The Continuing Relevance of Lorentz Ether Theory in the Age of Relativity

Doug Marett M.Sc.
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On line simulators and other information related to this talk are available at our website: http://www.conspiracyoflight.com
What is the experimental basis of the Special Relativity Theory?

From the website: http://www2.corepower.com:8080/~relfaq/experiments.html

- Prelude: Special Relativity and Experiments – 10 experiments
- I. Basic (Classic) experiments concerning SRT – 8 experiments
- II. Repetitions of the MMX – 13 experiments
- III. Repetitions of the Fizeau experiment – 3 experiments
- IV. Repetition of the Trouton-Noble experiment – 1 experiment
- V. Sagnac Effect – 1 review article
- VI. Repetition of the KTX – 1 experiment
- VII. Speed of Light independent of the velocity of the source – 4 experiments
- VIII. Isotropy of Space: Hughes Drever Experiments – 5 experiments
- IX. Isotropy of the Speed of Light – 4 experiments
- X. Relativistic Mass-Energy Relation – 11 experiments
- XI. Transversal Doppler effect – 10 experiments
- XII. Time Dilatation, Clock "paradox" – 14 experiments
- XIII. Some other Experiments – 7 experiments

Total: 91 Critical Experiments

Question: How can any other theory be consistent with all this data?
Answer:

An ether theory would have to be:

• so similar to Einstein’s theory that it arrives at the same result for all these experiments, even if it presumes a different *physical* interpretation
The big switch

- The “prototype” for SR was Lorentz’s ether theory of 1904
- speed of light is variable, time is absolute.
- undetectable preferred frame for light due to confounding properties of nature:
  1) change in the rate of a clock with velocity
  2) inability to measure the one-way speed of light - natural mechanisms cancel out 1st and 2nd order velocity effects.
  3) The contraction of matter with velocity

- Einstein reversed this!
- speed of light is constant in all moving frames
- rate of time variable.
- Undetectable ether irrelevant.
- switching $v$ for $\dot{t}$ - theories now “mathematically equivalent”
## Relativity is a Mathematical Equivalence of Lorentz Ether Theory

<table>
<thead>
<tr>
<th>Lorentz Ether Theory</th>
<th>Relativity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Dilation</strong></td>
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</tr>
<tr>
<td>Clocks slow due to motion because the speed of light changes in the clock</td>
<td></td>
</tr>
<tr>
<td>Real time is absolute</td>
<td></td>
</tr>
<tr>
<td>( \gamma T = T/\sqrt{1 - v^2/c^2} )</td>
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</tr>
<tr>
<td><strong>Lorentz Contraction</strong></td>
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</tr>
<tr>
<td>Length contracts with motion due to motional effect on molecular forces (dynamic explanation)</td>
<td></td>
</tr>
<tr>
<td>( l' = l\sqrt{1 - v^2/c^2} )</td>
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</tr>
<tr>
<td><strong>Fresnel Drag Coefficient</strong></td>
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</tr>
<tr>
<td>Lorentz (1892) derives the Fresnel Coefficient from his electromagnetic theory, explaining how EM waves are dragged by matter and not by ether</td>
<td></td>
</tr>
<tr>
<td>( c(v) = \frac{c}{n} + v\left(1 - \frac{1}{n^2}\right) - v = c/n - v/n^2 )</td>
<td>( c_{rel}(v) = \frac{\left(\frac{v + c}{n}\right)}{\left(1 + \frac{v}{nc}\right)} = \frac{c(1+n\beta)}{n(1+\frac{\beta}{n})} )</td>
</tr>
<tr>
<td><strong>Single Preferred Frame</strong></td>
<td><strong>All Relative Frames</strong></td>
</tr>
<tr>
<td>aether is a preferred frame for the speed of light, but is undetectable in conventional optical experiments</td>
<td></td>
</tr>
<tr>
<td>no preferred frames for light</td>
<td></td>
</tr>
<tr>
<td>What is undetectable need not be considered at all!</td>
<td></td>
</tr>
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</table>
How does Lorentz Ether Theory (LET) hold up to the Experimental Evidence?

