the larger the dimensions of the inertial system being considered, the greater is this 'inexactitude.' For example, the Earth is an inertial system. All of the people on it experience its common inertial motion through space, and the clocks of all such people are sequentially synchronized by time zones. Does this mean that a woman in London and a woman in Beijing experience the simultaneous perception of a distant light event, such as a sunrise? Of course not. Such women on opposite sides of the Earth cannot even observe the same sunrise event. There is no 'common local time' of perception for these observers, there is no common 'proper time' for a sunrise

⁸⁰ These arbitrary times can also create a false or illusory assumption of simultaneity.

⁸¹ Again, this inexactitude is caused by the somewhat greater distance/time interval delay of the light signal from the headlight of the somewhat more distant train to the eye of the observer with his watch in the train station. The linear motion of the train only varies the inexactitude.

event, and Einstein's attempt to arbitrarily create one (by synchronization of their clocks or by his absolute definition of mathematical distant simultaneity) becomes an impossible absolute concept fraught with great inaccuracy.

Now imagine, on a much greater scale, an inertial system one thousand times the size of the Sun, where two observers at opposite ends of a 300,000 km railway carriage simultaneously create light events. Each observer would not perceive the simultaneous light event at the other end of the carriage for a time interval of one second. Thus, even if their clocks were synchronized to the same 'common local time' or common 'proper time' of the giant railway carriage, the two distantly separated observers would not empirically perceive the two simultaneous light events to be simultaneous because of the distance/time interval delay of c between them. Empirically, there is no 'common local time' of perception for these observers with synchronized clocks, located on the same inertial frame and sharing the same common inertial motion. Likewise, there is no common 'proper time' or 'common local synchronous time' for perceptions by any spatially separated human observers on any inertial system.

From the above examples, it becomes obvious that empirically there are as many unique 'local times of perception' of a distant light event, as there are observers located at unique positions in the Cosmos. This is true, regardless of the state of motion of such observers or the state of synchronization of their clocks. (Figure 25.6B) Once this fact is realized, the common relative motion of inertial frames, inertial observers and the synchronization of their relatively stationary clocks become irrelevant to the determination of the time of occurrence of distant events by each human observer. The only thing that remains relevant to the concept of 'local time' is the distance/time interval

delay of c , from the unique position of the distant light event at the instant of light emission...to the unique position of the eye of each human observer at the instant of perception of such light event.

Since Einstein knew that the local time of perception of a distant light event was unique to each individual human observer's position,⁸² why then did he adopt the synchronized 'common local time' of an entire inertial system as his definition of 'time' for all observers and all events on such inertial system, regardless of their different positions? Why did Einstein define and apply 'proper time' and 'simultaneity' as between inertial systems (frames of reference), and not as between the position of emission of light and the position of an observer's perception thereof?

We have already answered these questions in the previous Section 25D of this chapter, and in other prior chapters. The most obvious answer is: because Einstein's Special Theory was constructed upon the concepts of Cartesian coordinates, Galileo's Relativity of inertial motions, the uniform velocities of Lange's inertial reference frames (systems), and the Galilean transformation equations from one inertial system (frame of reference) to another. The contrived differences in the perceptions of times, time intervals and distances which Einstein needed in order to demonstrate his concepts of the Relativity of Simultaneity and the Relativity of Distance (Chapter 26), so as to justify substituting the Lorentz transformations for the Galilean transformations (Chapter 27), could only be claimed as viewed and measured between two different inertial reference frames or systems (each with a different relative velocity and a different synchronous, common and proper time); not between the positions of a distant event and a local human

⁸² This knowledge was demonstrated by Einstein's acknowledgement of the inexactitude of approximate simultaneity in his railway station example.

observer. In other words, Einstein needed the ‘inexactitudes’ inherent in ‘apparent distant simultaneity’ and in the ‘common time’ and ‘proper time’ of different inertial reference frames in order to demonstrate and justify such twin concepts. (see Chapter 26)

In addition, transformation equations, and especially the Lorentz transformations, which constituted the mathematical foundation for his Special Theory, could only theoretically apply between inertial reference frames or (coordinate) systems in Lange’s abstract version of Galileo’s Relativity, not between the positions of individual human observers. (see Chapters 13, 14 and 16) In effect, Einstein’s Special Theory would not work if all that was considered was the unique position of each individual observer relative to the position of a distant light event, regardless of the state of their relative motion or the synchronization of their clocks.

There is yet another reason why Einstein’s ‘proper time of an inertial system’ or ‘modified local time’ is mathematically flawed and empirically meaningless. Lorentz’s April 1904 transformation equation for ‘modified local time’ (t'),

$$t' = \frac{t - vx/c^2}{\sqrt{1 - v^2/c^2}},$$

was theoretically measured from the ‘true time’ (t) of clocks absolutely at rest in the ether. Since neither ether nor absolute rest exists, there is no way to determine such ‘modified local time’ from universal ‘true time’ (t), which was pure fiction. (Bohm, pp. 40, 41) Since Einstein’s factor for ‘common time’ in his Lorentz transformation for time (t') is admittedly nothing more than Lorentz’s April 1904 transformation factor for ‘modified local time’ by the different name of ‘common time’ or ‘proper time’ (Pais, p. 141; Born, p. 250; Einstein, 1907 [Collected Papers, Vol. 2, p. 253]), there is no way to mathematically determine the value of such ‘common time’ or ‘proper time’ from such

fictional true time (t). The above algebraic symbols are empirically meaningless in both theories?

