Ether Existence.

佐々木 *Kenneth M. Sasaki.* けん

Abstract.

This work proves that the ether exists – at each event in space-time, there exists a state of translation only relative to which light speed is isotropic – proving as well that Special Relativity is inconsistent both internally and with observation.

Main.

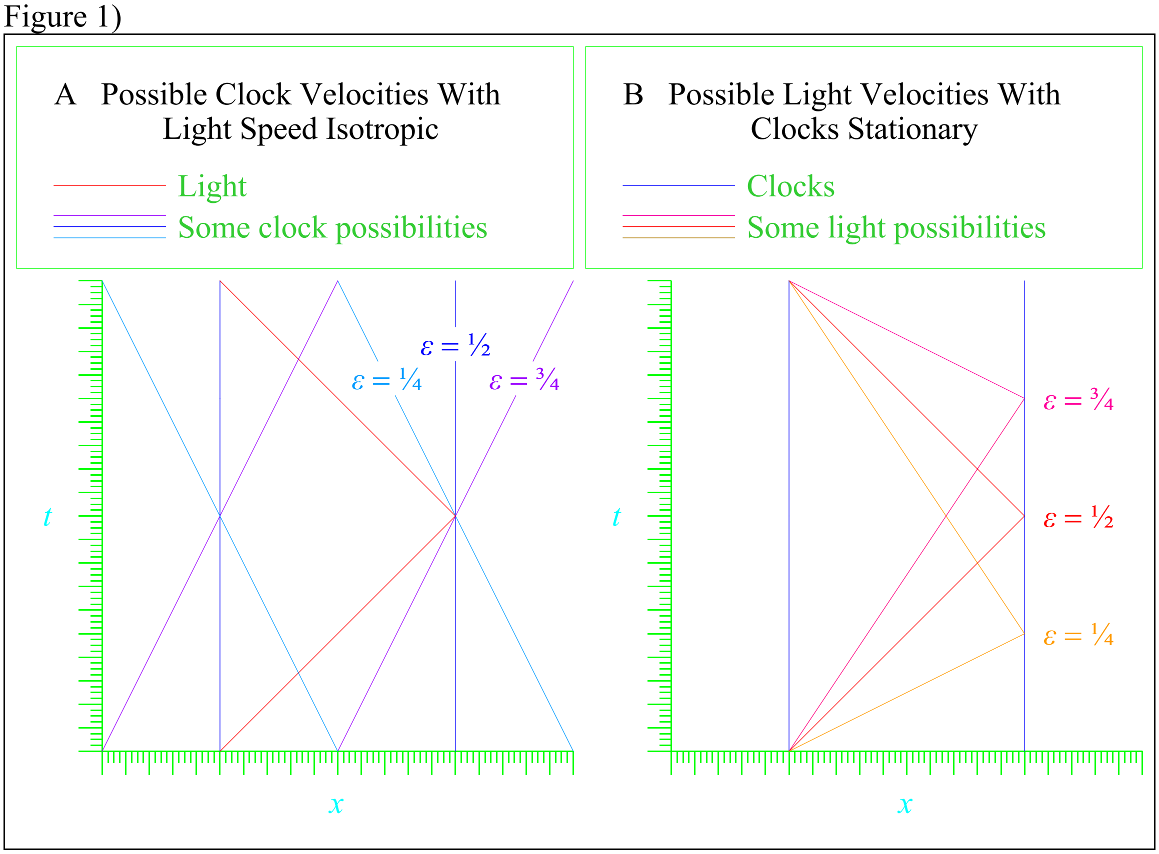
Special Relativity (SR) [1] assumes the relativity of inertial frames and invariance of (vacuum) light speed; whereas the Lorentz-Poincaré Ether Theory (LPE) [2-11] has heretofore assumed that the ether exists – at each event in space-time, there exists a state of translation only relative to which light speed is isotropic.

