

A Landmark Experiment:
The Linear Sagnac Test of Ruyong Wang

Analyst: Robert Bennett
robert.bennett@rcn.com

Abstract

Belief that the Sagnac test of 1913 only applied to rotational motion was discounted when Ruyong Wang found the same results for linear motion in 2004. The Sagnac result has never been credibly explained, despite its wide application in modern technology. In turn the Wang paper has been virtually ignored in the last ten years, but remedied by this paper, which establishes the test as a critical signal of striking new concepts.

Kinematic and dynamic motions are carefully distinguished here and the neglected topic of covariance is reviewed and applied to the Galilean dynamical law of velocity addition.

Analysis of Wang's result in the conveyor and lab frames with the premise of aether drag logically leads to identification of preferred motion in an absolute frame of reference ... the earth-bound laboratory frame!

That light speed in the lab frame will be the same as for the conveyor is a testable prediction of this paper..... the same as the Doufour-Prunier test.

Discovery of the absolute lab reference frame and a flexible aether - the ALFA model - refutes relativity and its alleged consequences, such as: both postulates of special relativity - general covariance in general relativity - Lorentz transformations - Minkowski space - length contraction - time dilation.... All disproven by ALFA via the Wang and Sagnac tests.

Keywords

Wang, Sagnac, relativity, absolute motion, linear motion, Doufour-Prunier, realism, kinematics, dynamics, reference frame, ALFA, Lagrangian, covariance, FOC, conveyor, geocentrism

Introduction

The foundation of the analysis is philosophical realism and the scientific method. Realism forms the basic worldview that is presented here and is required for a basic core of communication - it is described in detail here.ⁱ

The scientific method of Bacon includes testing hypotheses within equivalent environments, a condition more breached than observed in modern physics.

Velocity types

Kinematic

Experimental test of Galilean relativity are dynamic tests of mainstream predictions for relative velocity addition. In kinematics the velocity of motion is a description of the measurement, $V_{kin} = \Delta x / \Delta t$. It is an abstraction having no link to the real world. By pure reasoning the principle of relative motion can be asserted for two reference frames in relative motion:

$$V_{kin}(A,B) = -V_{kin}(B,A).$$

This is a truism that relates two separate frames of reference and makes no prediction about future motion of either frame.

Lagrangian Dynamics

By contrast, in dynamics the classical laws of motion - on Earth - are derived from the Lagrangian variational principle. These laws of mechanics and electromagnetism make predictions about motion based on forces on charges and masses. These derived dynamical motions, $V_{dyn}(x,t)$, are compared to test data, $V_{test}(x,t)$, to confirm validity of the physical laws.

For example, the simplest form of $L = T - V$ is just kinetic energy of motion, $T = mv^2/2$.

For this L the Euler-Lagrange equations yield

$$ma = 0$$

or

$$V_{dyn} = \text{constant} = v$$

Two ref frames, a and b , would then differ by $V_{a,b} = V_a - V_b = v$, or

$$V_a = V_b + v$$

Of course the simplest possible dynamics is just the Galilean law of velocity addition for inertial frames. What's important to note that:

- 1- The Lagrangian method is mathematical in its use of generalized coordinates. This is frame indifference; all observers in all reference frames will obtain the same dynamical laws.
- 2- Frame indifference (or covariance) is an assumption to be proven - or disproven - by experimentation.
- 3- Although the Lagrangian method assumes generic coordinate systems, the laboratory reference frame is the only one in which the dynamics predicted by the Lagrangian have been validated by experiment. The lab frame is the only ref frame proven to be covariant → dynamical laws are valid.

The initial testing of mechanics and electrodynamics was done in laboratories fixed to the ground - mainly by Galileo and Newton, Faraday and Maxwell...and of course, many others.