Apparent distant simultaneity (Figure 25.1B) is an illusion; it is not actual or empirical simultaneity, where two events occur at the same instant. It may even be described as relative simultaneity; that is, simultaneity relative to the distance/time interval delay of c between the distant occurring event and the eyes of the local human observer. No one needs to prove these empirical conclusions; they are obvious. Does Einstein's reference to a distant light event and a local observer as being on different inertial reference frames change the above scenario? No. Does Einstein's synchronization of clocks on each different inertial frame change the above scenario? No, but it does create an absolute and meaningless form of mathematical distant simultaneity which theoretically and mathematically makes "events occurring at two different places in that frame...simultaneous." (see Resnick, 1968, p. 52; Figure 25.1C) Has Einstein's synchronization of clocks in each co-moving frame resulted in a universal time scale that is used by humans?⁸³ No...only chaotic confusion for mathematicians between reference frames. (see Chapters 26 and 28) Was this Einstein's intent when he invented his Special Theory? Possibly.

In his 1916 book, *Relativity*, Einstein devised a different demonstration and illustration of his concept of simultaneity. (see Figure 25.4) However, this different illustration suffers from all of the same flaws and faults as his original 1905 definition and illustrations of simultaneity, as we shall further discuss in the next Chapter 26.

⁸³ Is it ever even referred to by astronomers or astrophysicists? Probably not.

F. Einstein's Definition of Simultaneity...Geometrically Illustrated

Rohrlich suggested a light experiment to test the simultaneity of events between two relatively stationary locations and clocks: the light location/clock A on Earth and the mirror location/clock B on the relatively stationary Moon, as measured on coordinates by an Earth observer and an observer on a rocket R' moving at v . (see Figure 25.7A)

Rohrlich concluded from the scenario described on Figure 25.7A that simultaneity between A and B had been established.⁸⁴ (*Id.*, pp. 63 – 64)

Of course, the time of clock/event A and the time of clock/event B were not empirically simultaneous, nor was the time of event C. They did not occur at the same instant. The time of the clocks at positions A and B were only synchronized by light rays and mathematically simultaneous according to Einstein's system of measurement, as were the events of emission (event A), reflection (event B) and receipt again at A (event C). Because this scenario was described as an inertial reference frame, the clocks of A and B showed the same synchronous common time, and for this reason Einstein would say that their time was simultaneous. (Einstein, 1905d [Dover, 1952, p. 40]) Similarly, the stationary observer at position A measured event A and event C with the same clock and within the same frame of reference, so both of such measurements could be considered by Einstein to be 'proper times;' and of course a 'proper time' is equivalent to 'common synchronous time.' Does any of this make any logical or empirical sense? No.

Rohrlich then stated that the above procedure could "be depicted graphically" by coordinates on a 'space-time diagram.' (Rohrlich, p. 64) Rohrlich's space-time diagram is illustrated on Figure 25.7B. Based on such space-time diagram Rohrlich concluded

⁸⁴ It turns out that the simultaneity between A and B was established only in the sense that the clocks on A and B were synchronous.

that: “The point B₁ is simultaneous with A₁ because at the instant t₀ + t/2 both are halfway in time between sending and receiving at A.” (*Id.*) This is a strange and contrived mathematical type of simultaneity.

Rohrlich also graphically demonstrated Einstein’s mathematical and coordinate concept of Relative Simultaneity. (Figure 25.7C) The fact that the relatively moving rocket pilot might mark down different coordinates for the same events because of his relative translatory motion v and his resulting physical delay in plotting such coordinates has absolutely nothing to do with the actual simultaneity or non-simultaneity of such events. (see Chapter 28) It is like comparing fire with water.

This abstract ‘space-time’ type of geometric simultaneity was invented in 1908 by Einstein’s colleague Hermann Minkowski *inter alia* for the specific purpose of illustrating Einstein’s concepts of Special Relativity. (see Chapter 30) Such a geometric abstraction may be mathematically meaningful to a pure mathematician, but it is certainly not the same concept as empirical simultaneity which even Einstein originally defined as: the ‘same instant that the hands of his watch point to seven and the train arrives at the station.’ Mathematical analogies and consequences may assist the mathematical physicist in his thinking process as long as he doesn’t take them too seriously, literally or confuse them with empirical reality. In the end, whatever concept or theory he comes up with must pass the empirical test of observation, experiment and physical reality.

(Chapter 1)

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For all of the above reasons, it becomes apparent that Einstein’s mathematical (coordinate, inertial frame, and synchronous time) concept of ‘simultaneity,’ which is

fraught with artificial definitions, inexactitudes and illusionary misassumptions, is not the proper method with which to analyze and describe the concept of the ‘time’ (instant or interval) of a distant light event for a local observer. The correct empirical procedure is to determine (by contemporary technological methods) the distance/time interval between the distant light event (at the instant of its emission) and the local observer (at the instant of his observation), and then apply the distance/time interval delay of c (300,000 km/s) to such determination.