- **1st order tests for a preferred frame for light**
- **2nd order tests for a preferred frame for light**
- Tests for time dilation
- One-way speed of light experiments
- Sagnac experiments
- Tests for Lorentz violations
1st Order Tests Using Refractive Index Differences in the Optical Path

- Galilean addition of velocities:
- glass with RI of $n = 1.5$,
- speed of light in the glass is: $c' = \frac{c}{n}$,
- ether is moving with respect to the glass, then: $c' = \frac{c}{n} \pm v$.

- Can this reveal our motion with respect to space?
- Hoek tried it with water $n = 1.33$
Simple Galilean addition of velocities should give a positive result. However on turning the device with respect to our motion, the fringe shift is null. There must be some factor $\phi$, an ether drag obscuring the expected fringe shift.

If $\phi = 0$ then no ether drag, if $\phi = 1$ then full ether drag.

臂 3 在线 W-E.

<table>
<thead>
<tr>
<th></th>
<th>Arm 1</th>
<th>Arm 2</th>
<th>Arm 3</th>
<th>Arm 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue path</td>
<td>$L_1/(c + v - \phi)$</td>
<td>$L_2/c$</td>
<td>$L_3/(c/n - v + \phi)$</td>
<td>$L_4/c$</td>
</tr>
<tr>
<td>Red path</td>
<td>$L_1/(c - v + \phi)$</td>
<td>$L_2/c$</td>
<td>$L_3/(c/n + v - \phi)$</td>
<td>$L_4/c$</td>
</tr>
</tbody>
</table>

如果设备旋转90度，使得臂3现在位于N-S，我们会得到：

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The value $\phi$ that exactly results in a null is: $\phi = v(1-1/n^2)$ The Fresnel Drag coefficient.
Physical Mechanism of the Fresnel Drag Coefficient
Lorentz’s Premise – Aether and matter interact via electrons

- The electric field of light displaces the electrons in glass creating a common motion.
- The moving electrons subjected to an additional Lorentz force from the magnetic field of the wave.

Effect: reduces wave velocity to $c/n - v/n^2$ when light and glass co-moving with the ether.

New treatment explains Arago, Fizeau, and Hoek experiments

Fresnel drag coefficient: due to matter slowing light waves, not aether entrainment.
William S.N. Trimmer - Experimental Search for Anisotropy in the speed of Light

Physical Review D Volume 8, Number 10, 1973 P. 3321 -3326.

- triangular Hoek Interferometer with glass in one arm.

- the anisotropy cancels around the paths completely
- analyzed using Lorentz’s method, the fringe shift for 375 km/s aether wind is zero. This is because the velocity of light in each arm is:

\[ c' = c/n - v/n^2. \]

First order tests cannot be used to distinguish between special relativity and ether theories...no such “experimentum crucis” is possible in principle...

Mansouri and Sexl, 1977
Experimental Evidence

- 1\(^{st}\) order tests for a preferred frame for light
- 2\(^{nd}\) order tests for a preferred frame for light
- Tests for time dilation
- One-way speed of light experiments
- Sagnac experiments
- Tests for Lorentz violations
Why 1\textsuperscript{st} Order Changes in Wavelength due to our Motion through Space are Invisible

Since $C = f \lambda$, if the speed of light ($c$) decreases, then so does the wavelength ($\lambda$). The frequency ($f$) must remain constant.
The null result can only occur if the horizontal arm contracts by \((1/2D)(v^2/c^2) = (1-v^2/c^2)^{1/2}\)
As techniques improve the measured fringe shift gets closer to zero.
Physical Justification for the Lorentz Contraction

- Lorentz - intermolecular forces are altered by motion
- space between the electrons are contracted by \((1-v^2/c^2)^{1/2}\)
- flattening of electric fields and magnetic vector potentials of moving charges - implied from Maxwell’s equations.
- The particles themselves are not considered to contract.
Experimental Evidence

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Experiments Verifying the Validity of Time Dilation (1): Ives and Stilwell (1938)

- Herbert Ives was an advocate of Lorentz Ether Theory
- demonstrated that a moving proton experiences a frequency shift of:
  \[ f = f_o \cdot \left(1 - \frac{v^2}{c^2}\right)^{1/2} \]
- results are consistent with the mechanical time dilation theory of Lorentz and Larmor, but also matches the predictions of Einstein.
Carried caesium clocks in opposite directions around the world, and compared their time increments to a reference clock at the origin.