Hertz's generalized the partial time derivative in Maxwell's laws to include a convective term for fluid motion. This new terms brings covariances to dynamics (motion) and electromagnetics

Mechanical dynamics is covariant under a Galilean transformation but electrodynamics - Maxwell's laws - are not. Einstein tried to resolve the lack of covariance between the two law sets by using the Lorentz transformation in electrodynamics. A mistake. Maxwell had assumed the aether to be immovable... a solid. But Hertz generalized the partial time derivative in Maxwell's laws to include a convective term for fluid motion of the aether... a total time derivative of the EM fields. A new variable is introduced thereby - the velocity of the aether frame to the lab observer's frame. This extension of Maxwell's laws is now Galilean covariant, as is Newtonian mechanics. We will call this extension the Maxwell-Hertz laws of EM.

However, the laws of dynamics were not tested formally and rigorously for Galilean (or inertial) covariance in any other ref frames moving relative to the lab - until Fizeau, Sagnac and Wang. No formal tests of dynamic covariance were done in cars, trains, planes, spacecraft.... nor on the Sun, Moon or a planet.

Since it is known that the laws of dynamics are valid in the lab frame...that is, the lab frame is covariant... we can use the dynamic law of velocity addition to establish useful relations between frames a and b for testing by Wang.

$$V_{a,b} = V_a - V_b = v$$

If $a = b$,

$$V_{a,a} = V_a - V_a = 0$$

For any frame x , the identity axiom is true:

$$V_{x,x} = 0$$

From

$$V_a = V_b + v$$

with $a = \text{lab frame}$ and $b = \text{nlab (any non-lab frame)}$,

$$V_{\text{lab}} = V_{\text{nlab}} + v$$

Finally, for an object at rest, dynamic laws are valid in the lab frame if the equations of motion use

$$V_{\text{restobj,lab}} = 0$$

Measured

A third type of motion is V_{meas} , the experimentally determined motion using the kinematic definition of velocity, $v = dx/dt$.

A central issue in the Wang FOC test is discernment whether $V_{\text{meas}} = V_{\text{dyn}}$. Do the dynamic laws agree with reality for all observers.... in all reference frames?

Covariance in dynamics means that measurements in a reference frame satisfy the laws of physical motion - for mechanics and electromagnetism, the laws of Newton and Maxwell.

The first postulate of special relativity asserts that inertial frames, like the linear conveyor, are covariant. Frames accelerated relative to the conveyor would not be covariant in special relativity.

The Wang experiment not only tests whether the for the Speed of Light(SoL), Sagnac result:

$$\text{SoL} = c \pm v$$

in rotating bodies also holds for linear motion. It also tests if aether outside a moving body is co-moving with the body, as Sagnac surmised. Fizeau had already found that aether is dragged inside a moving object at a lesser speed, supporting the drag equation for SoL in a moving fluid,

Fresnel drag:

$$\text{SoL} = c/n + v(1 - 1/n^2)$$

Tested also is whether the conveyor frame is covariant. Does V_{meas} in the conveyor frame equal the prediction of the laws of dynamics, V_{dyn} , as the conveyor moves linearly relative to the lab frame?

The world of kinematics is abstract and symbolic; the world of dynamics is concrete and empirically based. It will be important to distinguish these concepts in the following analysis.

Ruyong Wang Fiber Optic Conveyor (FOC)

The results of the Sagnac experiment of 1913ⁱⁱ were interpreted by Sagnac as disproving the second postulate of special relativity for constant $\text{SoL} = c$ and establishing the existence of co-rotating aether "whirlpools" around spinning objects.

The condition for co-moving rotor and aether is

$$V_{\text{ae,rotor}} = 0$$

It was assumed that the Sagnac results only applied to rotational dragging of aether. But 91 years later in 2004 Ruyong Wangⁱⁱⁱ showed the same result is found when aether is dragged in a straight line by a mass in linear motion.