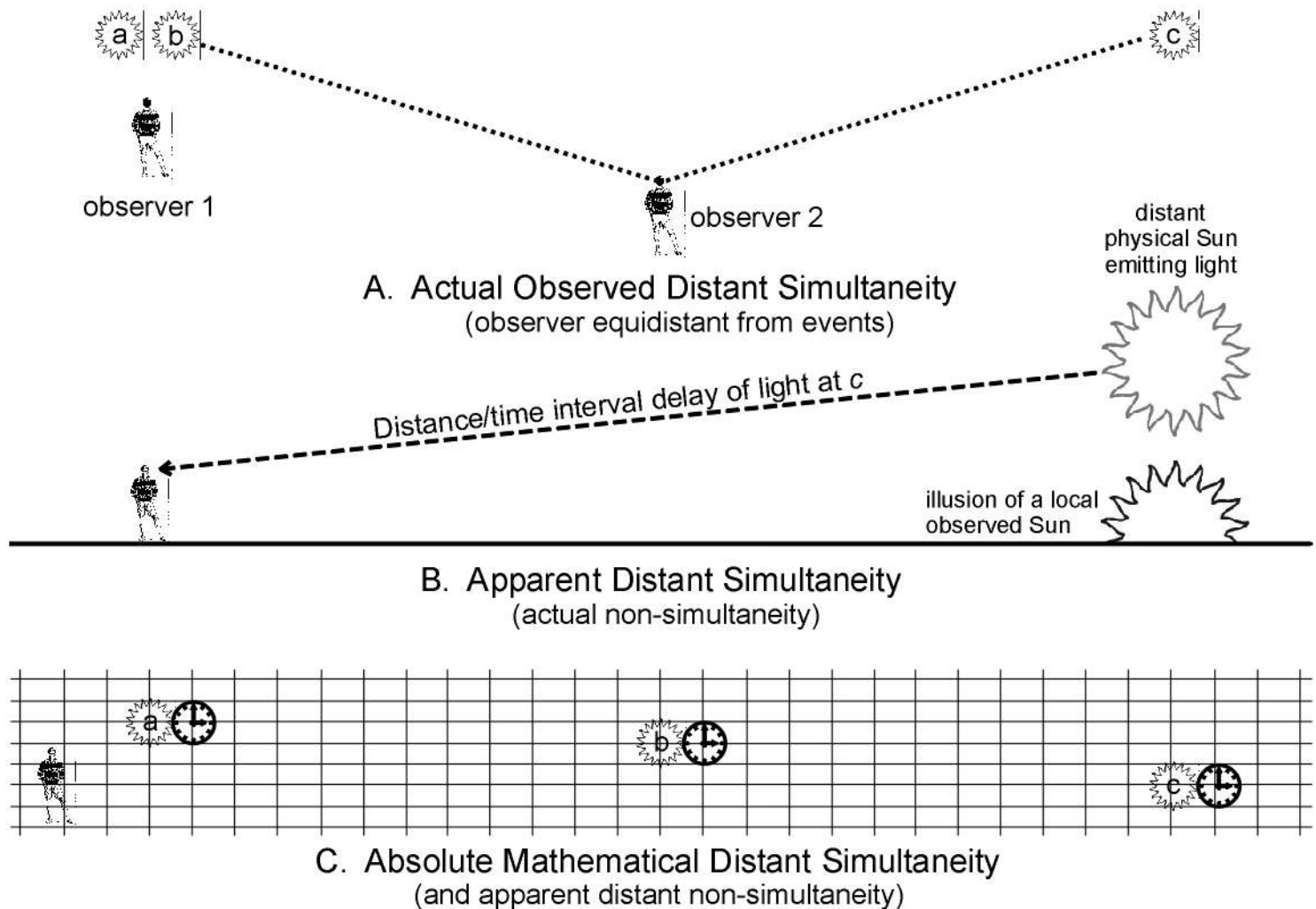
We have also demonstrated that Einstein’s related concepts of a synchronous ‘common time’ for various spatially separated observers, and the ‘proper time’ for an inertial system as a whole with respect to an event, with which Einstein attempted to create an illusionary assumption of simultaneity, are in fact merely rough approximations of time intervals and actual observed distant simultaneity which were invented by him in order to attempt to make his Special Theory work. These abstract, *ad hoc* and contrived concepts are replete with ‘inexactitudes’ and inaccuracies which produce all kinds of distorted measurements of time, space and distance, and other bizarre consequences when used to plot the positions, distances, and time intervals of different events on different sets of inertial coordinates relative to one another.⁸⁵ (see Guilini, pp. 51 – 58; Hoffmann, pp. 96 – 105) Such antiquated, invalid, meaningless, and distorting concepts must be discarded.