We will prove that the ether exists, from which it immediately follows that SR is inconsistent both internally and with observation, revealing LPE to be our best classical theory of flat space-time. In preparation, we will discuss a dilemma in observing velocity and simultaneity, and also how changing the properties of reference clocks transforms reference frames. We will then make a key observation and prove that the ether exists.

We will not address the question of a luminiferous "medium".

We will use the convention $c = 1$.

Figure 1)



Suppose two separate comoving clocks, A and B. Light leaves A when A reads *time* t_1, reflects off of B when B reads t_2, and arrives back at A when A reads t_3. To observe any velocity, a simultaneity of distant events must be known; yet, to observe any simultaneity of distant events, a velocity must be known [5,12a]. So, with light as the fastest signal and only fixed-speed propagator, an observer could precisely *measure* only $t_3 - t_1$ at A, and t_2 at B, with t_2 possibly any time between t_1 and t_3 [12a,10].

Letting $0 < \varepsilon < 1$, Reichenbach accounted for the t_2 possibilities with [12b]:

1) $$t_2 = t_1 + \varepsilon(t_3 - t_1).$$

Figure 1) shows world lines that are possible for our clocks and light, along with their corresponding ε values. Our clocks are at rest, with light speed isotropic, iff $\varepsilon = ½$ [12c].

SR *assumes* that $\varepsilon = ½$ for all states of translation attainable by clocks [12c]; while LPE *has assumed* (what we will prove) that $\varepsilon = ½$ for only one state of translation, with ε varying as in Figure 1A). The uncertainty in ε is what seemingly allows both SR and LPE to model observations, with illusion hiding SR's inconsistencies.

In Figure 1B), each ε value is correct iff the associated light cone exists; and were all of the light cones to exist, each would be different from the other two.

KEY DEFINITIONS:

1) RF(translation,rate,spacing,synchrony): a *reference frame* defined by the states of translation, rate, spacing, and synchrony, for its reference clocks, which we designate using letters, as in RF(A,B,D,K), all letters the same, as in RF(A,A,A,A) ≡ RFA, iff the frame indicates an isotropic light speed of c.
2) T(A,B,D,K): the *transformations* from a particular frame, RFE, to RF(A,B,D,K).

(See [13,14,9,10,15] for relevant discussions of reference-frame transformations.)

Figure 2) shows five reference frames, each showing two strings of clocks, one blue and one red. All of the clocks are initially stationary unit-spaced references for RFE which is in Figure 2A), then the clocks accelerate to comove with the other frames. The blue clocks, which are unconnected, accelerate so as to maintain constant RFE spacing; while the red clocks, which are connected by rods (not shown) that length contract, maintain constant proper spacing [16] by following hyperbolae.

With $\vec{v}$ $(= ¾\hat{x})$ the *velocity* of RFB, relative to RFE, and $\gamma = (1 - v^2)^{-1/2}$, the left-side matrices of Equation 2A) successively transform the first four frames of Figure 2) into the respective subsequent frames, with Equations 2B) through 2D) successive steps:

