Absolute velocity of earth from our stationary Michelson-Morley-Miller experiment at CIF

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Absolute velocity of earth from our stationary Michelson-Morley-Miller experiment at CIF, Bogota, Colombia (presented at PIRT-2017 at Bauman University, Moscow, but not included in the Proceedings)

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Twenty years ago, present writer identified weaknesses in the design, execution, and interpretation of classical experiments to measure relative motion of earth and ether. It is not generally known that Michelson did not record the whole observed fringe-shift, but merely its fractional part; same protocol was used by Michelson and Morley, and also by Miller. Hence, the fringe-shift amplitude leading to earth's velocity was systematically underestimated. To confirm this theoretical claim, in the period 2002-2005 we repeated at CIF the interferometer experiment using modern technology, and concomitantly implementing changes in design to fix additional issues in the pioneering experiments. As usual in second-order experiments, two velocities of our sun relative to a preferred frame were obtained from our data: (a) CIF-S in the southern hemisphere: V_S = 500 km/s, R.A. = 16h-40m, Dec = -75º, and (b) CIF-N in the northern celestial hemisphere: V_S = 365 km/s, R.A. = 5h-24m, Dec = 79º. These values are similar to other estimates of absolute solar velocity, and are consistent with the existence of a preferred frame. Moreover, there is a high correlation between our CIF-S and CIF-N velocities with frequency variations in microwave cavities measured by a Stanford group in 2002 (that they interpreted as consistent with Lorentz invariance), and with the variation of amplitude in the standing-waves experiment by de Haan in 2012. Empirical evidence in natural science should be based on adialeiptometry (i.e., long-term repetitive almost continuous observations), rather than on meager isolated short-term observations at particular times of day.

Keywords: Michelson-Morley experiment, Miller experiments, Lorentz invariance, absolute space, absolute earth velocity, absolute solar velocity, ether, preferred frame, Stanford Lipa experiment, de Haan experiments

Overlooked and unaccounted weaknesses in classical interferometer experiments

By the end of 18th century it was thought that the only relevant motion of our sun was towards constellation Hercules[1] with speed of 19 km/s, similar to earth's orbital motion of 30 km/s [1, p1], [2, p124-125]. In such context Michelson estimated that in early April 1881 the interference pattern of his interferometer at Berlin (Germany) would shift in a turn by less than one fringe-width [2]; hence, he only recorded fractions of one fringe-shift, i.e., without looking for interference drifts larger than one fringe-width. Michelson's 1881 results were not particularly good [3, p251-260].

As independently noted by Lorentz and by Potier, and as acknowledged by Michelson [4, p450-451], the analysis of the transversal arm of the interferometer in the 1881 paper was not correct [2, p121]. A repetition of the experiment by Michelson and Morley (MM henceforth) was carried out in Cleveland over four days in July 8-12, 1887, for a total of six sessions, half at noon, half at 6 pm; there were six turns of the interferometer in each session, for a total of 36 turns of the apparatus. As in 1881, MM only recorded fractions of a fringe-shift, and ignored the possibility of more than one fringe-shift during successive readings. However, MM accepted that "*in what precedes, only the orbital motion of the earth is considered. If this is combined with the motion of the solar system, concerning which but little is known with certainty, the result would have to be modified...*" [4, p458] (emphasis added). It may be stressed that Michelson did not even consider the possibility that solar speed could be large [3, 5-7], as it turned out to be [8]. Indeed, solar motion much larger than earth's orbital implies a large variable speed projected on the plane of the MM apparatus. Hence, in one turn of the interferometer the interference pattern drifts by more than a fringe-width (contrary to 1881 expectations).

Michelson and Morley found that "*the relative velocity of the earth and the aether is probably less than one sixth the earth's orbital velocity, and certainly less than one fourth*" [4, p458], i.e., observed speed probably less than 5 km/s, and "certainly" less than 7.5 km/s. It is our

[1] The same assumption was present in Miller's work from 1902 to 1924 [16, p353], until it was finally realized that "*motion towards Hercules is not a component of the absolute motion of the earth*" [17, p223].

contention that the small speed of earth reported by MM was a mere artifact of Michelson's data gathering of only a fractional amplitude *A*, rather than *A+n*, where *n* is the integer number of fringe-shifts missed by MM [3, 5-7]; an additional minor effect was MM's controversial averaging of data [9, 10], also noted by this writer [3, 5-7, 11, 12]. At any rate, MM observed a small but non-zero relative velocity between earth and absolute space, that they interpreted as zero: "*if now it were legitimate to conclude from the present work that the aether is at rest with regard to the earth's surface...*" [4, p459]. This is the so-called null-interpretation of the 1887 MM experiment that led Lorentz and FitzGerald to hypothesize length-contraction. However, Lorentz was always very uneasy about MM's "null" results, and in letter to Lord Rayleigh (August 18/1892) Lorentz asked: "*Can there be some point in the theory of Mr. Michelson's experiment which has as yet been overlooked?*" [13, p32]. Our answer to Lorentz is positive: Yes, Michelson's choice to record only fractions of a fringe-shift was not appropriate [3, 5-7]; such protocol could be valid only if solar motion is very slowly relative to absolute space.

After Michelson left Cleveland in 1899, Dayton C. Miller joined Morley in 1902 to go on with the interferometer experiment [14, 15], and continued alone after Morley retired [16, 17]. Miller's experiments involved thousands of turns of the interferometer over more than twenty years [16, p360; 17]; in contrast, MM only carried out 36 turns over four days [4]. According to Miller: "*We had definite pictures in our minds as to what should happen... In every case we found that the result was negative as to these expectations. But it was never numerically zero, not even in the original Michelson and Morley experiment*" [16, p354]. As seen next, a chief preconceived picture continued to be the expected fringe-shift less than one fringe-width.

