Ives-Stilwell Time Dilation Li$^+$ ESR Darmstadt Experiment and neo-Lorentz Relativity

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Botermann, Bing, Geppert, Hänsch, Huber, Karpuk, Krieger, Kühl, Nörtershäuser, Novotny, Reinhardt, Sánchez, Schwalm, Stöhlker, Wolf, and Saathoff in Test of Time Dilation Using Stored Li$^+$ Ions as Clocks at Relativistic Speed, Physical Review Letters, 2014, 113, 120405, reported results from an Ives-Stilwell-type time dilation experiment using Li$^+$ ions at speed 0.338c in the ESR storage ring at Darmstadt, and concluded that the data verifies the Special Relativity time dilation effect. However numerous other experiments have shown that it is only neo-Lorentz Relativity that accounts for all data, and all detect a 3-space speed $V \approx 470$km/s essentially from the south. Here we show that the ESR data confirms neo-Lorentz Relativity, and gives a speed $V \approx 470$km/s.

1 Introduction

Botermann et al. [1], reported results from an Ives-Stilwell [2, 3] time dilation experiment using Li$^+$ ions at speed $v = 0.338c$ in the ESR storage ring at Darmstadt, and concluded that the data verifies the Special Relativity time dilation effect, in (1). However numerous other experiments [4, 5] have shown that it is only neo-Lorentz Relativity that accounts for all of the data from various experiments, all detecting a 3-space speed $V \approx 470$km/s approximately from the south, see Fig.3. Here we show that the ESR data confirms neo-Lorentz Relativity, and that the ESR Darmstadt experimental data also gives $V \approx 470$km/s.

2 Special or Lorentz Relativity?

The key assumption defining Special Relativity (SR) is that the speed of light in vacuum is invariant, namely the same for all observers in uniform relative motion. This assumption was based upon the so-called null results from the Michelson-Morley (MM) 1887 experiment that was designed to detect any anisotropy in the speed of light. However the MM interferometer had a design flaw [4], resulting in the device being only able to detect such anisotropy when operated in gas-mode, i.e. with a gas in the light paths, as was the case with air present in the MM 1887 experiment. As well it requires a neo-Lorentz Relativity length contraction, from (4), of the interferometer arms in order to determine the calibration. This results in the device being some 2000 times less sensitive that assumed by MM who used Newtonian physics. Reanalysis of the MM data then led to a significant light speed anisotropy indicating the existence of a flowing 3-space with a speed of some 500km/s from the south. This result was confirmed by other experiments: Miller 1925/26 gas mode Michelson interferometer, DeWitte 1991 coaxial cable RF speeds, Cahill 2009 Satellite Earth-flyby Doppler shift NASA data [6], Cahill 2012 dual coaxial cable RF speed, [7], Cahill 2013-2014 [8,9] Zener diode 3-space quantum detectors. These and other experiments are reviewed in [4,10]. All these experiments also revealed significant space flow turbulence, namely gravitational waves [10]. However there are numerous experiments which are essentially vacuum-mode Michelson interferometers in the form of vacuum resonant optical cavities, see [11], which yield null results because there is no gas in the light paths. These flawed experimental designs are quoted as evidence of light speed invariance. So the experimental data refutes the key assumption of SR, and in recent years a neo-Lorentz Relativity (LR) reformulation of the foundations of fundamental physics has been underway, with numerous confirmations from experiments, astronomical and cosmological observations [12–14].

