A Logical Analysis of Albert Einstein's Mirror-Light-Clock Gedankin

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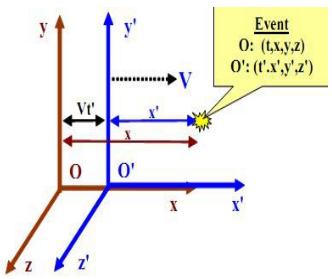
Introduction:

Ironically, it is the malformed concept of the Voight-Einstein "Galilean Transform" diagram which led Einstein down the rabbit trail of clock non-synchronization and non simultaneity. This led to his "Mirrors and Photon" light clock Gedankin. The irony being, in my humble opinion, that by connecting the coincidence of origins *to the object which emits the pulse of the light* and then ignoring the radiation leaving the event,* rejects the whole purpose of the "transformation:"

The "event" is claimed to be a flash or pulse of light. From this instant forward, both Woldemar Voight and Albert Einstein concentrate on "transforming" point "p" (the yellow blob in the drawing) from one "coordinate system" to another one that is separating at a "relativistic" speed. The diagram is said to be "Galilean" because Galileo Galilei, they suppose, did not understand that the speed of light is finite, and this diagram is how they surmise Galileo would have diagrammed the situation. The problem is that not only do the two origins coincide, but the pulse is emitted simultaneously at t=t'=0. They, (Albert, anyway) stop right here with the emission of the pulse and begin extrapolating the mathematics for his theory, using the position of point "p" transformed as time passes and reference frames separate.



Drawing 1: The "Galilean Diagram:" In reality, the "event,"(point "p") being the emission of a pulse, takes place at the coincidence of O and O', and the point of emission of the pulse remains fixed to x' drawing by R. D. Field, Univ. Florida

The part of the theory about the finite speed of light is left completely out of the diagram! They are essentially transforming the *emitter*, not the *emission*. The emitter must remain fixed to the origin of one or the other frames of reference. The *emission* expands away from the emitter at the speed of light. The point of emission is merely a point of reference in the second reference frame, antecedent to the emission.

The finite speed of light reenters the theory with his introduction of the Mirror-Light-Clock Gedankin. Somewhere during the development of these ideas, he added his "brilliant" idea to place the passage of time on a "fourth axis" in the Cartesian coordinate system. This idea merely complicates the reality and simplicity of understanding the propagation of light. (and is nonsense because a fourth axis perpendicular to the three needed to locate a point in Euclidean space produces a duplicate of an already existing axis. Hence the need to postulate a "fourth dimension," useful to mathematically manipulate to any desired purpose)

Albert. Einstein invented the idea of the photon. A "photon" has never been observed being emitted, because in order for it to be observed, it must be absorbed. Likewise the photon has never been observed being detected, because it is only after absorption, that a particle of matter reacts. On the other hand, a very short pulse of light *in motion has been detected,* even photographed. For this reason, this

*(the coincidence lasting only for the tiniest duration of time, I might add, and is displayed in the initial set-up of the "Galilean Transform Diagram;" @ t=t'=0, the time and place where this emission "event" at point "p" takes place. The event in this case being the emission of the pulse.)

analysis will discuss the movements of a pulse of light rather than the "photon" that Albert invented.

A frame of reference is merely a method of bookkeeping for objects in space. All objects within a "frame of reference" are at rest with each other; at fixed distances. If some object or set of objects move or change distance with any of these objects, those objects are in a different "frame of reference."

A coordinate system provides an origin and axes for the "reference frame," from which said distances are measured. They are abstractions used to keep our understanding organized and logical. They do nothing to reality, just as lines of longitude and latitude cannot be found on the actual surface of the Earth. Einstein seems to have reified these abstract concepts into physical existence.

A *postulate* is a statement "Claiming or assuming the existence or truth of, especially as a basis for reasoning or arguing; or *assuming without proof*, or as self-evident; taking for granted."

Albert Einstein claimed several *postulates,* the two most referenced are:

> "The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of coordinates in uniform un-accelerated motion *or:* The laws of physics are the same in all inertial frames of reference."

and:

> "As measured in any inertial frame of reference, light is always propagated in empty space with a definite velocity *c* that is independent of the state of motion of the emitting body. *or:* The speed of light in free space has the same value c in all inertial frames of reference."

