Geometry of Observation: Space-time perspective*

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It is argued that, the very process of observation using light induces the hyperbolic Minkovski structure characteristic of Special Relativity. This observation leads in turn to the understanding that time dilation and space contraction are not ontic effects, but artifacts of the observation process affecting only received signals. Taking account of this structure permits the formulation of a fully relativistic Hamiltonian structure for interacting particles.

I. THE ISSUE

Special Relativity is vexed by preternatural effects: time-dilation and Fitzgerald contraction. They are problematic in the first instance because they are counter intuitive. In addition, they are believed to be the reason that no relativistic formulation of Hamiltonian Mechanics for interacting particles (not a single particle in an exterior field) exists. In other words: because there is believed to be no coherent proper time for a system of particles, or in other words the proper times of individual particles cannot be coordinated, it is thought that there is no variable conjugate to the system Hamiltonian.(1) The simplest example of this problem is captured by the legendary "twin paradox" in which asymmetric ageing implies that the integral of arc lengths along the two different world lines that cross twice, are not equal.

II. THE RESOLUTION

This writer holds that these opinions are in error and caused by confusion resulting from not distinguishing between emission times and reception times of signals. I argue that the geometry of particles as emitters is Euclidean 3+1, with no metric relation between the 3-space and the 1-space (time). But, I will also argue, that the geometry of the very process of observation using light rays induces the Minkowski-hyperbolic structure of Special Relativity (SR). That is, the physical circumstances of observation with light are a realization of the mathematical structure of projective geometry from the 3+1 Euclidean ontological space onto the celestial sphere of an observer (i.e, the retina [of *one* eye]).(2)

III. TECHNICALITIES

The mathematics of projective geometry is complex enough to challenge one's patience. For present purposes it is not necessary to go into details; I shall only suggest some thoughts intended to motivate further detailed study. Projective geometry, which was static and intended for for realistic drawing, was originally developed implicitly with the idea that projective rays have infinite velocity. This assumption must be extended by considering a physical projective ray to be a light ray as described by geometric optics. Such an extention brings with it two well verified empirical features from geometrical optics:

1. Light rays traverse straight lines in empty 3-space.

2. The ratio of variations in 3-space to the index of variation (time), is a constant.

What can be said from projective mathematics applied to this situation is:

1. Signals arriving at an eye from the same direction at any given instant along a specific direction can have originated at various distances. Their "resolution distance" can be null whatever their physical (3-space) distance if their time-separation interval is appropriate. This is a physical effect or fact unaltered by any change of the observer's eye's position or state of motion.

2. Transformations at or of the eye that leave the null-distance of incoming signals invariant are know to be the Lorentz transformations.(3; 4)

These facts can lead only to the conclusion, that effects derived from Lorentz transforms are artifacts of observation, they are not caused by, nor effect, nor pertain to the source of the signals by themselves.

IV. AN APPLICATION: THE "TWIN" PARADOX

The application of the principles outlined above to the "clock" or "twin" paradox can be greatly simplified by considering the trip to be compose of two components, an outgoing and an incoming. For each component, all accelerations are considered to have occurred in preparation and that the traveler's outbound clock is started by instantaneous contact as the preaccelerated traveler passes the stationary twin. Then the outbound traveler starts the clock of a preaccelerated inbound traveler by instantaneous contact. Finally, the inbound traveler stops his clock and that of the stationary twin also by contact so that the trip is comprised of two segments, none with acceleration.

For analysis of the trip now, the crucial issue is the location of the contact point of the inbound and outbound travelers (or the reversal point). According to the analysis above, the changes brought about the the changes due to the boost given the traveler do not affect object in the frame of the stationary twin, including the distance of the reversal point; thus,

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MINKOWSKI CHARTS FOR RELATIVE MOTION