A run in Miller's experiments consisted of twenty turns of the apparatus lasting from fourteen to twenty minutes; often he observed that the reference fringe shifted by more than two fringe-widths from the fiducial point. As noted by Hicks [9], temperature variations may partially account for drifts of the reference fringe; this incorrectly led Miller to attribute integer fringe shifts to thermal effects only, and to restore the reference fringe "*to its central position simply by placing a small weight of two or three hundred grams on the end of the arm or by removing a weight from the arm. This is done without stopping the uniform turning of the apparatus and usually without interrupting the readings*" [17, p212]. Miller also reported that "*the final adjustment of the central fringe to the fiducial point is secured by means of small weights placed on the end of the arm of the cross, causing a change of length by flexure ... a weight of 282 grams placed on the end of one arm produces an elongation in the multiple light-path sufficient to displace the fringe system one fringe-width*" [17, p215]. A typical run, say September 23/1925 at Mount Wilson from 03:02 to 03:16 shown as figure 8 in [17, p213], exhibits three adjustments to eliminate drifts of the reference fringe. Adjustments were at the beginning of the sixth, the tenth and the twentieth turns, which means that the interference pattern shifted anywhere from three to six fringe-widths during the fifteen minutes of this particular run. Miller's adjustments amounted to using four different apparatuses during a single run, with one of the arms having four different lengths: L1 for turns 1 to 4, L2 for turns 5 to 9, L3 for turns 10 to 19, and L4 for the last turn 20. Miller forgot here that good experimental practice forbids variations of the experimental apparatus during a run! If the drift were due to thermal effects only, Miller's procedure would be a correction by hardware on real-timen-line. However, the drift of the reference fringe may also contain a significant contribution from solar motion relative to the preferred frame [5-7, 18]. The measurement of such motion was the object of the experiment, so that Miller's adjustments amounted to discarding the useful empirical information, thus explaining why he obtained terrestrial speeds of 10 km/s only, rather than 200km/s, or more. Miller was perplexed: "*for some unexplained reason the relative motion of the earth and the ether in the interferometer at Mount Wilson is reduced to 10 km/s*" [16, p364]. He then conjectured that either "*the earth drags the ether*", or alternatively, it "*may be explained by the theory of the Lorentz-FitzGerald contraction*" [16, p365]. Our answer is simple: Miller threw away the integer fringe-shifts.

By the end of 1924 there was a turning point in Miller's way of thinking: "*a complete calculation of the then expected effects, for each month of the year, was made for the first time. This indicated that the effect should be a maximum about April 1, and further, that the direction of the effect should, in the course of the twenty-four hours of the day, rotate completely around the horizon*" [16, p356], underlining added. Such calculations were based on work done by Nassau and Morse [19], and led Miller to redirect his experiment to "*observations extending over the whole twenty-four hours of the day, in order to determine the exact form of the daily variation in magnitude and azimuth of the effect, and by means of observations made at different times of year, in order to prove that the effect is dependent on sidereal time*" [16, p366]. This programme was carried out by Miller from April 1925 to February 1926 [17, p.228-232], but unfortunately he kept registering the fractional part of the fringe-shift only, leading to the usual terrestrial speeds around 10 km/s. Actually, to obtain his reported solar speed in the range 200-280 km/s Miller entered corrections by hand, see table V [17, p235]. Miller's continuous series of observations in 1925-1926 was never repeated.

The stationary Michelson-Morley interferometer à la Miller at CIF (Bogota)

At the beginning of present century, James De Meo went to Cleveland, unearthed Miller's laboratory notes, and kindly supplied photocopies to the present writer. Miller's notebooks confirm that, quite often, in one-turn of the apparatus there were several adjustments of the position of the reference fringe. Naïvely one could tentatively guess the amount of each adjustment, and reverse it to produce approximate "unadjusted" fringe-shift values, but such data would not be credible. Rather, this writer opted to repeat Miller's programme of 1925-1926. First step was to predict expected fringe-shifts according to modern values of solar velocity $\mathbf{V}_S$, assuming that light moves with constant speed c relative to the isotropic absolute space Σ. An inertial frame of reference was attached to Newtonian fixed stars, and the X-axis of the system of coordinates was directed towards the sun at noon UT on March 21, 2000. For a symmetric interferometer with equal arms of length L, the relative time-dependent fringe-shift $\Delta F(t)$ is approximately given by [18]

$$\Delta F = F(t) - F(midnight) = \frac{L}{\Lambda}\left(\beta_H^2 \cos 2\gamma - \beta_H^2(mn)\cos 2\gamma(mn)\right). \quad (1)$$

The wavelength of the interferometer light source is Λ, and the reference time is local midnight (mn). The absolute velocity of earth's center of mass is $\mathbf{V}_T$ formed by the vector addition of earth's orbital velocity and the absolute solar motion $\mathbf{V}_S$ relative to Σ. In a Cartesian system of coordinates attached to a laboratory on the surface of earth, the time-dependent components of $\mathbf{V}_T$ are (V_E, V_N, V_Z) along the local east, north and zenith (or vertical) directions. The horizontal projection of $\mathbf{V}_T$ on the plane of the interferometer is V_H, and its direction is given by angle γ relative to local east:

$$\beta_H = \frac{V_H}{c}, V_H = \sqrt{V_N^2 + V_E^2}, \tan\gamma = \frac{V_N}{V_E}. \quad (2)$$