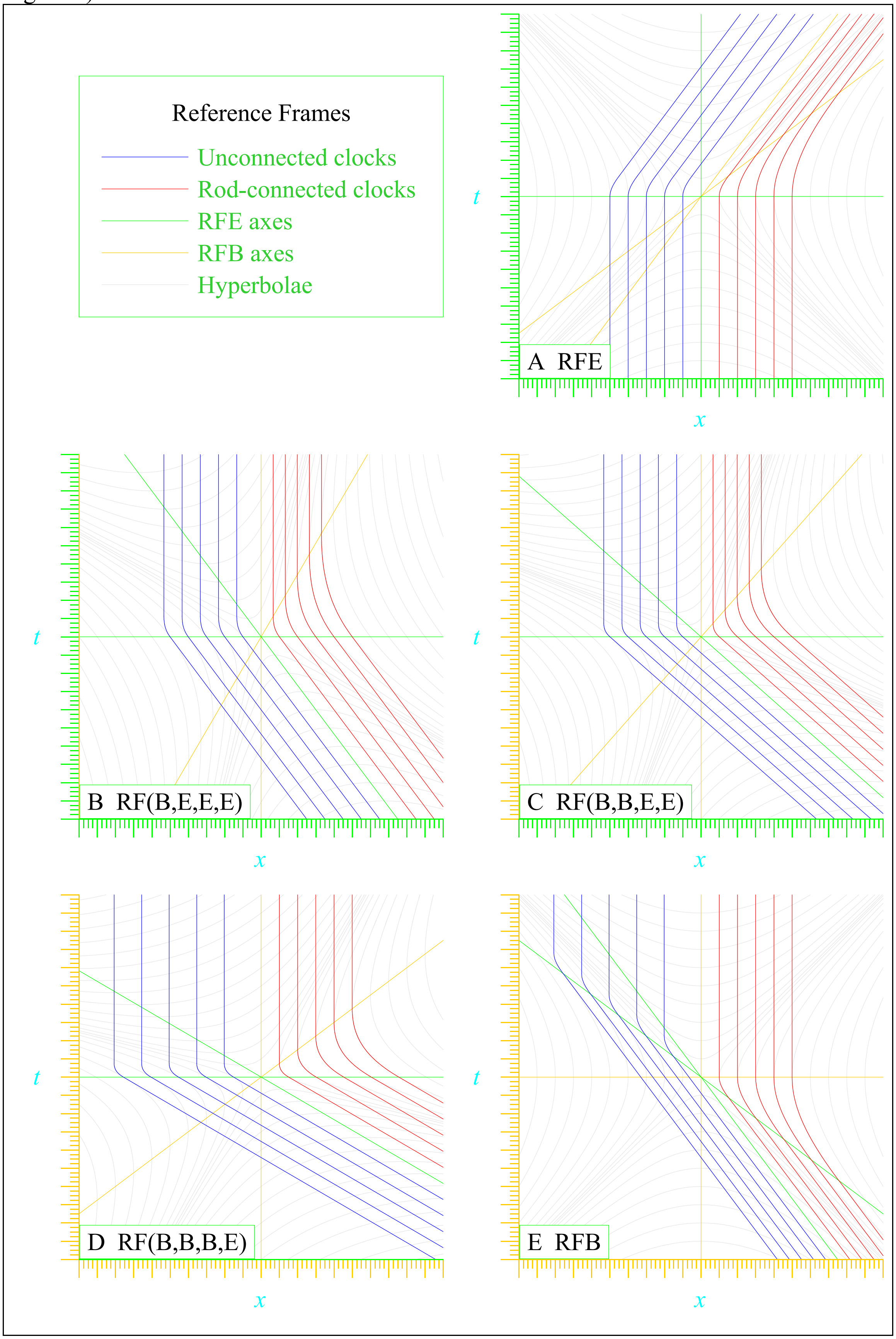
2A) $$\begin{pmatrix} 1 & -v \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & \gamma \end{pmatrix}\begin{pmatrix} \gamma^{-1} & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ -v & 1 \end{pmatrix}\begin{pmatrix} t \\ x \end{pmatrix} = \begin{pmatrix} \gamma & -\gamma v \\ -\gamma v & \gamma \end{pmatrix}\begin{pmatrix} t \\ x \end{pmatrix} = \begin{pmatrix} \gamma t - \gamma v x \\ -\gamma v t + \gamma x \end{pmatrix}$$

2B) $$\begin{pmatrix} 1 & 0 \\ -v & 1 \end{pmatrix}\begin{pmatrix} t \\ x \end{pmatrix} = \begin{pmatrix} t \\ -vt + x \end{pmatrix}$$

2C) $$\begin{pmatrix} \gamma^{-1} & 0 \\ -v & 1 \end{pmatrix}\begin{pmatrix} t \\ x \end{pmatrix} = \begin{pmatrix} \gamma^{-1} t \\ -vt + x \end{pmatrix}$$