His first *postulate* allows the speed of light to be the accepted *in vacuo speed of about 186,000 miles, 300,000 kilometers per second,* or for the sake of reasonable scale, about a foot per nanosecond, with respect to a source and detectors at rest with each other.

Since the *at rest with the source* measurement of c is as above, and *the at rest with the source* measurement of the Doppler spectrum shift is neutral; these two measured phenomena seem to be self evidence that c ***is*** *dependent* upon the source of emission within said inertial frame, and true for every inertial frame. The preceding leaves his next postulate, "The speed of light in free space has the same value c in all inertial frames of reference," true for sources and detectors within said frames of reference but lost in ambiguity with respect to the speed of light emitted from a source in one reference frame and detectors located in another "moving" frame.

Einstein employed the Mirror Light-Clock Gedankin to demonstrate his theory of why "time slows in one frame of reference as observed from another inertial frame. In his Gedankin, a "photon" bounces back and forth between a pair of mirrors, creating a "light-clock." Every bounce of the "photon" constitutes another "tick" on the clock. (In reality, his "photon" disappears in the detection of the first tick of his clock.) Albert suggested that an observer in a frame of reference that is in relative inertial motion with the mirrors and *this "photon"* will "see" *this same "photon"* bouncing back and forth

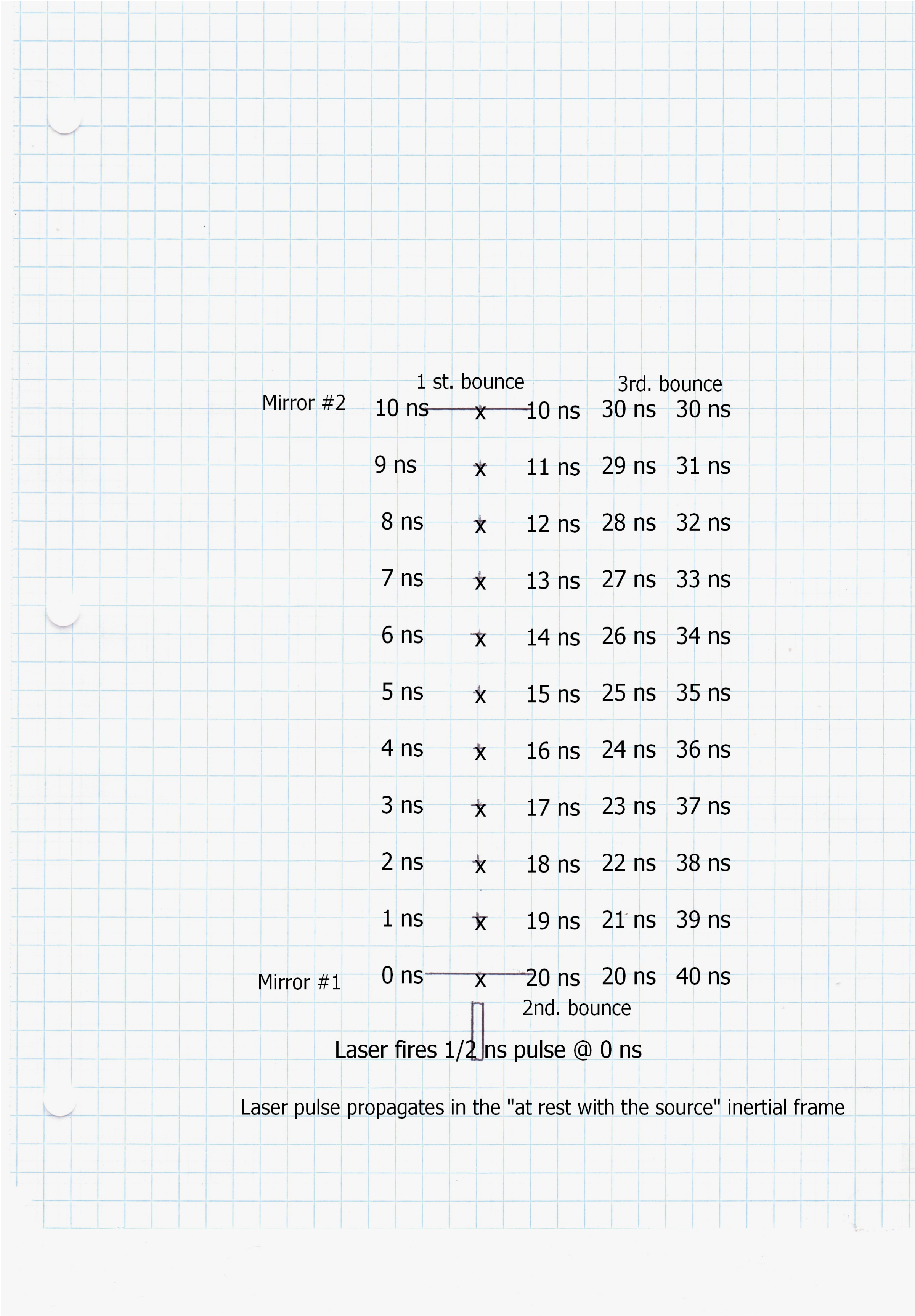


Illustration 1: The at-rest-with-the-Source-and -Mirrors detector array

between mirrors that have been skewed so that the “photon” travels in a zigzag path between said mirrors. (A pulse of laser light rather than a “photon” is used in this analysis, because it can actually be detected many times, successively, in its travels.)

Albert insists that this “photon,” by taking the zigzag path, must still travel at the same speed of light as is measured in the original frame of reference. Since the zigzag path is longer than the perpendicular distance in the original frame of reference, he suggests that the passage of time in this reference frame runs at a slower rate than the ticks on the same clock when detected in the original frame of reference. He then “postulates” that the longitudinal distance in the zigzag frame shrinks, which would then allow his “moving clock” to tic at the same rate as the source frame clock! He can't really have time dilation and distance contraction simultaneously