Our experiment at the International Centre for Physics (CIF) in Bogota has several improvements relative to Miller's experiment: a laser light source, automatic data gathering with video camera, and a stationary interferometer to avoid Lodge's acid criticism: "*surprising that the readings were made by a peripatetic observer, with the instrument in constant and not very slow rotation … a stoppage of the frame and a reading of the fringes by a seated observer in many azimuths, would have been more satisfactory*" [20], emphasis added. Table 1 compares several features of our setup at CIF to Miller's experiment at Mount Wilson Observatory [17, 21]. During a preliminary phase in 2002 it was determined that a stationary experiment with laser light was feasible, both with red and green lasers, we also checked the stability of the setup relative to local vibrations and to environmental variables (pressure, temperature and humidity). We locally developed software to capture interference images at various rates of data sampling with a computer attached to a commercial video camera, and to convert the analogue images into digital interference patterns. The experiment itself ran from January 2003 to February 2005, collecting data day and night, at a rate of one image of the interference pattern every minute for a total of 1,440 images in one daily rotation. Several acceleration, temperature and humidity sensors were deployed across the laboratory. In each month several runs were carried out, each one of several days duration. The reference fringe over time exhibited clear periodicities, both with red and green lasers (see fig. 1); the latter was finally selected due to voltage and temperature stability [22].

Table 1. Summary comparison of interferometer experiments at CIF and at Mount Wilson

Name	International Centre for Physics	Mount Wilson Observatory
Place	Bogotá, Colombia	Pasadena, California, USA
Location/altitude	74°-05’W, 4°-38’N / 2,556 m	118°W, 34°-13’N/ 1,830 m
Observation period	Jan. 2003 to Feb. 2005	Apr. 1925 to Feb. 1926
Apparatus support	Pneumatic table/ 13 ton concrete	Steel cross on stone/ floating in Hg
Interferometer type	Slow rotation/ symmetrical	Fast rotation/ symmetrical
Rotation period	24 hours, stationary in laboratory	50 seconds
Optical path	Arm length: 2.044 m/single path	Light path: 224 feet/multiple paths
Light source	Laser green light 532 nm	White (acetylene)
Observations in 360°	1,440	16
Azimuthal resolution	360°/1440 = 1.5°	360°/16 = 22.5°
Interference image	On stationary frost glass	Rotating telescope focused on mirror
Observer	Stationary video camera	Human eye (observer running in circle)
Recording	Computer	Human assistant

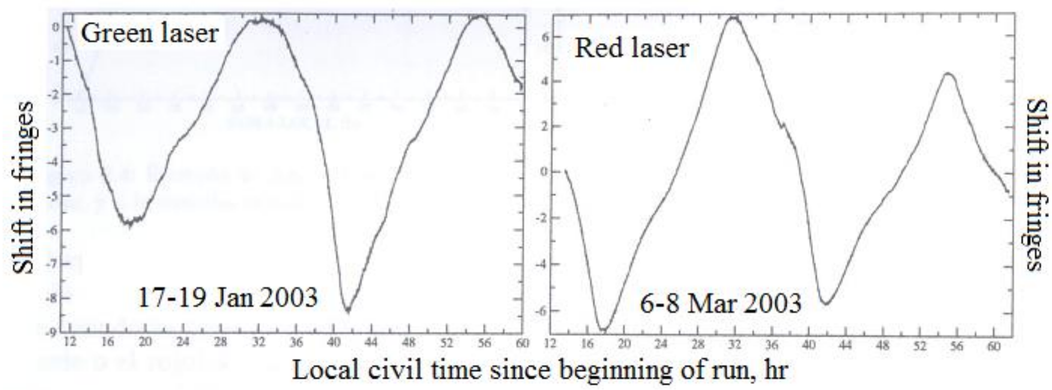

Fig. 1. Periodical fringe shifts with green and red lasers at CIF experiment [22, p6].

Index of refraction in air depends on temperature, pressure, humidity and carbon dioxide concentration [23]. Temperature varied in our laboratory around ±0.4°C (same order as resolution of sensor), and humidity varied several percentage points in the 60% range. The maximum daily pressure variation at the ground altitude of Bogota is around 11 hPa [24]. The fringe-shift in the CIF interferometer expected from variations in index of refraction of air were calculated according to [23]; it was found to be several orders of magnitude lower than observed shift. The influence of pressure on fringe-shift was experimentally checked by placing a small interferometer in a vacuum chamber and letting pressure slowly return to ambient pressure [22, p19-21]. Since the daily variation of pressure in Bogota exhibits a 12-hour period and the maxima and minima seem to be related to solstices and equinoxes [24, p130-139], it was checked whether observed fringe-shifts at CIF and daily variations of pressure in Bogota were correlated. Since a strong correlation was found it was decided to apply a stochastic procedure to subtract from our observed curves the fraction of signal correlated with pressure. Similar corrections were applied to correct for unwanted contributions from temperature and humidity. The residual curves were no longer correlated with the said environmental variables, but still exhibited similar periodicities, as attested by fig. 2. For further details see [7] and [22, p17-54].