However of relevance here are the key differences between SR and LR regarding time dilations and length contractions. In SR these are

$$\Delta t = \Delta t_0 / \sqrt{1 - v^2/c^2}$$

$$\Delta L = \Delta L_0 \sqrt{1 - v^2/c^2}$$

where $v$ is the speed of a clock or rod wrt the observer, $c$ is the invariant speed of light, and subscript 0 denotes at rest time and space intervals. In SR these expressions apply to all time and space intervals. However in LR the corresponding expressions are

$$\Delta t = \Delta t_0 / \sqrt{1 - v_R^2/c^2}$$

$$\Delta L = \Delta L_0 \sqrt{1 - v_R^2/c^2}$$
where $v_R$ is the speed of a clock or rod wrt the dynamical 3-space, and where $c$ is the speed of light wrt the dynamical 3-space. In LR these expressions only apply to physical clocks and rods, and so the so-called time dilation in SR becomes a clock slowing effect in LR, caused by the motion of clocks wrt the dynamical 3-space. Only by using (4) in place of (2) does the data from the Michelson-Morley and Miller gas-mode interferometers agree with the results from using other experimental techniques [5].

The interpretation of (1 and 3), relevant to the experiment discussed herein, is that if a time interval $\Delta t_0$ corresponds to 1 cycle of an oscillatory system at rest wrt to an observer in SR, or at rest wrt to space in LR, then $v_0 = 1/\Delta t_0$ is the frequency of the emitted photon. When the system is moving, with speed $v$ wrt to an observer, or with speed $v_R$ wrt to space, then the time internal $\Delta t_0$ is increased, and the emitted photon frequency is decreased to $\nu = 1/\Delta t$.

Here the LR effects are applied to the frequencies of photons emitted by the moving $Li^+$ ions, to the Doppler shifts of these photons, and to the clock slowing of the two detectors that measure the detected photon frequencies.

Fig.1 shows the direction of the 3-space flow as determined from NASA satellite Earth-flyby Doppler shifts [6], revealing that the flow direction is close to being South to North, which is relevant to the ESR Darmstadt experiment in which the $Li^+$ ions travel also from South to North.

Fig.2 shows the simple circuit for the quantum detection of the 3-space velocity. The measured 3-space speeds are shown in Fig.3, and follow from measuring the time delay between two such detectors, separated by 25cm and orientated such that the maximum time delay is observed for the 3-space induced quantum tunnelling current fluctuations.

### 3 Special Relativity and $Li^+$ ESR Darmstadt Experiment

The $Li^+$ ESR Darmstadt experiment measured the photon frequencies $\nu_N$ and $\nu_S$ at the two detectors, emitted by the ions moving North at speed $v = 0.338c$, see Fig.4 Top. In SR there are two effects: time dilation of the emitting source, giving emitted photons with frequency $\nu_0 \sqrt{1 - v^2/c^2}$, from (1), where $\nu_0$ is the frequency when the ions are at rest wrt the two detectors. The 2nd effect is the Doppler shift factors $1/(1 \pm v/c)$, giving the detected frequencies

\[
\nu_N = \nu_0 \sqrt{1 - v^2/c^2} / (1 - v/c) \tag{5}
\]

\[
\nu_S = \nu_0 \sqrt{1 - v^2/c^2} / (1 + v/c) \tag{6}
\]

Then

\[
\nu_N \nu_S / \nu_0^2 = 1 \tag{7}
\]
and this result was the key experimental test reported in [1], with the data giving
\[ \sqrt{\nu N \nu S} / \nu 0^2 - 1 = (1.5 \pm 2.3) \times 10^{-9} \] (8)
On the basis of this result it was claimed that the Special Relativity time dilation expression (1) was confirmed by the experiment.