Source Frame detection of the light pulse:

Since the path of the laser pulse is rectilinear, the array is merely a line of detectors spaced between the mirrors. These detectors produce a record of the elapsed time (in nanoseconds per foot) as the pulse of light travels back and forth. Every two intersections along the axis in the graph represents one foot. Since a pulse of light travels about a foot per nanosecond, every two intersections along the axis also represent a nanosecond. The mirrors represented by this drawing are ten feet apart. The light pulse takes twenty nanoseconds to make the twenty foot round trip from mirror #1 to mirror #2 and back to mirror #1. In this manner the detectors reveal the location of the pulse each nanosecond, as it bounces between the mirrors

Next we explore a reference frame of moving detectors:

Detectors are either at rest with the source or their distance from the source is changing. If their distance is changing, they are in a different reference frame. One's point of view is arbitrary here as to which reference frame you choose to be “stationary” and which is in “motion.” One may choose the “at rest with the source” reference frame to be “moving” with respect to the detector reference frame whose distance is changing relative the source frame. Neither view point changes the physical situation as to where the emitted pulse is at any instant. In Einstein's vernacular, the reference frame possessing the Mirror-Light-Clock can be on the train or fixed to the tracks.

The pattern (or array) of the detectors necessary to detect the said rectilinear going pulse in any relativistically transversely moving reference frame *do* form a zigzag geometry, *however this geometry is not the pulse itself.* The zigzag is the placement of detectors in the moving frame that correspond respectively and coincidentally with each successive detector in the source frame.

Apparently, during the last 100 + years, no one has noticed that if $t=t'=0$, (when the origins coincide and the pulse is emitted), there must also be an elapsed vt in any “moving frame” for every elapsed ct, of the pulse, as the pulse travels between the mirrors. The next diagram of sensors show where the pulse of light diagrammed in the above graph *will be detected in this moving reference frame* by an array of properly spaced detectors. Since each detector in this array will detect the laser beam at the same time and place respectively as one of the stationary detectors fixed in place in the laser beam, both detect the light pulse *simultaneously.*