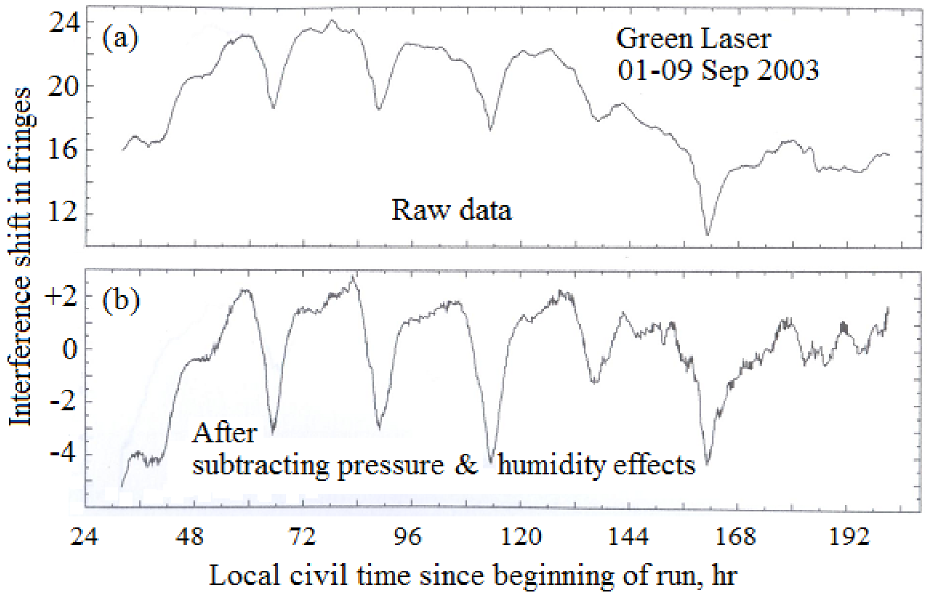

Fig. 2. Periodical fringe-shifts structure is maintained after stochastic environmental corrections.

Periodicities underlying the fringe-shift structure of individual runs were quantitatively extracted using discrete Fourier transforms (DFT). For the raw data of 1-9 September 2003 shown in fig. 2 (upper panel) the main periods were 8.1, 12.1, 24.2 and 42.3 hr. To obtain the longest periods underlying the fringe-shift curves, a synthetic series was prepared using all green laser runs during 2003, the shortest and longest periods extracted by DFT are shown here as fig. 3. Periods T with largest amplitudes A (in fringes) are listed in table 2, some periods of physical interest, but small amplitude, are also included; for further details see [22, ch.4].

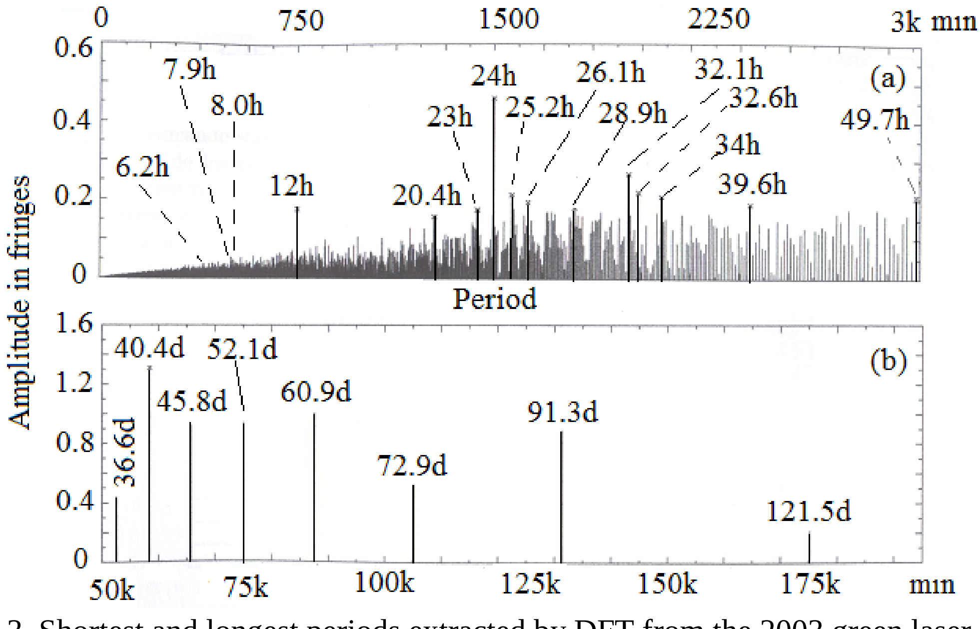

Fig. 3. Shortest and longest periods extracted by DFT from the 2003 green laser data.

All periods appearing in panel (b) of fig. 3 correspond to harmonics of the tropical year (see last column in table 2), thus confirming the expected annual dependence arising from orbital motion of earth. Daily motion of interferometer relative to the sun (due to earth's rotation) is reflected in the 24 hour period, and its harmonics (12, 8 and 6 hr). Although the number of observations was not sufficient to attain a good resolution, the sidereal period T = 23.9 hr was also observed (this may be related to motion of sun relative to our galactic center [25]).