In the next Chapter 26, we will discover how Einstein used his arbitrary and artificial concepts of ‘simultaneity,’ ‘common time’ and ‘proper time’ to create his twin illusions of the ‘Relativity of Simultaneity’ and the ‘Relativity of Distance.’ These twin

⁸⁵ Einstein’s algebraic and coordinate approximations may have been state of the art in 1905, but they are certainly archaic now.

concepts then constituted his rationalizations and justifications for scrapping the Galilean transformation (translation) equations and replacing them with his radical Lorentz transformation equations. (Chapter 27)

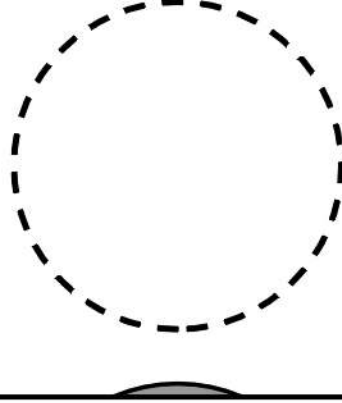
The obvious differences and confusions between the following concepts and definitions are probably the reason why Einstein told Besso: "Time cannot be absolutely defined, and there is an inseparable relation between time [simultaneity] and signal velocity." (Folsing, p. 155)



Three spatially separated light events (a, b & c) actually occur at the same instant on a system of coordinates or a reference frame (actual or absolute distant simultaneity), where synchronized clocks at the position of each event record the same absolute time of occurrence for each such event (absolute mathematical distant simultaneity). But the distant human observer sees such events occur in sequence (a, b and then c), because of the distance/time interval delay of light at c (apparent distant non-simultaneity).

Figure 25.1 Different Types of Simultaneity And Non-Simultaneity

Local Earth time of observation for the observer on Earth
6:00AM

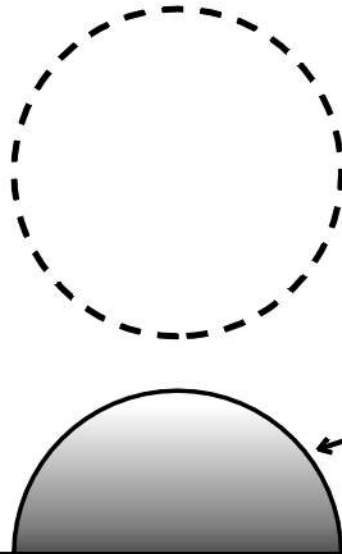


The Sun is physically above the horizon, but it cannot be seen nor perceived by the observer on Earth because its light takes 8.3 minutes to propagate the distance of 93 million miles at c from the Sun to the Earth.

Horizon of the Earth's Surface

Figure 25.2A

Local Earth time of observation for the observer on Earth
6:02AM



The physical Sun is still not perceived by the observer on Earth.

But the visible Sun (light which was emitted by the Sun 8.3 minutes ago) is perceived by the observer on Earth.

Horizon of the Earth's Surface

Figure 25.2B

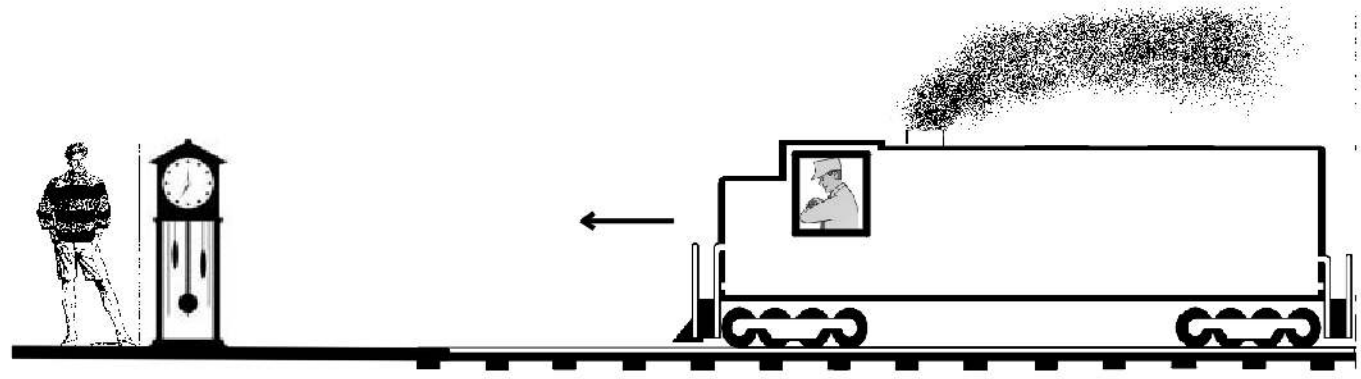
The elapsed time from the instant the rim of the Sun is first perceived by the observer on Earth (Figure 25.2A) until the entire globe of the Sun is finally perceived by the same observer, is a time interval of approximately 3 minutes.

A similar phenomenon occurs for the light event called 'sunset,' but in reverse order.

Figure 25.2 The Distance/Time Delay of Light at Sunrise

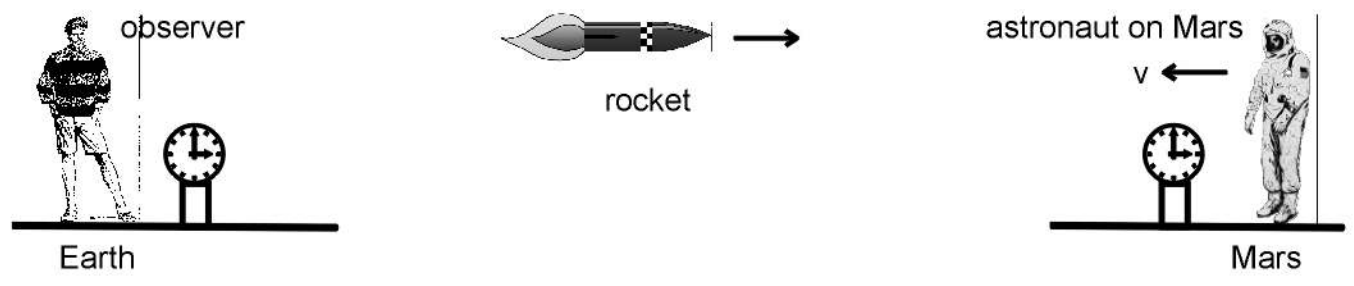
(NOT EXACTLY TO SCALE)