2D) $$\begin{pmatrix} \gamma^{-1} & 0 \\ -\gamma v & \gamma \end{pmatrix}\begin{pmatrix} t \\ x \end{pmatrix} = \begin{pmatrix} \gamma^{-1} t \\ -\gamma v t + \gamma x \end{pmatrix}.$$

Figure 2)



Reference Frames
Unconnected clocks
Rod-connected clocks
RFE axes
RFB axes
Hyperbolae
A RFE
B RF(B,E,E,E)
C RF(B,B,E,E)
D RF(B,B,B,E)
E RFB
t
x

The Galilean transformations [10,15], T(B,E,E,E) in Equation 2B), spatially skew RFE into RF(B,E,E,E) which is in Figure 2B). In RF(B,E,E,E), the variant hyperbolae show an asymmetric light cone and, by the events at which they cross the time axis, the translational time dilation of comoving clocks. The blue clocks become stationary unit-spaced references for RF(B,E,E,E), if they maintain E synchrony and their rates are artificially adjusted to counter the natural time dilation.

T(B,B,E,E), in Equation 2C), adds time-axis contraction to T(B,E,E,E), to produce RF(B,B,E,E) in Figure 2C), for which the blue clocks become stationary unit-spaced references if they maintain E synchrony.

The Tangherlini transformations [13,9,10,15], T(B,B,B,E) in Equation 2D), further add space-axis expansion to produce RF(B,B,B,E) in Figure 2D), for which the red clocks become stationary unit-spaced references if they maintain E synchrony.

And the Lorentz transformations (see [6,11] for histories), TB in the totality of Equation 2A), finally add temporal skew to produce RFB in Figure 2E), for which the red clocks become stationary unit-spaced references if they adopt B synchrony.

All four of the above transformations thus apply to reality, in their own ways.

Each classical object is in just one place at any time, and thus has just one world line; and between clocks representable by Figure 1B), the round-trip-average speed of light always appears to be *c*. Together, these observations imply our key observation.

KEY OBSERVATION:

A) Each event has exactly one light cone.

THEOREM: *The ether exists.*

Proof: Let each event have a light cone of RFE, and let B be arbitrary except B ≠ E.

Reference-clock translation, rate, and spacing change with the transformations from RFE to RF(B,B,B,E); so, at each event, the same light cone is in both frames. However, no translation of light changes with the changing synchrony from RF(B,B,B,E) to RFB; a single observer could construct both frames, using the same light signals to synchronize the same reference clocks, while only mentally switching synchrony between E and B; so, at each event, the light cone of RF(B,B,B,E) and RFE differs from that of RFB, in the manner of the light cones in Figure 1B). Hence, by Observation A), since each event has a light cone of RFE, the light cones of RFB are fictitious. Thus, light speed is isotropic only relative to E translation.

Therefore, the ether exists. ∎

In short: Since, by assumption, light travels isotropically relative to E translation, E synchrony is correct; so, light travels anisotropically relative to B translation; hence, by Observation A), light does not travel isotropically relative to B translation.

The preceding simple logic clearly makes no hidden assumption that the ether exists.

In SR, Observation A) is true, with *the* one double light cone "absolute", at each event [17]. But, also in SR, since $\varepsilon = ½$ for each state of translation attainable by clocks, each event has a light cone of each RFB; so, in SR, Observation A) is false. Therefore, SR is inconsistent both internally and with observation (as is any theory that always assumes a particular ε, $\varepsilon \neq ½$).

Were Figures 2D) and 2E) equally valid for the same scenario, as SR implies, all events in their superposition would occur and be observable. Thus, each clock would have multiple world lines, most clearly showing that SR is inconsistent with observation.

Therefore, LPE is our best classical theory of flat space-time.

References.