Table 2. Summary of periods obtained by DFT from the 2003 data

T, hr	A, frng	T, hr	A, frng	T, hr	A, frng	T, day	A, frng	T, day	A, frng	n	Y/n = 365.2422/n
6.2	0.03	23.0	0.18	37.2	0.16	5.14	0.86	26.11	0.69	14	26.09
7.9	0.05	23.9	0.16	39.6	0.19	5.90	0.97	28.11	0.07	13	28.10
8.0	0.05	24.0	0.45	44.9	0.16	6.77	0.70	30.40	0.95	12	30.44
9.5	0.06	25.2	0.21	47.3	0.17	7.77	0.91	33.19	1.03	11	33.20
11.9	0.07	26.1	0.19	49.7	0.21	8.28	0.94	36.56	0.43	10	36.52
12.0	0.17	27.3	0.16	56.6	0.25	10.40	1.06	40.44	1.29	9	40.58
15.8	0.10	27.6	0.16	57.1	0.29	14.04	1.33	45.75	0.91	8	45.66
17.2	0.10	28.9	0.18	61.7	0.29	15.19	1.13	52.08	0.93	7	52.18
18.9	0.13	32.1	0.27	68.9	0.43	18.23	1.12	60.87	0.99	6	60.87
19.7	0.13	32.6	0.21	75.6	0.53	20.23	1.03	72.92	0.51	5	73.05
20.3	0.15	34.0	0.21	95.3	0.49	22.40	0.96	91.30	0.88	4	91.31
22.8	0.14	35.2	0.16	109.4	0.76	24.34	1.23	121.53	0.21	3	121.75

As usual in second-order experiments (say, Miller [17]), two velocities of sun relative to a preferred frame were obtained from our data: (a) CIF-S in the southern celestial hemisphere: V_S = 500 km/s, R.A. = 16h-40m, Dec = -75º [26], and (b) CIF-N in the northern celestial hemisphere: V_S = 365 km/s, R.A. = 5h-24m, Dec = 79º [27]. These results are compatible with previous work supporting absolute motion [28].

Consistency of our absolute solar motion with two recent independent experiments

The CIF-S and CIF-N absolute solar velocities lead to an alternative view for the Lorentz invariant experiment at Stanford in 2002 [29]. They are also correlated to de Haan experiments in 2012 [30]. Correlation of atmospheric pressure to our CIF experiment is addressed firstly.

Table 3. Correlations of atmospheric pressure and absolute velocity in Bogota

Month (2003)	Components of absolute velocity of terrestrial laboratory										MMMM fringeshift	
	East		North		Zenith		Horizontal		Angle			
	Corr.	Ph.	Corr.	Ph.	Corr.	Ph.	Corr.	Ph.	Corr.	Ph.	Corr.	Ph.
January	0.492	2	0.492	8	0.490	20	0.930	19	0.488	2	0.936	7
February	0.515	4	0.513	10	0.515	22	0.943	21	0.511	4	0.948	9
March	0.526	6	0.523	12	0.528	0	0.950	23	0.521	5	0.952	11
April	0.483	7	0.480	13	0.483	1	0.920	0	0.467	8	0.923	12
May	0.528	9	0.527	15	0.529	3	0.947	2	0.524	8	0.947	14
June	0.500	11	0.497	17	0.503	5	0.922	4	0.498	10	0.921	16
July	0.442	12	0.438	18	0.447	6	0.863	6	0.444	12	0.861	18
August	0.491	15	0.491	21	0.494	9	0.891	9	0.490	15	0.892	21
September	0.573	18	0.579	0	0.572	12	0.908	11	0.570	18	0.910	23
October	0.576	21	0.576	3	0.574	15	0.905	14	0.570	21	0.909	2
November	0.546	23	0.545	5	0.543	17	0.913	16	0.539	23	0.918	4
December	0.487	1	0.486	7	0.483	19	0.900	18	0.479	1	0.905	6
CIF-S: Av.	0.513		0.512		0.513		0.916		0.508		0.918	
CIF-N:Av.	0.513		0.513		0.513		0.853		0.509		0.856	

Atmospheric pressure in Bogota, Colombia

Absolute velocity of our laboratory in Bogota on the 16th day of each month of year 2003 was calculated using the two absolute solar velocities CIF-S and CIF-N obtained from our own experiment; response of our stationary Michelson-Morley-Miller-Múnera (MMMM) interferometer at the said location was also calculated. It was trivial to expect a high correlation with the reported local hourly pressure [24]. However, correlations in table 3 show that only horizontal projection on the laboratory floor is highly correlated with pressure (91.6% for CIF-S velocity). On the contrary, individual Cartesian components (V_E, V_N, V_Z) of absolute velocity just have a modest correlation at the 51% level, see table 3, last column. These facts explain two separate questions: (a) The observed high correlation between MMMM experiment and local pressure, where horizontal speed and fringeshift are connected by eqs. (1) and (2). The connection between pressure and horizontal absolute speed is left as an open question. (b) Existence of a periodical fringe-shift structure after correcting for pressure (see fig. 2b). Residual periodicity may be, thus, related to daily and annual variations of (V_E, V_N, V_Z).

Lipa 2002 experiment at Stanford University, California

Lipa experiment compared frequency ν from two microwave cavities oriented along local East-West and vertical direction, the apparatus is thus equivalent to a vertical interferometer. This well controlled experiment controlled cavity temperature within $\pm 5 \times 10^{-6}$ K [29]. Data was sampled every second, and averaged every 100 seconds; it is unknown whether apparatus was contained within a pressure and composition controlled atmosphere. Since observed periodical variations were attributed to unexplained “mechanical disturbances”, an equation with six free parameters was fitted to such signal (i.e., the disturbances), which was subtracted leaving a structureless noise that was interpreted as supporting Lorentz invariance. Lipa’s data was recovered from their eq. 4, and was correlated to absolute velocity at Palo Alto (California) obtained from our CIF-S and CIF-N solar velocities according to methodology described in [18] (see fig. 4). Table 4 shows correlations for data calculated every 15 minutes for each of the nine sessions in year 2002 [29].