4 Lorentz Relativity and Li\(^+\) ESR Darmstadt Experiment

In LR expressions (5) and (6) are different, being
\[ \nu_{LN} = \frac{\nu_0 \sqrt{1 - (v - V \cos \theta)^2 / c^2 - V^2 \sin \theta^2 / c^2}}{(1 - v / (c + V \cos \theta)) \sqrt{1 - V^2 / c^2}} \] (9)
\[ \nu_{LS} = \frac{\nu_0 \sqrt{1 - (v - V \cos \theta)^2 / c^2 - V^2 \sin \theta^2 / c^2}}{(1 + v / (c - V \cos \theta)) \sqrt{1 - V^2 / c^2}} \] (10)
where \( \nu_0 \sqrt{1 - (v - V \cos \theta)^2 / c^2 - V^2 \sin \theta^2 / c^2} \), from (3), is the expression for the lower emitted photon frequency with the ions moving at velocity
\[ \nu_R = (v - V \cos \theta, V \sin \theta) \] (11)
wrt the 3-space, with \( 1 / (1 - v / (c + V \cos \theta)) \) and \( 1 / (1 + v / (c - V \cos \theta)) \) being the Doppler shift factors as the photons have speed \( c \pm V \cos \theta \) wrt the detectors frame of reference; and \( 1 / (1 - V^2 / c^2) \) being the time dilation effect for the clocks in the frequency measuring devices, as the slowing of these clocks, from (3), makes the detected frequency appear higher, as they have speed \( V^n \) wrt the 3-space; see Fig.4 Bottom. From (9) and (10) we obtain
\[ \nu_{LN} \nu_{LS} / \nu 0^2 = 1 - \frac{v^2 \sin \theta^2}{c^2(c^2 - v^2)} V^2 + O[V^4] \] (12)
which is identical to (7) to 1st order in \( V \). Then we obtain
\[ \sqrt{\nu_{LN} \nu_{LS} / \nu 0^2} = 1 - 1.2 \times 10^{-9} \] (13)
and, for example, \( V = 470\text{km/s} \) at an angle \( \theta = 5^\circ \), with \( v = 0.338c \), gives
\[ \sqrt{\nu_{LN} \nu_{LS} / \nu 0^2} = 1 - 1.2 \times 10^{-9} \] (14)
which is consistent with the result from [1] in (8). Hence the \( Li^+ \) ion experimental data is consistent with neo-Lorentz Relativity with a 3-space flow speed of 470km/s.

A more useful result follows when we examine the ratio \( \nu_{LN} / \nu_{LS} \) because we obtain a 1st order expression for \( V \)
\[ V \cos \theta = \frac{c v - v^2}{2v^2} \left( \frac{c + v}{c - v} - \frac{\nu_{LN}}{\nu_{LS}} \right) \] (15)
which will enable a more sensitive measurement of the projected \( V \cos \theta \) value to be determined from the \( Li^+ \) ESR Darmstadt data. This result uses only the neo-Lorentz Doppler shift factors. \( V \cos \theta \) will show space flow turbulence fluctuations and over months a sidereal time dependence. The
values are predicted to be like those in Fig.3 from the 3-space quantum detectors. Indeed such a simple detection technique should be run at the same time as the \( \dot{L}_\text{E}^+ \) data collection. The data is predicted to give \( V \cos[\theta] \approx 470\text{km/s} \), as expected from Fig.3. Then the \( \dot{L}_\text{E}^+ \) experiment will agree with results from other experiments [4–10].

Note, that SR gives, from (5) and (6),

\[
\left( \frac{c + v}{c - v} - \frac{\nu_L}{\nu_S} \right) = 0
\]

(16)

in contrast to (15).

5 Conclusions

The non-null experimental data, from 1887 to the present, all reveal the existence of a dynamical 3-space, with a speed \( \approx 500\text{km/s} \) wrt to the earth. Null experiments are based on flawed instrument designs, with the false null results being misinterpreted as supporting the SR spacetime formalism. Originally Lorentz proposed an aether moving through a static geometrical space. However the data and theory imply a different neo-Lorentz Relativity, with there being a dynamical fractal flowing 3-space, which posses an approximate geometrical measure of distances and angles, which permits the geometrical description of relative locations of systems. As well the dynamical theory for this 3-space has explained numerous gravitational effects, with gravity being an emergent quantum and EM wave refraction effect, so unifying gravity and the quantum. An important aspect of Lorentz Relativity, which causes ongoing confusion, is that the so-called Lorentz transformation is an aspect of Special Relativity, but not Lorentz Relativity. The major result here is that the \( \dot{L}_\text{E}^+ \) ESR Darmstadt experimental data confirms the validity of neo-Lorentz Relativity, and may be used to accurately measure \( V \cos[\theta] \).

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References