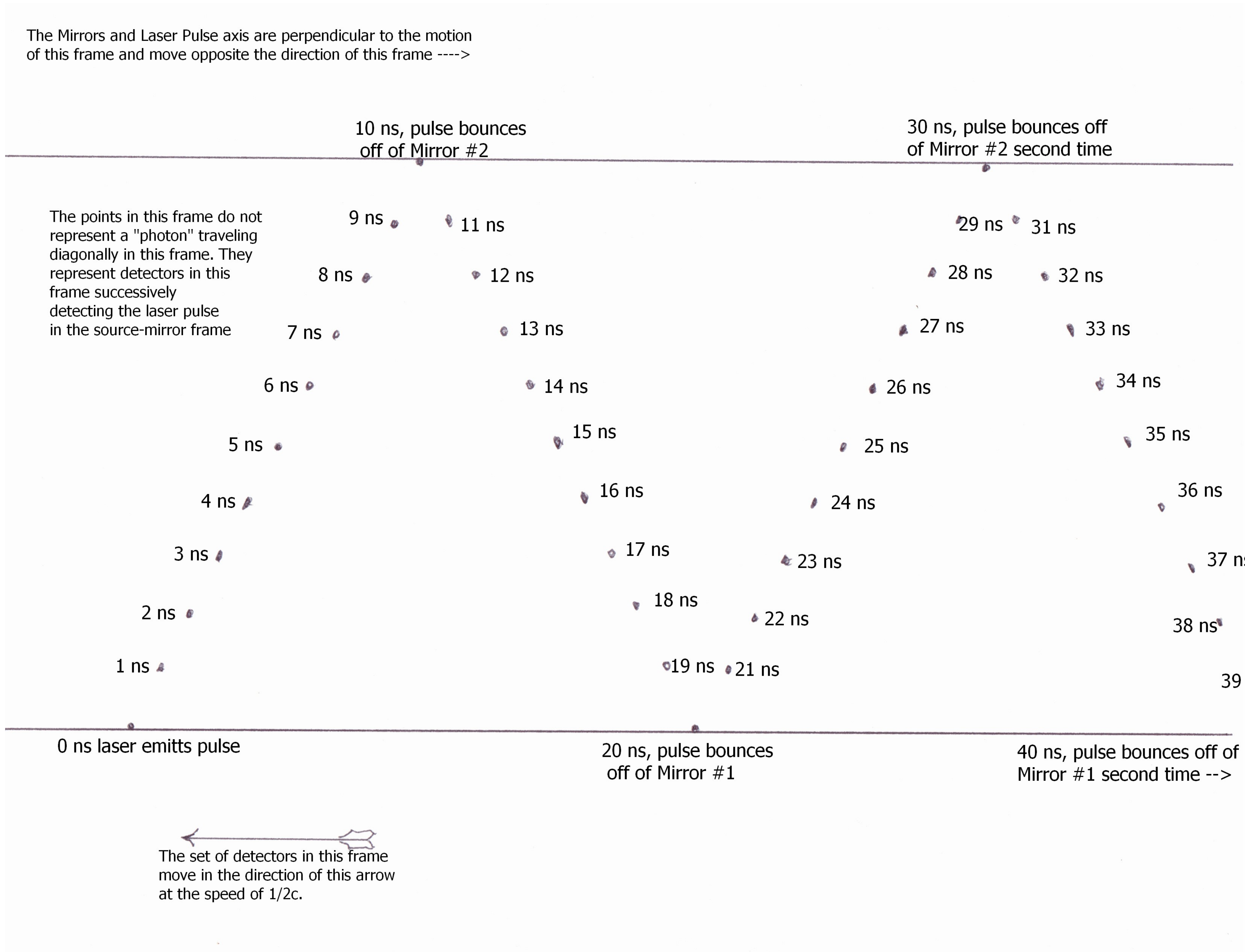


Illustration 2: Transverse Detector frame separating at 1/2 c from source

As you can see from the illustration #2, the detectors produce a zigzag pattern in the array. The important point is that, while the placement of detectors trace a zigzag pattern, they still show that the pulse takes twenty nanoseconds to travel the round distance between mirrors, no matter how fast a set of observers pass the mirrors and the transverse laser pulse. (Do not be confused: the laser pulse does not travel diagonally between detectors in illustration 2. The additional horizontal distance is just the distance traveled by the next detector arriving at the beam-mirror axis. The two mirrors appear as two horizontal lines in this frame. Mirror # 1 on the bottom and Mirror # 2 on the top. The transformation of the mirrors from the source frame to this one actually become phantoms; two continuous parallel lines, ten feet apart.)

How was this diagram made?