With the sole exception of day 3, there is a high correlation of the so-called “mechanical disturbances” with all components of absolute motion at Palo Alto, including the three individual components of velocity (V_E, V_N, V_Z). Our remarks above regarding pressure correlations in Bogota imply that, even if there are atmospheric pressure effects at Palo Alto, there would still exist a periodical residual correlated to absolute velocity of earth. Last column in table 4 predicts that Lipa experiment is correlated with fringeshift in a horizontal MMMM apparatus operating in Palo Alto on same date. Our claim is that Lipa’s cavities and the MMMM aparatus both support existence of absolute motion.

Table 4. Correlations of “mechanical disturbances” with absolute velocity in Palo Alto

Day	Date (2002)	Components of absolute velocity at earth’s surface					MMMM experiment fringeshift
		East	North	Zenith	Horizontal		
					Speed	Angle	
1	May 30	0.993	0.993	0.993	0.998	0.991	0.995
3	Jun 01	0.557	0.556	0.554	0.536	0.630	0.556
18	Jun 16	0.883	0.884	0.885	0.912	0.838	0.922
26	Jun 24	0.902	0.901	0.901	0.924	0.936	0.929
59	Jul 27	0.829	0.831	0.830	0.838	0.780	0.843
78	Aug 15	0.931	0.932	0.932	0.961	0.913	0.969
80	Aug 17	0.984	0.984	0.983	0.981	0.966	0.980
95	Sep 01	0.948	0.950	0.947	0.956	0.921	0.960
98	Sep 04	0.808	0.811	0.806	0.817	0.759	0.825
Average CIF-S		0.871	0.871	0.870	0.880	0.859	0.887
Average CIF-N		0.871	0.871	0.871	0.882	0.856	0.886

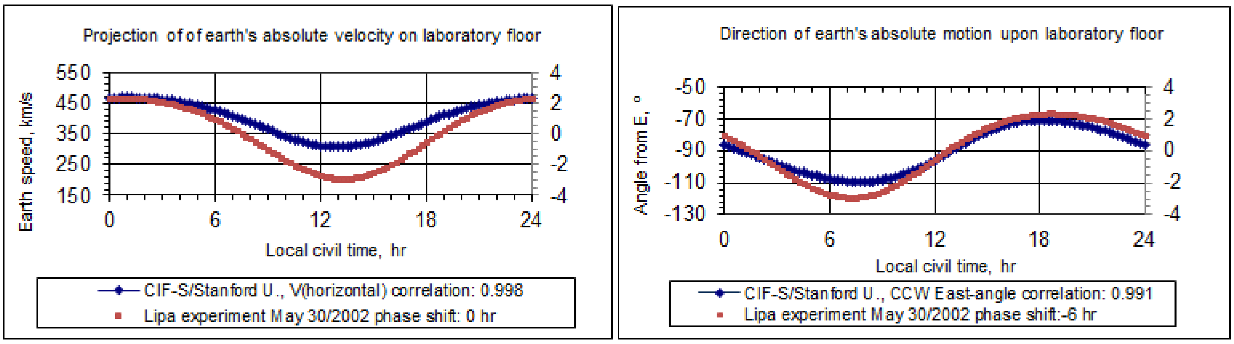

Fig. 4. Observed mechanical disturbances (lower red curve) are highly correlated to absolute velocity at Palo Alto (upper blue curve).

De Haan 2012 and 2014 experiments at Puttershoek, The Netherlands

A first experiment in April 07-16, 2012 compared phase difference in a Mach-Zehnder interferometer to phase of a standing wave; a second experiment from April 8, 2013 to September 10, 2014 involved Fabry-Perot cavities. In both cases de Haan reported well-defined periodic responses in amplitude, and less definite periodicities in azimuth [30]. Using both CIF-S and CIF-N, we calculated absolute velocities at Puttershoek in April 12/2012 (middle of first experiment), and 8 April 2013, first day of second experiment. De Haan's amplitudes are highly correlated to terrestrial absolute velocity, while azimuths are only poorly correlated (see fig. 5 and table 5). Of course, de Haan's amplitudes would also show correlation with fringeshift in a MMMM apparatus operating at Puttershoek (see previous to last column in table 5).

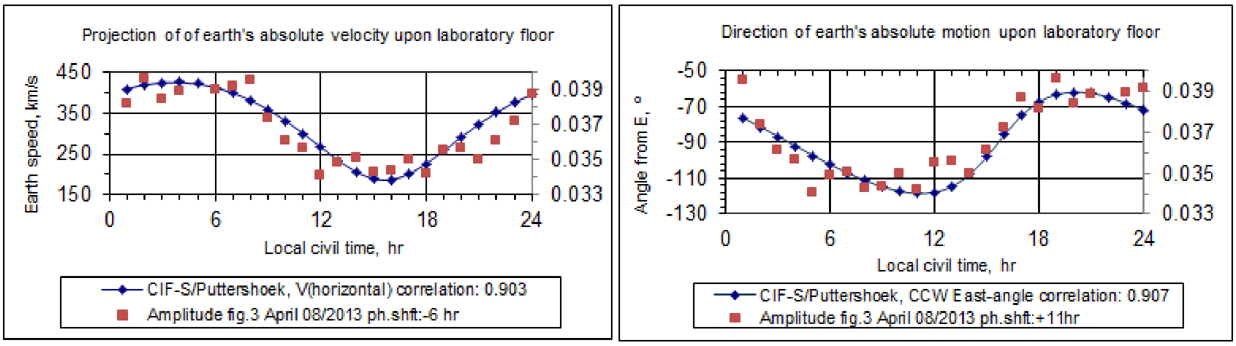

Fig. 5. Observed amplitudes in de Haan experiments (brown squares) are highly correlated to absolute velocity at Puttershoek, The Netherlands (blue continuous curve).