Figure 25.3 The Illusions And Inexactitudes Of Simultaneity



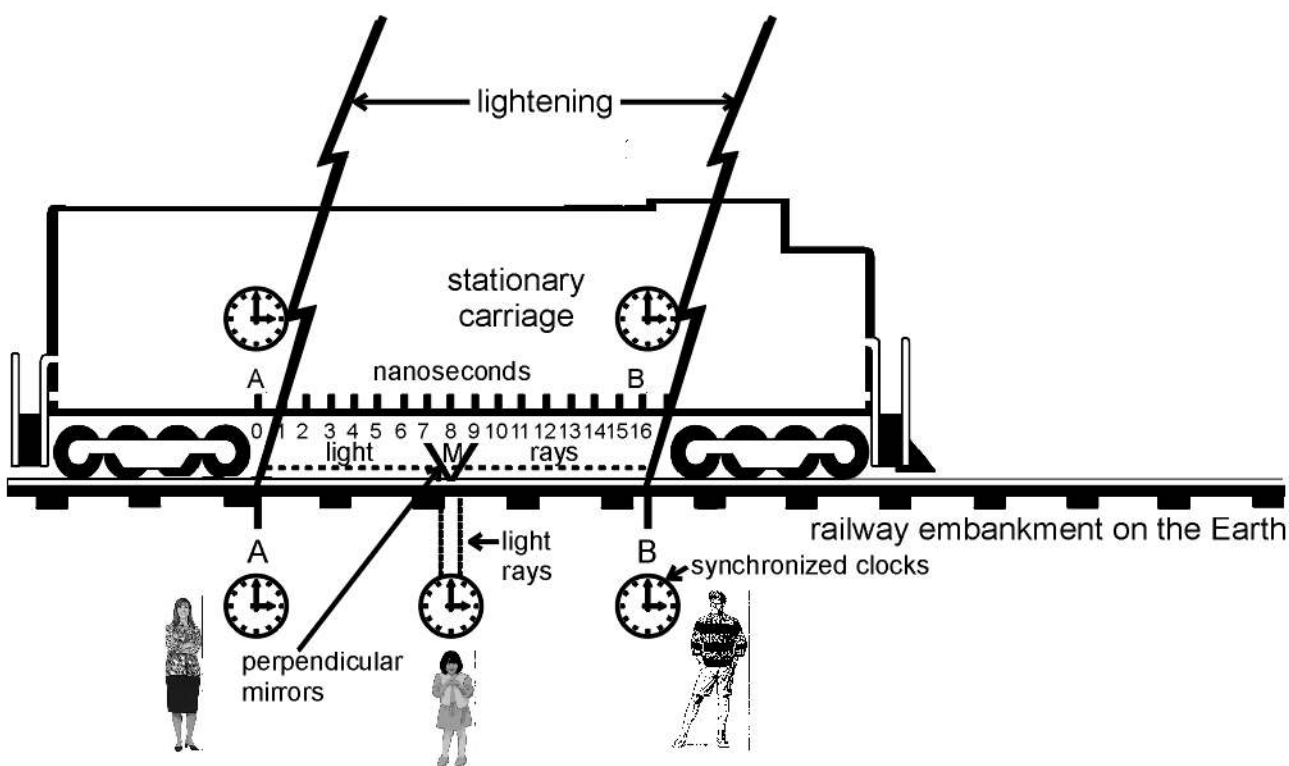
A. The man locally observes the positions of the hands of the nearby clock (or watch) striking 7 and the slightly more distant train entering the station to be simultaneous events.

The pilot of a rocket radio's to each observer on Earth and on Mars that the rocket is equidistant between them and everything is going fine. Immediately thereafter, the rocket catches on fire, and the astronaut begins moving toward the rocket at 1,000 km/hr.



B. The astronaut on Mars will see the fire through his telescope first and at a different synchronous time than the Earth observer because of his motion toward the rocket, and he will assume that the pilot's radio message was not correct when he made it or was not simultaneous for both observers.

Figure 25.4 Einstein's Concepts Of Simultaneity, And The Fictional Common Time Of An Inertial Frame Of Reference



The relatively stationary observer at A on the embankment (inertial frame of reference) observes her watch and the lightning flash at A simultaneously at the same location. (Einstein, 1905 [Dover, 1952, p. 39]) But she cannot assert that the lightning flash at B was also simultaneous, because of the distance/time interval delay of light at c . Similar conclusions hold true for B relative to A.