Illustration #1. shows where the light pulse is during each nanosecond/foot of its travel back and forth. Each diagram is scaled to one side of a square equals ½ foot. Each successive diagram uses the same scale. To produce the next diagram, a piece of semi transparent velum is overlain on diagram #1. This is the second coordinate system. To represent the speed of ½ C, this page of velum will advance one square to the left, as we mark each new position of the light pulse in the underlying source-mirror coordinate system. The new position on the velum simulates the simultaneous detection in this frame with the detection of the pulse in the source frame (as seen through the velum.). The mirrors, being fixed in the source frame, appear as two continuous horizontal lines in this frame. Whereas Albert Einstein's Special Theory of Relativity postulates that there is a diagonal going “photon,” or “group of photons,” that can only travel at one foot per nanosecond in the “moving frame,” (as compared to the light pulse traveling in the “source frame,”), *there is no diagonal going “photon,” or group of “photons,” that only travel at one foot per nanosecond in the “moving frame.”* The diagonal is formed by coincidently detecting sensors in the moving frame, their speed being the transverse speed of the moving frame

A glimpse into why Einstein, et al, felt the need for dilated time and contracted space

This next illustration shows a detector array (reference frame,) in relative rectilinear motion to the source frame @ one half C, parallel (longitudinal) to the laser beam and the mirrors .The results of the array's travel at ½ C, are represented by the following diagram (#3 *The Longitudinal Detector reference frame.*) The round trip bounce of the laser pulse still takes twenty nanoseconds, as it did in both illustrations above.

Whereas the initial firing of the laser pulse is depicted at the bottom of Illustration #1; *in this illustration*, mirror #1 appears at the top of the page. (Motion in one frame’s direction appears as motion in the opposite direction in the opposite frame.) Please notice that during the oncoming laser pulse, the detectors in this frame are distanced *one and a half times* the separation as in the original diagram (illustration #1, above). Conventional wisdom never contemplates the approaching light pulse, They assume the contracted placement of sensors in this frame is contracted space.

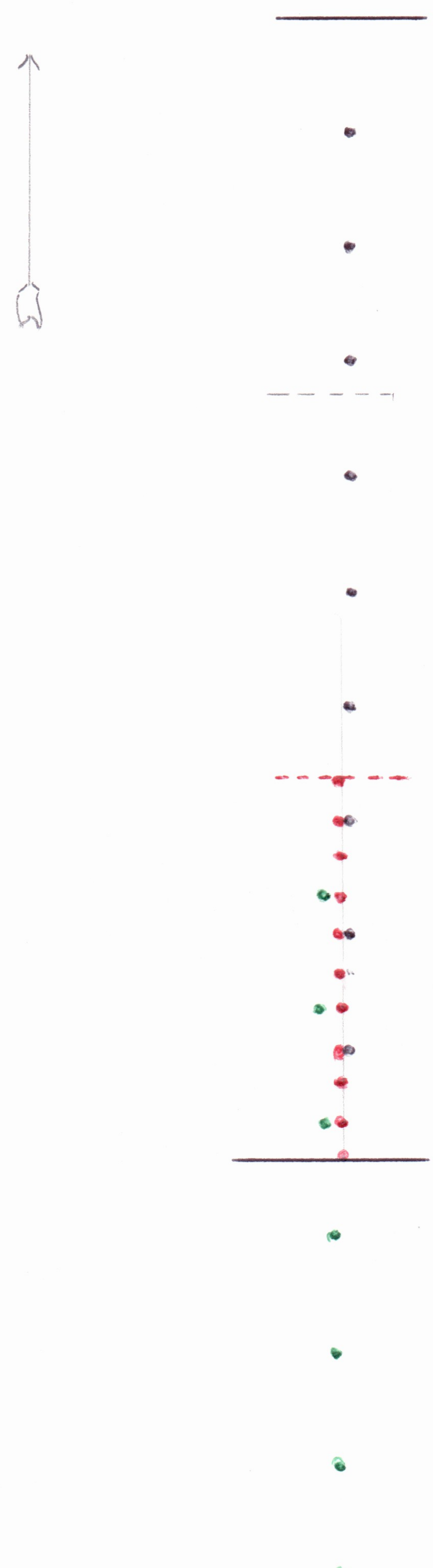


Illustration 3: Longitudinally separating frame at 1/2c

(The additional distance between detectors is not the distance traveled by the light pulse, it is the distance between detectors as this array passes through the track of the light pulse and coincide with the respective *at-rest-with-the-source* detectors diagrammed in illustration #1.)The return pulse positions of the detectors in illustration #3, denoted in red, are traveling (because they are fixed to the moving frame of reference) in the same direction as the laser pulse in illustration #1, and are spaced at one half the distance. (Again: do not be confused; the shortened distance here is not the distance traveled by the light pulse, just because the pulse is detected by the array; it is the distance between detectors in the array, as the array passes through the track of the light pulse diagrammed in illustration #1.)