Table 5. Correlation of amplitude and azimuth with absolute velocity at Puttershoek

De Haan experiments at Puttershoek, Netherlands		Laboratory velocity at earth's surface					MMMM fringe-shift	Average correlation	
		Velocity components			Horizontal				
		East	North	Zenith	Speed	Angle		CIF-S	CIF-N
Apr12/2012	Amplitude	0.892	0.893	0.892	0.884	0.885	0.866	0.885	0.892
Apr08/2013	Amplitude	0.931	0.931	0.931	0.903	0.907	0.882	0.914	0.930
Apr12/2012	Azimuth	0.737	0.737	0.737	0.735	0.654	0.732	0.722	0.730
Apr08/2013	Azimuth	0.574	0.574	0.574	0.579	0.517	0.569	0.564	0.573

Towards a new era of absolute space, anisotropy and adialeiptometry

Absolute 3D-space Σ is isotropic and homogeneous by definition, and at large scale might be curved, but our local environment is approximately Euclidean, and anisotropic in the sense that nearby cosmic matter (i.e., Sun, Moon, planets, and Milky Way) modifies flow and distribution of primordial fluid —which in regions devoid of matter is homogeneous at large-scale (see companion paper).

Local anisotropy of matter leads to periodic phenomena on the rotating earth, amply documented in biological, glacial, and geological records [31, 32], and to apparently preferred directions in space associated with position of neighbouring cosmic bodies, as in Allais's local gravity anomalies [33], in Baurov's diurnal and annual effects upon nuclear decay rate [34], and in similar regularities in biological and non-biological processes documented by Shnoll over more than forty years [35, 36]. All these studies share a common trait: long-term, repetitive and almost continuous observation of a phenomenon, approach that is standard in astronomy since Babylonian time. Present writer coined the neologism *adialeiptometry* [7] to refer to such procedures. The aforementioned evidence and the results of our CIF experiment suggest that it is high-time for adialeiptometry to become the preferred approach to collect empirical evidence in natural science (physics included), rather than the usual isolated short-term observations at particular times of day, as, for instance, the widely quoted MM experiment [4].

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To the memory of my mother, Laura Orozco de Munera (10.October.1918 - 05.April.2017).

References

1. de Fonroque N.D. (1877). *The pendulum—Theory of the displacements of the the plane of oscillation* (in French: *Du pendule—Théorie de déplacements du plan d'oscillation*), Imprimerie de la Cour, Bucharest, Romania (available at http://www.Allais.info).
2. Michelson A.A. (1881). The relative motion of the earth and the luminiferous ether. *American Journal of Science* (*third series)*, 22, 120-129.
3. Múnera H.A. (2010). The Michelson-Morley experiment and Einstein's second postulate: inextricably entangled (in Spanish, El experimento de Michelson-Morley y el segundo postulado de Einstein: inextricablemente unidos). *Einstein: Scientist and Philosopher* (in Spanish: *Einstein: Científico y Filósofo*), Guerrero-Pino G. (ed.), 245-289. University of Valle Press, Cali, Colombia, 410 pp. ISBN: 978-958-670-835-7.
4. Michelson A.A., Morley E.W. (1887). On the relative motion of the earth and the luminiferous ether. *London, Edinburgh and Dublin Philosophical Magazine (5^{th} series)*, 24, 449-463. Same paper in *American Journal of Science* (*third series)*, 34, No.203, 333-345.
5. Múnera H.A., Alfonso E., Arenas, G. (2002). Empirical verification of the existence of large fringe-shifts in the original Michelson-Morley and Miller experiments, and a novel interpretation of its origin. *Journal of New Energy*, 6, No.4, 185-209.
6. Múnera H.A. (2006). The evidence for length contraction at the turn of the 20th century: Non-existent. Dvoeglazov V. V. (editor), *Einstein and Poincaré: The Physical Vacuum*, Apeiron Press, Montreal, Canada, 87-102. ISBN: 0-9732911-3-3.
7. Múnera H.A., Hernández-Deckers D., Arenas G., Alfonso E. (2006). Observation during 2004 of periodic fringe-shifts in an adialeiptometric stationary Michelson-Morley experiment. *Electromagnetic Phenomena (Kharkov, Ukraine)*, 6, No.1-16, 70-92.
8. Smoot G.F., Gorenstein M.V., Muller R.A. (1977). Detection of anisotropy in the cosmic blackbody radiation. *Physical Review Letters*, 39, No.14, 898-901.
9. Hicks W.M. (1902). On the Michelson-Morley experiment relating to the drift of the aether. *London, Edinburgh and Dublin Philosophical Magazine (6^{th} series)*, 3, 9-42 and 256.
10. Handschy M.A. (1982). Re-examination of the 1887 Michelson-Morley experiment. *American Journal Physics*, 50, No.11, 987-990.
11. Múnera H.A. (1998). Michelson-Morley experiments revisited: systematic errors, consistency among different experiments, and compatibility with absolute space. *Apeiron*, 5, No.1-2, 371-376.