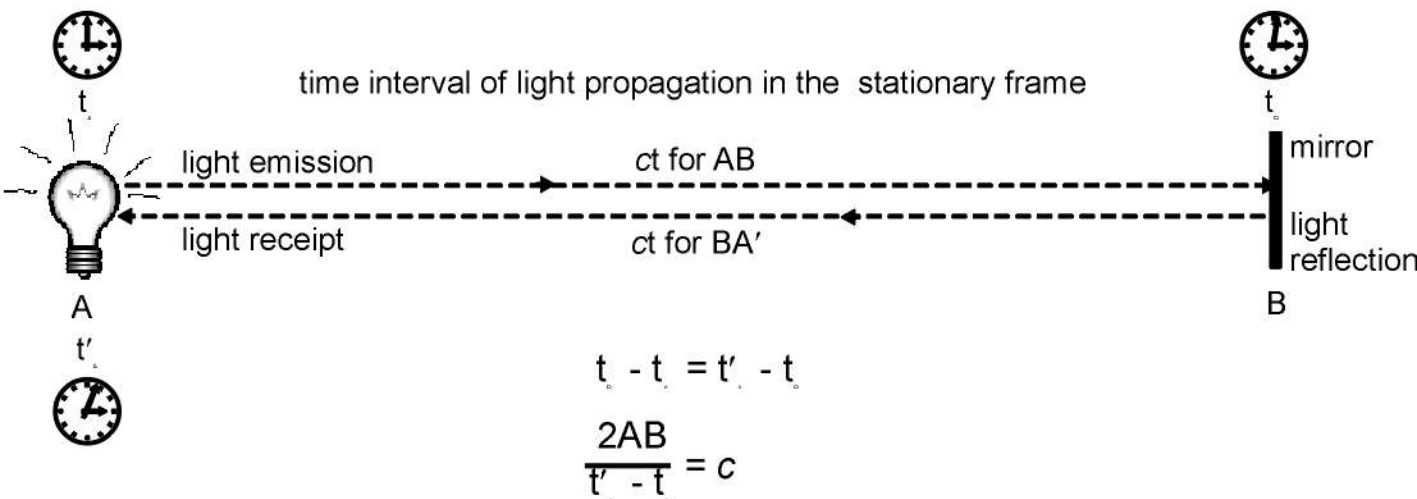
However, by use of light rays and mutually perpendicular mirrors at the midpoint M between A & B, Einstein (in 1916) devised a 'simultaneous time' for an observer at position M, which would allow such observer at M to locally evaluate the simultaneity of two distant events, such as the two lightning flashes A and B, without synchronous clocks. (Einstein, *Relativity*, pp. 26 - 28)

Such simultaneous time for M could then become a synchronous time or common time for observers A, B, M and any other observers on such inertial frame whose clocks were synchronized by light signals. (*Id.*)

This is all well and good, but such 'common time' is actually a fiction. A actually observes the flash at B 16 nanoseconds after the strike at A, because of the distance/time interval delay of c from B to A. The reciprocal result is equally true for B's observation of the flash at A.

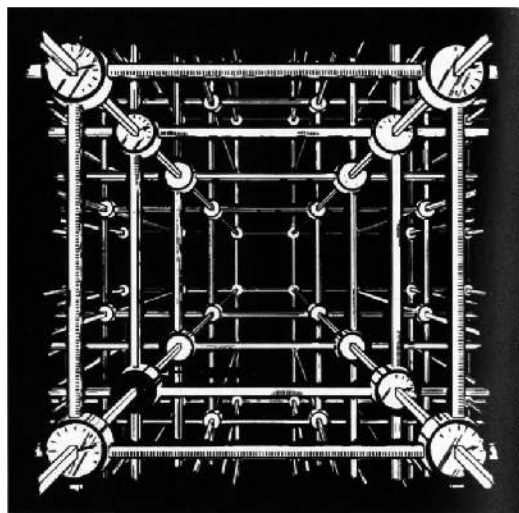
A and B do not simultaneously perceive either lightning flash at the same instant (time) regardless of their synchronized clocks. Neither do A₁ and B₁. The only observer who actually locally observes such distant simultaneity is M. (see Figure 25.1A)

A. Einstein's And Poincaré's Method Of Distant Clock Synchronization



Source: Einstein, 1905d [Dover, 1952, p. 40]]

B. Einstein's space-time coordinates using synchronized clocks between a distant light event and a local coordinate measurer (observer).