- The clocks ran faster at altitude and slowed with velocity
- rate dependent on their direction around the globe (a form of Sagnac Effect).
- On the face of it, supports Einstein’s prediction of gravitational time dilation.
An LET Model of Gravitational Time Dilation

Although Lorentz never anticipated gravitational time dilation, it is a logical consequence of the mathematical equivalence of the two theories.

**Lorentz Ether Theory**

- Speed of light increases with altitude
- Gravity is a velocity well

**Relativity**

- Rate of time increases with altitude
- Gravity is a time well

\[ V = c \times (1 + \frac{gh}{c^2}) \]

\[ \Delta t = \frac{gh}{c^2} \]
Experiments Verifying Time Dilation

**Velocity Time Dilation**

  
  An Experimental Study of the Rate of a Moving Atomic Clock. II J. Opt. Soc. Am. **31** 369-374 (1941)


**Gravitational Time Dilation**


Experimental Evidence

- 1\textsuperscript{st} order tests for a preferred frame for light
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Other Attempts to Break the “Conspiracy of Light”

A Hypothetical One-Way Speed of Light Test Using Two Synchronized Lasers

Phase difference on rotation should be proportional to our velocity with respect to the aether as well as the distance between the two lasers.

Wavelengths contracted - arrive at the detector in phase

Wavelengths expanded - arrive at the detector out of phase
The Clock Effect in Moving Sources:

**Time Effect:**
\[ \Delta t = t \left( \frac{1}{1-v^2/c^2} \right) \left( \frac{L}{2c^2} \right) V \omega \text{rot} \sin(\theta) \]

**Fringe Shift:**
\[ \Delta \text{fringe} = t \left( \frac{1}{1-v^2/c^2} \right) \left( \frac{L}{2c\lambda} \right) V \omega \text{rot} \sin(\theta) \]

**Reference:**
LETTERE AL NUOVO CIMENTO
VOL. 7, N. 15 11 Agosto 1973
On the Impossibility of the First-Order Relativity Test.
A. A. Tyapkin
Joint Institute for Nuclear Research - Dubna

**Net Result:**
The fringe shift along the optical path due to the change in the one-way speed of light will be exactly cancelled by the frequency shift in the laser due to it’s rotation!
One Line Calculator of the Fringe Shift vs. Clock Effect

The two effects exactly cancel out!
The Cialdea One-Way Speed of Light Experiment

The experiment claims that the lack of phase shift between two independent lasers means that there is no detectable aether wind down to 0.9 m/s.

We replicated this experiment in 2010 and were able to show that it is incapable of detecting a phase shift induced by a reliable positive control – it fails on practical grounds.

This same experiment prompted A.A. Tyapkin to write his paper “On the Impossibility of the 1st Order Relativity Test” demonstrating that the experiment also fails on theoretical grounds – due again to the “clock effect”.
The Clock Effect also Explains why Mossbauer tests fail to detect an Aether

“the proper interpretation of the predicted null result is that detection of an ether is precluded as required by the special theory of relativity and that existence of an ether is permitted as required by the (Lorentz) contraction theory. “

Clock Effect – Also explains lack of Ether Drift in GPS One-Way Range Measurements

Figure 1 Ether Drift Geometry for GPS

The effect of an ether drift on the GPS one-way range measurements is exactly counteracted by the effect of the ether drift on the receiver clocks.

References:

Experimental Evidence

- 1\textsuperscript{st} order tests for a preferred frame for light
- 2\textsuperscript{nd} order tests for a preferred frame for light
- Tests for time dilation
- One-way speed of light experiments
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- Tests for Lorentz violations
The Sagnac Effect:

Proves: speed of light is not constant (in rotation).
Can it detect a preferred frame for the speed of light?