12. Múnera H.A. (2005). The missing statistical analysis in the original 1887 Michelson-Morley experiment. Presented at ICPE2005 *International Conference on Physics Education: World View on Physics Education 2005: Focusing on Change*, New Delhi, India (21-26 Aug).
13. Shankland R.S. (1964). Michelson-Morley experiment. *American Journal Physics*, 32, No.1, 16-35.
14. Morley E.W., Miller D.C. (1905). Theory of experiments to detect aberrations of the second degree. *London, Edinburgh and Dublin Philosophical Magazine (6^{th} series)*, 9, 669-680.
15. Morley E.W., Miller D.C. (1905). Report of an experiment to detect the FitzGerald-Lorentz effect. *London, Edinburgh and Dublin Philosophical Magazine (6^{th} series)*, 9, 680-685.
16. Miller D.C. (1928). Conference on the Michelson-Morley experiment held at the Mount Wilson Observatory, Pasadena, California, February 4 and 5, 1927. *Astrophysical Journal*, 68, No.5, 352-367.
17. Miller D.C. (1933). The ether-drift experiment and the determination of the absolute motion of the earth. *Reviews of Modern Physics*, 5, 203-242.
18. Múnera H.A. (2002). The effect of solar motion upon the fringe-shifts in a Michelson-Morley interferometer à la Miller. *Annales de la Fondation Louis de Broglie*, 27, No.3, 463-484.
19. Nassau J.J., Morse P.M. (1927). A study of solar motion by harmonic analysis. *Astrophysical Journal*, 65, No.2, 73-85.
20. Lodge O. (1926). On Prof. Miller's ether-drift experiments. *Nature*, 117, No.2955, 854.
21. Miller D.C. (1925). Ether-drift experiments at Mount Wilson. *Proceedings National Academy of Sciences*, 11, 306-314.
22. Hernández-Deckers D. (2005). *Data reduction in the Michelson-Morley-Miller experiment with stationary interferometer* (in Spanish: Reducción de datos del experimento con interferómetro estacionario de Michelson-Morley-Miller), B.Sc. thesis, Department of Physics, National University, Bogotá, Colombia, 77 pp.
23. Leach R.K. (1999). *Calibration, traceability and uncertainty issues in surface texture metrology*, Centre for Basic Thermal and Length Metrology, Middlesex, UK.
24. Eslava J.A. (1995). *Atmospheric Pressure Regime in Colombia*, Colombian Academy of Sciences (in Spanish: Régimen de la presión atmosférica en Colombia, Academia Colombiana de Ciencias Exactas, Físicas y Naturales), No. 8, Bogotá, Colombia, 149 pp.
25. Múnera, H.A. (2013). Is our sun falling toward the blackhole at the center of our galaxy? *Proceedings of the NPA* 10, 198-203. ISBN 978-1-304-19506-7.
26. Múnera H.A., Hernández-Deckers D., Arenas G., Alfonso E. (2007). Observation of a significant influence of earth's motion on the velocity of photons in our terrestrial laboratory. Presented at SPIE-2007, San Diego, California. Roychoudhuri Ch., Kracklauer A. F., Creath C. (eds), *The Nature of Light: What Are Photons*, Proceedings of SPIE, vol. 6664, 66640K.
27. Múnera H.A., Hernández-Deckers D., Arenas G., Alfonso E., López I. (2009). Observation of a non-conventional influence of earth's motion on the velocity of photons, and calculation of the velocity of our galaxy. Proceedings of *Progress in Electromagnetics Research Symposium, PIERS 2009*, Beijing (23-27 March 2009).
28. Múnera, H.A. (2009). Towards the reinstatement of absolute space, and possible cosmological implications. *ICFAI University Journal of Physics* 2 (2-3) 9-24.
29. Lipa J.A., Nissen J.A., Wang S., Stricker D.A., Avaloff D. (2003). A new limit on signals of Lorentz violation in electrodynamics. *Physical Review Letters*, 90, 060403.
30. de Haan V.O. (2015). Experiments to test special relativity. *Proceedings of International Scientific Meeting PIRT-2015*, Moscow (29 June-02 July), 131-139. ISSN 2309-7604.
31. Walker J.C.G., Zahnle K.J. (1986). Lunar nodal tide and distance to the Moon during the Precambrian. *Nature*, 320, No.6063, 600-602.
32. Puetz S.J., Prokoph A., Borchardt G., Mason E.W. (2014). Evidence of synchronous, decadal to billion year cycles in geological, genetic, and astronomical events. *Chaos, Solitons & Fractals (Nonlinear Science, and Nonequilbrium and Complex Phenomena)*, 62-63, 55-75.

33. Allais M. (1997). *The Anisotropy of Space* (in French: L'Anisotropie de L'Espace), Editions Clément Juglar, Paris, 757 pp.
34. Baurov, Yu.A. (2002). Structure of physical space and nature of de Broglie waves. *Annales de la Fondation Louis de Broglie*, 27, No.3, 443-455.
35. Shnoll S.E., Kolombet V.A., Pozharskií E.V., Zenchenko T.A., Zvereva I.M., Konradov A.A. (1998). Realization of discrete states during fluctuations in macroscopic processes. *Physics-Uspekhi* 41 (10) 1025-1035.
36. Shnoll S.E., Pozharski E.V., Zenchenko T.A., Kolombet V.A., Zvereva I.M., Konradov A.A. (1999). Fine structure of distributions in measurements of different processes as affected by geophysical and cosmophysical factors. *Phys.& Chem. Earth A: Solid Earth & Geod*. 24 (8), 711−714.