Furthermore, the detectors corresponding to those after the first bounce in illustration #1, appear to be going backwards in time, in illustration #3. Such is not the case. The underlying array is traveling toward the bottom of the page at *one half the speed of light.* The light pulse depicted in illustration #1. is also traveling towards the bottom of the page, *at the speed of light.* Thus the light pulse is overtaking the array. The detectors labeled as 11 nanoseconds through 20 nanoseconds are sensed successively after second bounce. At no time does "time" reverse.

The detectors in this array will encounter Doppler spectrum blue shift as they approach the oncoming laser pulse, and encounter Doppler spectrum red shift as they recede from the bounced pulse off of the second mirror.(The above charts demonstrate that time and distance exist together; and can be so used in charting moving frames vs a particular frame need be specified as a ratio portion of the speed of light.) Einstein and his followers believe motion rearranges objects and the distances between them. In the diagram (#4.), the detectors are initially detecting the oncoming laser pulse. When the pulse bounces off of Mirror #2, it is then traveling with the detectors.

Einstein's childhood dream

Albert said that, as a child, he tried to imagine what it would be like to ride a ray of light at the speed of light. Diagram #4 demonstrates the situation (after the first bounce): Initially, detectors approaching the ray experience Doppler blue shift, which is just the momentum of the detectors vs the oncoming wave fronts. However, moving with the receding light ray, the Doppler shift removes all the momentum (energy) from the beam. Only one detector is needed to collect the pulses on the first bounce since the detector is traveling with the pulse; Einstein would not see anything of the light wave since he would be at rest with it. On the second bounce the pulses reappear as in the initial emission to the first mirror.

In his "Measuring the Moving Train from the Platform" Gedankin, (paraphrased) Albert postulates why the train should be shorter (contracted) than the same train measured at rest with the platform.: As the train approaches the platform, a technician marks the platform exactly when the front of the train reaches him, and simultaneously signals another technician at the the receding end of the platform to mark the back end of the train. Since the train keeps moving while the signal propagates to the rear, the train has moved forward by the time the rear technician makes the mark on the platform, making the measurement "contracted." Now, by measuring the train from back to front, and having the rear technician send the signal forward, the same basic experiment measures the moving train longer than at rest! So the length of the moving train depends upon whether the initial measurement is at the back or the front. The third Illustration aptly shows expansion vs compression that is ignored in conventional reasoning.

This frame has relative motion to the Source-Mirror frame @ c. opposite the initial direction of the laser pulse.

Illustration 4: Longitudinally moving Detector Frame at c

Some questions (My conclusions are in the form of questions, to invite discussion and criticism):

Where do we find Einstein's diagonal going “photon/light pulse,” that can only travel at one foot per nanosecond in the “moving frame,” as compared to the light pulse traveling at the same speed in the “at rest with the source” frame?” (There is none, so no problem with its speed.)

How can one build the relativistic triangle from which all of Einstein's mathematics are generated considering that detectors in the frame opposite the source frame form the zigzag; and *not an actual “photon”?*

Where is the length shortening and the time slowing purported to happen in the “opposite the source frame?”

Why does “time” need to be diagrammed on a fourth axis, perpendicular to the only three that can exist in space? Every distance is a latency duration for the propagation of light.

Why is Einstein's fixation on Clocks? Attempting to imagine what the expanding wave front is doing from a distance, as Einstein seems to have done, complicated by attempting to visualize the moving observer, produces an unfathomable story.

In the Voigt/Einstein “Galilean Transform” the *source* of a pulse of light is “transformed;” however, *the radiation from the source is never considered*. It is the speed of the radiation upon which his Special Theory of Relativity is supposedly expounded. How can that be, if the radiation is left out of the diagram upon which his/their mathematics depends?

Secondary events, being the detection of the laser pulse when and where it is detected as it travels, rather than the initial emission event, are not considered in the “Special Theory of Relativity. This seems a rather large omission. no?