- On the bench, C is variable with respect to the lab (ECEF) frame.
- If bigger, can detect rotation diurnally – in the ECI frame
- Best detect our sidereal motion – in the heliocentric frame

With respect to what is the Sagnac interferometer rotating?!
The Sagnac Interferometer

The Sagnac Interferometer detects absolute rotation – with respect to the “fixed stars”.

It is perfectly incapable of detecting our translational motion through space.
Experimental Evidence

- 1\textsuperscript{st} order tests for a preferred frame for light
- 2\textsuperscript{nd} order tests for a preferred frame for light
- Tests for time dilation
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Mansouri-Sexl Test Theory of SR

- Tests for Lorentz Invariance: Second Order Coefficients:
  - $\alpha = \text{time dilation factor} = -1/2$
  - $\beta = \text{Lorentz contraction factor} = +1/2$
  - $\gamma = \text{contraction perpendicular to } v = 0$

- Michelson-Morley Type Experiments: Test $(\beta - \gamma)$
- Ives-Stilwell Type Experiments: Test $(\alpha)$
- Kennedy-Thorndike Type Experiments: Test $(\alpha - \beta)$

Tests for Lorentz Invariance cannot distinguish between the predictions of Special Relativity and Lorentz Ether Theory.
Experiments Demonstrating Lorentz Invariance:

<table>
<thead>
<tr>
<th>Group:</th>
<th>Type</th>
<th>Certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ives and Stilwell (1938)</td>
<td>$(\alpha + 1/2)$</td>
<td>$0.5 \times 10^{-2}$</td>
</tr>
<tr>
<td>Riis (1988)</td>
<td>$(\alpha + 1/2)$</td>
<td>$1 \times 10^{-7}$</td>
</tr>
<tr>
<td>Reinhardt (2007)</td>
<td>$(\alpha + 1/2)$</td>
<td>$8.4 \times 10^{-8}$</td>
</tr>
<tr>
<td>Michelson-Morley (1887)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>$1 \times 10^{-3}$</td>
</tr>
<tr>
<td>Joos (1930)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>$3 \times 10^{-5}$</td>
</tr>
<tr>
<td>Mueller (2003)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>$-2.2 \times 10^{-9}$</td>
</tr>
<tr>
<td>Schiller (2005)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>$(-0.6 \pm 2.1 \pm 1.2) \times 10^{-10}$</td>
</tr>
<tr>
<td>Antonini (2005)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>$(+0.5 \pm 3) \times 10^{-10}$</td>
</tr>
<tr>
<td>STAR Mission (2010)</td>
<td>$(\beta - \gamma - 1/2)$</td>
<td>Expected $10^{-12}$</td>
</tr>
<tr>
<td>Kennedy-Thorndike (1932)</td>
<td>$(\alpha - \beta + 1)$</td>
<td>$2 \times 10^{-2}$</td>
</tr>
<tr>
<td>Essen (1955)</td>
<td>$(\alpha - \beta + 1)$</td>
<td>$1 \times 10^{-3}$</td>
</tr>
<tr>
<td>Hils and Hall (1990)</td>
<td>$(\alpha - \beta + 1)$</td>
<td>$6.6 \times 10^{-5}$</td>
</tr>
<tr>
<td>STAR Mission (2010)</td>
<td>$(\alpha - \beta + 1)$</td>
<td>Expected $10^{-10}$</td>
</tr>
</tbody>
</table>

Uncertainties are now $10^{-6}$ to $10^{-9}$ less than in the original experiments.
Conclusions:

An ether theory can remain consistent with the evidence to date if it:

• Retains velocity and gravitational time dilation in concept
• The Lorentz contraction is real
• Fresnel Drag Coefficient is valid
• consistent with Sagnac effect (absolute rotation)

• Dragging of ether by gravity may be unnecessary

Lorentz Ether Theory remains viable by meeting these criteria