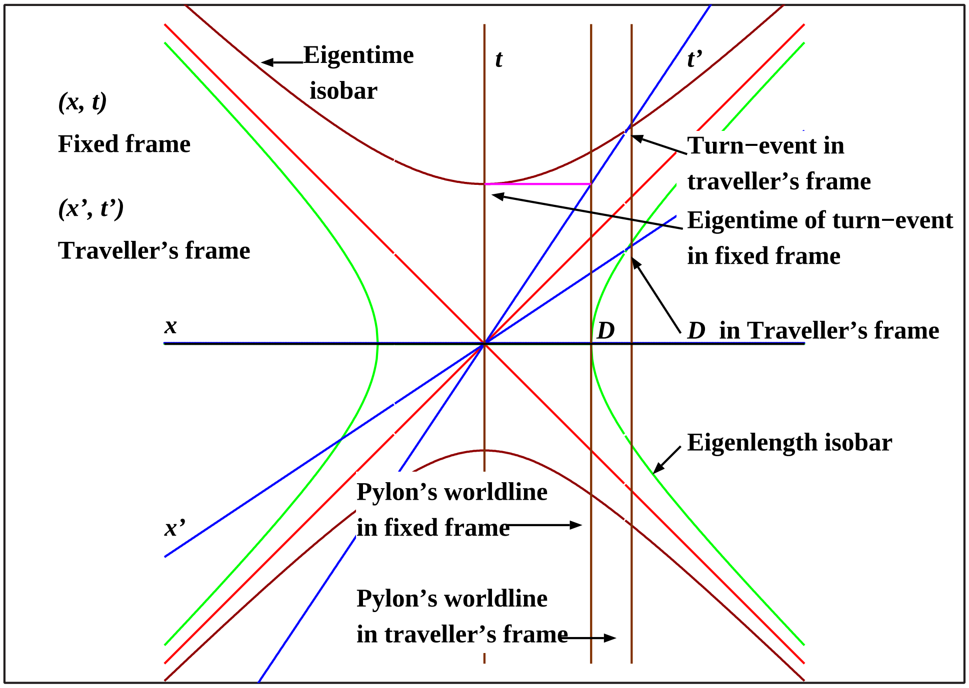

Figure 1 This figure is comprised of two Minkowski charts superimposed on each other. The world line of the reversal point in the fixed frame passes through the point '*D*' on the -axis. The corresponding point on the x'-axis is found by sliding up the *eigen*length isocline to the intersection with the *x*'-axis. The world line of the reversal point passes through this point on the prime chart. The intersection of the reversal point's world line with the x'-axis is the point on the traveler's chart representing the 'turn-around' event. The *eigen*time of the turn-around event in the fixed frame is found by sliding down that *eigen*time isocline which passes through the turn-around event to its intersection with the t-axis. It is clear that this value is identical with the time assigned by the fixed twin to the turn-around event as it may be projected horizontally over to the intersection of the reversal point's world line in the fixed frame with the time axis of the traveler. The paradox arises by using, incorrectly, that *eigen*time isocline which passes through the intersection of the traveler's and the reversal point's fixed frame worldlines.(5)

it is invariant. This means that its location on the Minkowski chart of the traveling twin is located along the hyperbolic isocline defied by the Lorentz transformation, and is further out along the world line of the traveler in his frame than the usual analysis of such a trip would have it. In fact the difference exactly compensates the time-dilation or FitzGerald contraction factor.

V. EXPERIMENTS

Textbooks on Special Relativity all cite certain experiments considered to verify either time dilation or FitzGerald contraction. Upon examination, it turns out, there are really only two such experiments; and, both can be criticized.

One is the clocks-around-the-world in which atomic clocks were transported around the world in commercial airliners and compared afterwards with similar clocks stationary on the ground. The published conclusions of this experiments seemed to confirm the reality of time dilation. In fact, however, subsequent analysis by A. Kelly showed that the stability of the clocks involved was at least two orders of magnitude too weak to show the effect at appropriate scale.

The other common experiment is that based on the observation of decay mesons at ground level when the common analysis seems to show that all such mesons should have decayed within 200-300 meters based on the observed life time and velocity. However, the standard analysis of this phenomenon overlooks some technical points. In the first place, the governing equation for decay:

$$N(x) = N_0 e^{\frac{-t}{\lambda}}.$$

According to the standard analysis, λ, as the half-life, is subject to time dilation under Lorentz transformation.

In this writer's view, this analysis is too simple. First, note that this function is finite out to infinity, which means that some mesons will always be detected at the surface of the earth, the issue is: how many? To draw the usual conclusion the answer must be many more than would be seen for an identical ensemble that is stationary. It is just this requirement, however, that is affected by space-time perspective; the coefficient N_0 has the units of [No./L^3], and one of the L's is transformed because of the change of inertial frame between a stationary and moving ensemble. When this is taken into account, the whole decay curve for the moving ensemble from the point of view of a stationary earthbound observer is magnified and therfore greater at longer times in comparison to the imagined equivalent stationary ensemble. Again, this is just a space-time perspective effect, and like all such effects is an artifact of the geometry of observation and does not represent an ontological modification of the observed objects.

VI. CONCLUSION

This analysis leads to the conclusion that the individual proper times of two or more particles comprising a system do not conflict, the integrated arc length along all world lines crossing twice are identical between the crossing points; i.e., the integrand of arc-length is singled valued and analytic and therefore path independent.

The importance of this analysis is most significant with regard to the existence of a Hamiltonian formulation of relativistic mechanics as it removes the presumed exclusion of a system proper time as the variable conjugate to the system Hamiltonian.(6; 7)

Note: Preprints of Refs.: (2; 5–7) can be downloaded from: `http://www.nonloco-physics.000freehosting.com`

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