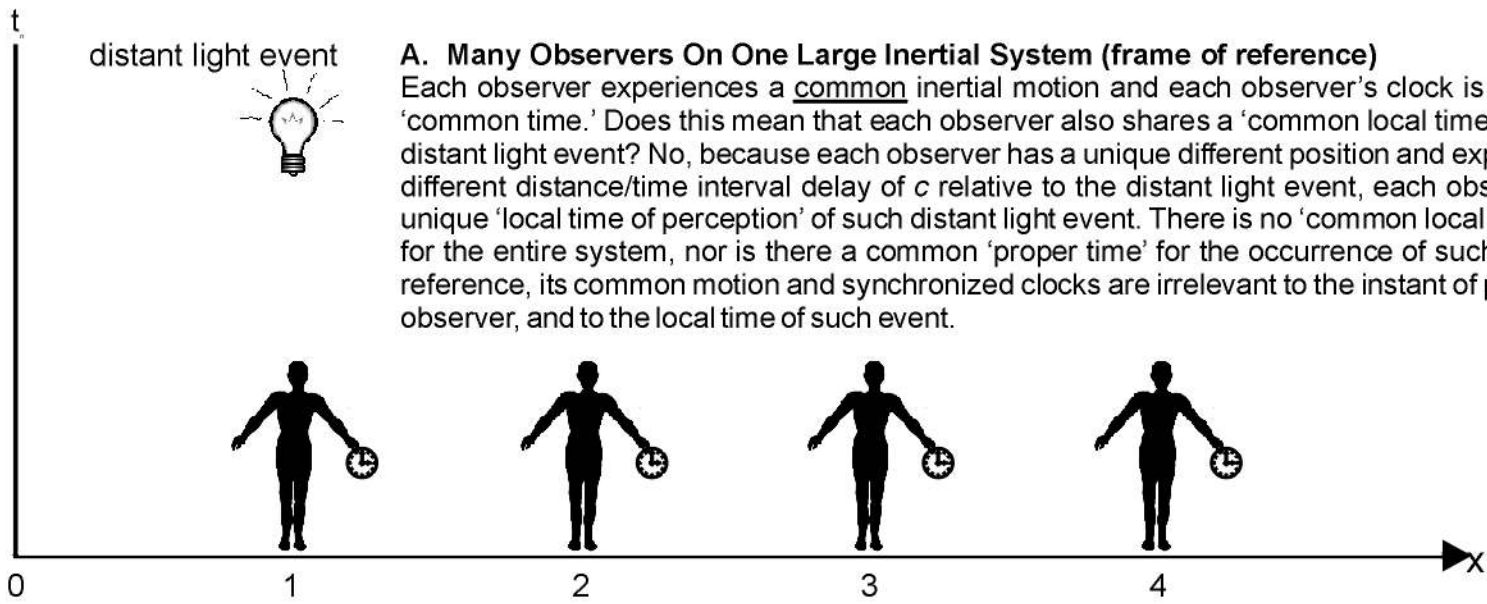


A framework of measuring rods and clocks that might be used by an observer in a particular reference frame to determine the space-time coordinates of a light event.

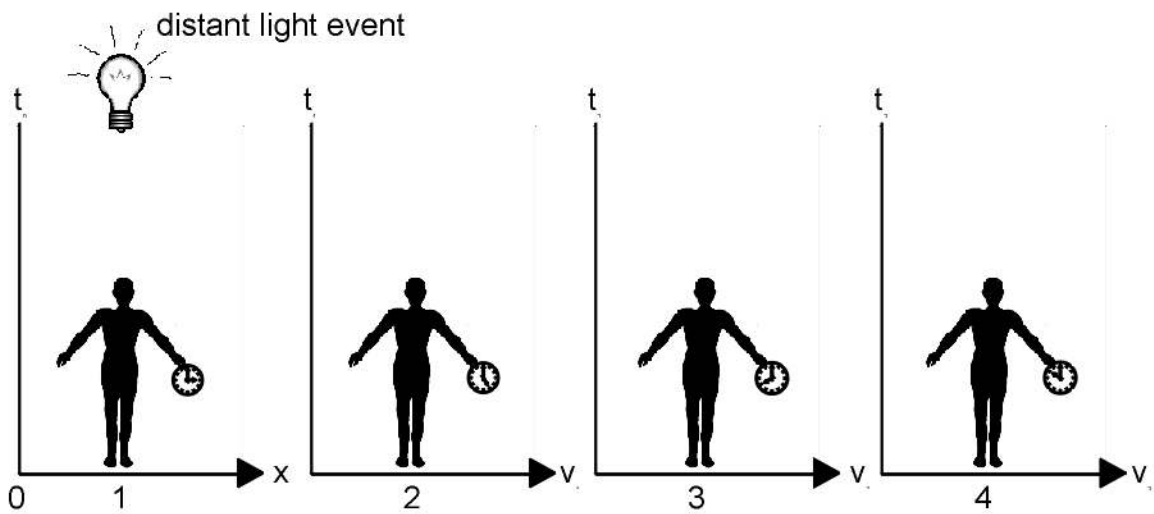
Source: Resnick, 1992, p. 476

Figure 25.5 Einstein's 1905 Coordinate Method Of Determining The Local Time For A Distant Light Event

Figure 25.6 Einstein's Concept That Each Inertial System (Frame Of Reference) Has A 'Common Local Time' Of Perception



A. Many Observers On One Large Inertial System (frame of reference)
 Each observer experiences a common inertial motion and each observer's clock is synchronized to a 'common time.' Does this mean that each observer also shares a 'common local time' of perception of a distant light event? No, because each observer has a unique different position and experiences a unique different distance/time interval delay of c relative to the distant light event, each observer has his own unique 'local time of perception' of such distant light event. There is no 'common local time' of perception for the entire system, nor is there a common 'proper time' for the occurrence of such event. A frame of reference, its common motion and synchronized clocks are irrelevant to the instant of perception by each observer, and to the local time of such event.