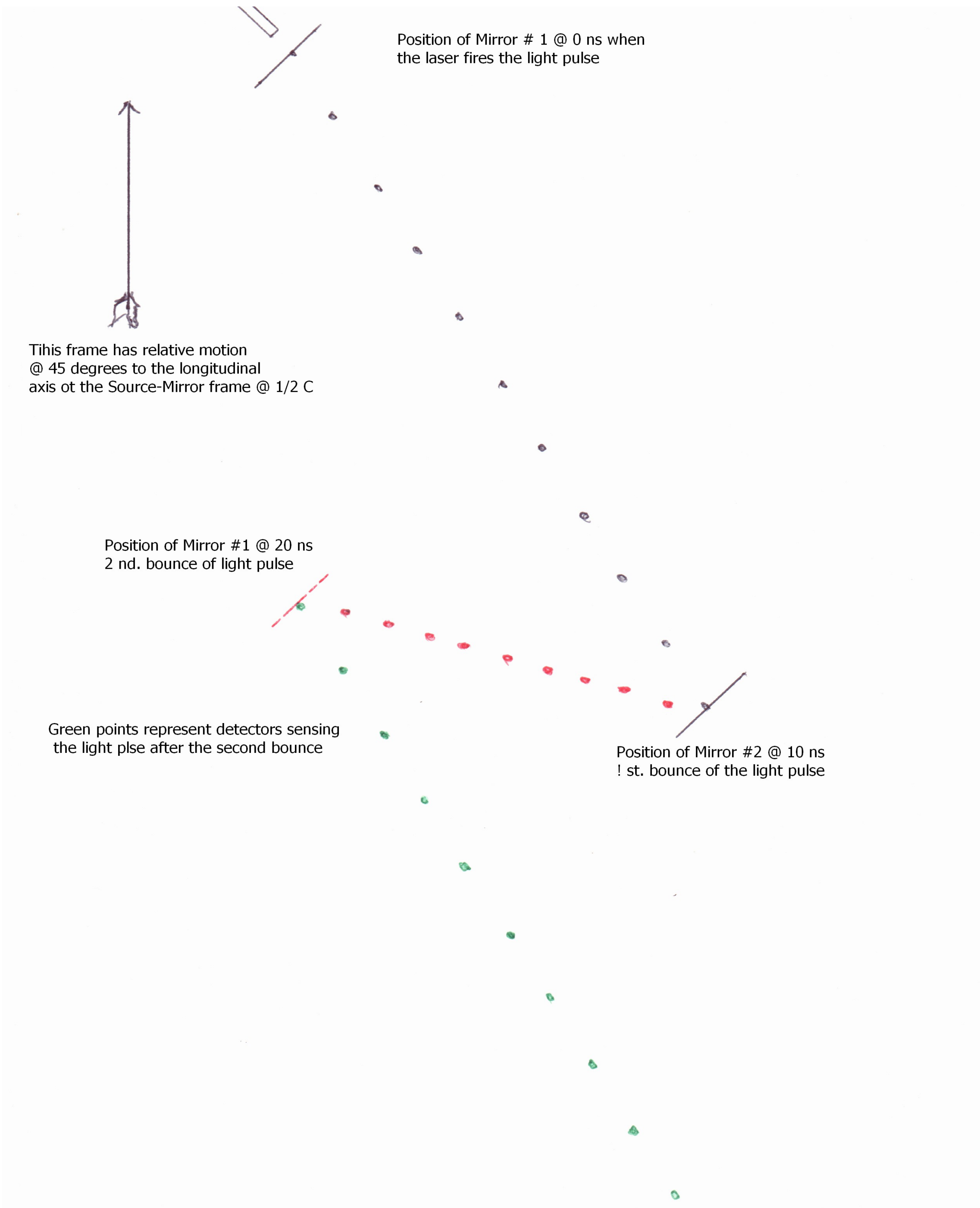


Illustration 5: *Motion of detector frame @½ c at 45 degrees to Source -Mirror frame*

This last Illustration is the simple layout of a detector reference frame moving diagonally to the source mirror frame, detecting the light pulse successively at each detector in the source-mirror reference frame, all but impossible in Einstein's theory.

Resources

A. Einstein,
On the Electrodynamics of Moving Bodies, http://www.fourmilab.ch/etexts/einstein/specrel/www/

Herbert Dingle, http://www.ebook30.com/science/physics/141144/science-at-the-crossroads.html

Thomas Smid, (M.Sc. Physics, Ph.D. Astronomy) http://www.physicsmyths.org.uk/

Harry H Ricker III, http://gsjournal.net/Science-Journals-Papers/Author/327/H.H.,%20Ricker%20III

Eric Reiter, http://unquantum.net/

Steve Waterman, http://watermanpolyhedron.com/s4observers.html