[1] A. Einstein, *Ann. d. Phys. (Leipzig)* **17**, 891-921 (1905), *Zur Elektrodynamik bewegter Körper.*

[2] J. Larmor, *Phil. Trans. Roy. Soc. A. (London)* **190**, 205-300, 493 (1897), *A Dynamical Theory of the Electric and Luminiferous Medium.– Part III. Relations with Material Media*; *Aether and Matter*, Chapt. X-XI (Cambridge Univ. Press, Cambridge, 1900).

[3] H. A. Lorentz, *Proc. KNAW* **6**, 809-831 (1904), *Electromagnetic phenomena in a system moving with any velocity less than that of light*, reprinted in *The Principle of Relativity*, 9-34 (Methuen, London, 1923) (Dover, London 1952); *The Theory of Electrons and its Applications to the Phenomena of Light and Radiant Heat* (Teubner, Leipzig, 1909) (Dover, New York, 1952).

[4] H. Poincaré, *Arch. néer. Sci. ex. nat.* **5** (2), 252-278 (1900), *La théorie de Lorentz et le principe de réaction*; *La Science et l'Hypothèse* (Flammarion, Paris, 1902); *C. R. Acad. Sci. Par.* **140** (5), 1504-1508 (1905), *Sur la dynamique de l'électron*.

[5] H. Poincaré, *The Value of Science*, Chapt. VIII (Science Press, New York, 1907), English translation by G. B. Halsted, from *La Valeur de la Science* (Flammarion, Paris, 1905).

[6] E. T. Whittaker, *A History of the Theories of Aether and Electricity*, *Vol. 1: The Classical Theories*, Chapt. XIII (Nelson & Sons, London, 1951), *Vol. 2: The Modern Theories, 1900-1926*, Chapt. II (Nelson & Sons, London, 1953).

[7] H. E. Ives, *Phil. Mag.* **36** (257), 392-403 (1945), *Derivation of the Lorentz Transformations*.

[8] G. Builder, *Aust. J. Phys.* **11**, 279-297 (1958), *Ether and Relativity.*

[9] R. Mansouri and R. U. Sexl, *Gen. Rel. Grav.* **8** (7), 497-513 (1977), *A Test Theory of Special Relativity: I. Simultaneity and Clock Synchronization*.

[10] T. Sjödin, *Nuov. Cim. B* **51** (2), 229-246 (1979), *Synchronization in Special Relativity and Related Theories*.

[11] S. J. Prokhovnik, *Z. Nat.* **48a**, 925-931 (1993), *The Physical Interpretation of Special Relativity – a Vindication of Hendrik Lorentz*.

[12] H. Reichenbach, *The Philosophy Of Space And Time*, [a: 126-127] [b: 127] [c: 126-127] (Dover, New York, 1957), English translation, with omissions, by M. Reichenbach and J. Freund, from *Philosophie der Raum-Zeit-Lehre* (de Gruyter, Berlin, 1928); *Axiomatization of the Theory of Relativity*, [b: 35] [c: 44-45] (Univ. of California Press, Berkeley, 1969), English translation by M. Reichenbach, from *Axiomatik der relativistischen Raum-Zeit-Lehre* (Vieweg, Braunschweig, 1924).

[13] F. R. Tangherlini, *Nuov. Cim. Suppl.* **20**, 1-86 (1961), *An Introduction to the General Theory of Relativity.*

[14] W. F. Edwards, *Am. J. Phys.* **31** (7), 482-489 (1963), *Special Relativity in Anisotropic Space*.

[15] S. K. Ghosal, B. Raychaudhuri, A. K. Chowdhury, and M. Sarker, *Found. Phys. Lett.* **16** (6), 549-563 (2003), *Conventionality of Simultaneity and the Tippe Top Paradox in Relativity.*

[16] E.F. Taylor and A.P. French, *Am. J. Phys.* **51** (10), 889-893 (1983), *Limitation on proper length in special relativity.*

[17] R. M. Wald, *General Relativity*, 5 (Univ. of Chicago Press, Chicago, 1984).