B. One Observer On Each Different Inertial System (frame of reference)
 A light event is perceived by 4 observers, each moving inertially at a different relative velocity in 4 separate inertial systems. There is a unique 'local time of perception' for each observer located at a unique different position (distance) relative to the distant light event. Each observer in Figure 25.6A and 25.6B perceives the distant light event at a different instant in time, regardless of the state of their common, inertial, other motion...or non-motion, and regardless of the time shown on their clocks.

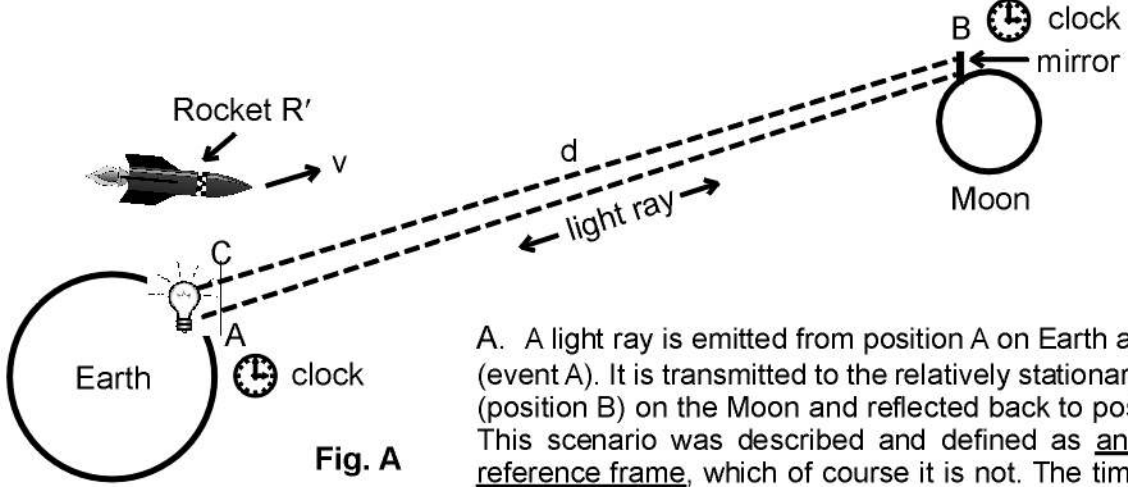


Fig. A

A. A light ray is emitted from position A on Earth at time t_0 (event A). It is transmitted to the relatively stationary mirror (position B) on the Moon and reflected back to position A. This scenario was described and defined as an inertial reference frame, which of course it is not. The time (t) for such total transmission was twice the distance (d) divided by c : $t = 2d/c$. Thus the time of the reflection at position B (event B) was $t_0 + t/2$. After t occurs, the light ray is received back at position A (event C).

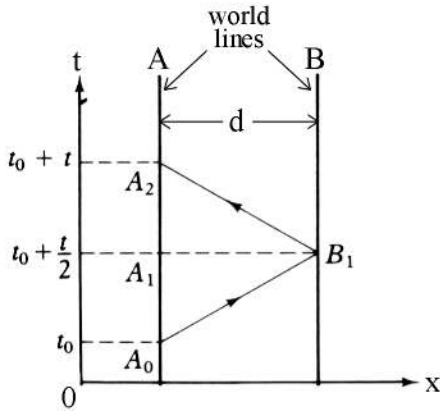


Fig. B

Simultaneity
(a form of symmetry)

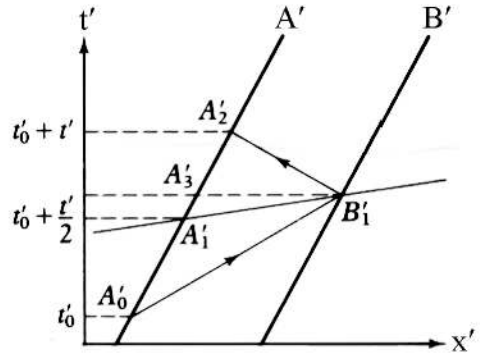


Fig. C

Non-Simultaneity or
Relativity Simultaneity
(a form of asymmetry)

B. A light ray is emitted at t_0 and A_0 . It transmits at c to B_1 and arrives at $t_0 + t/2$. It then reflects and returns at c to A_2 at $t_0 + t$. Rohrlich concluded that: "the point B_1 is *simultaneous* with A_1 because at the instant $t_0 + t/2$ both were halfway in time between sending and receiving at A." (Rohrlich, p. 64)

C. Rohrlich claimed that the simultaneity of Figure B was relative and different for Rocket R'. Why? Because of the relative motion at v between Rocket R' and relatively stationary points A & B, R' would plot A & B at different coordinates A'_2, A'_1, A'_0 and B'_1 (Figure 25.7C) than were plotted by a relatively stationary Earth observer in Figure 25.7B.

Therefore, Figure 25.7C shows that it takes more time for light to go from A'_0 to B'_1 than from B'_1 to A'_2 , thus instant A'_1 is earlier than instant B'_1 . B'_1 was therefore not simultaneous with A'_1 (as it was in Figure 25.7B), but rather is simultaneous with A'_2 . (Rohrlich, pp. 64, 65) Thus, concluded Rohrlich and Einstein: Simultaneity is relative to the velocity of the observer. Actually, it is only relative to mathematics.

Figure 25.7 The Simultaneity Of Relatively Stationary Clocks And Events, And The Relativity Of Such Simultaneity