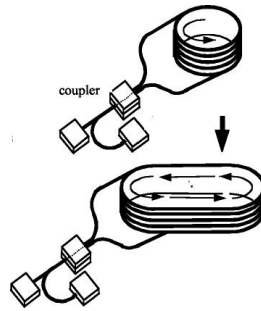


Fig. 1. Converting a FOG into a FOC

The Sagnac setup is improved by using fiber optics instead of mirrors to form the optical path and amplify the timing difference by using multiple coils – the Fiber Optic Gyro - FOG (Fig.1 top). Then the loops are distorted into a racetrack oval to create linear sections (Fig.1, bottom). Linear motion will not affect the phase shifts of the circular sections, so any recorded effect is due to the linear motion of the linear fiber optic cable.

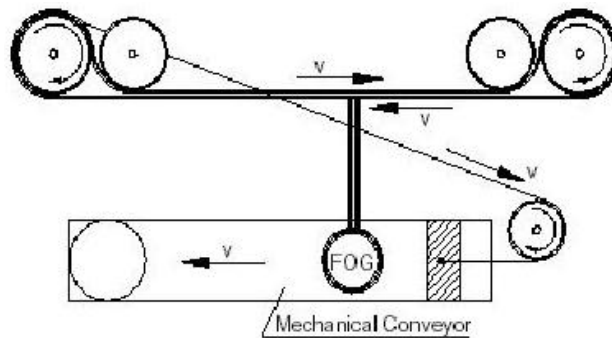


Fig. 2. Fiber Optic Conveyor - FOC - seen in the lab reference frame.

In Fig 2 the bold line is the optical path/fiber which corresponds to the fiber optic path in Fig. 1. The light diagonal line is the conveyor cord. The FOG interferometer is mounted on a conveyor and records the change in SoL as the system moves linearly with speed v in the lab frame. Just as with the Sagnac test, a light beam is split and the two half-beams are sent in opposite direction through the linear segments. The FOG has the same speed as the conveyor.

Fig. 3 shows the physical layout - the fiber cable wrapped around two wheels moving at the same speed as the conveyor. The bottom FO cable is moving to the left, so it drags aether to the left at v ; the top FO cable is moving to the right, so it drags aether to the right at v , according to Sagnac's interpretation. In this way the light beam direction is always with the aether direction or always opposite. In neither half-beam does the aether speed cancel on a roundtrip of the beam (clever!).

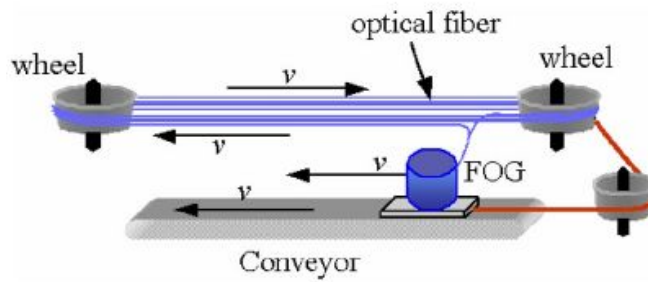


Fig 3 The 2 wheel version of the FOC

Conveyor frame analysis

The FOG is only needed to provide the source and detector, beam splitter and condenser, as the FOG will not detect phase shifts with any linear motion. Fig 4 shows the essentials of the test equipment; the arrows indicate the motion of both fiber optic cable and the aether entrained by the motion of the wheels and cable.

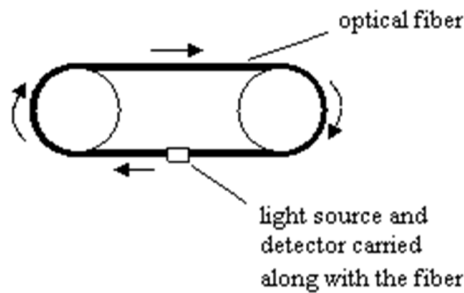


Fig.4 Schematic of the Wang FOC test

Wang took light speed measurements in the conveyor frame, SoLcon, where the FOC is at rest and the lab frame is moving at $-v$, and found the results graphically displayed in Fig. 5.

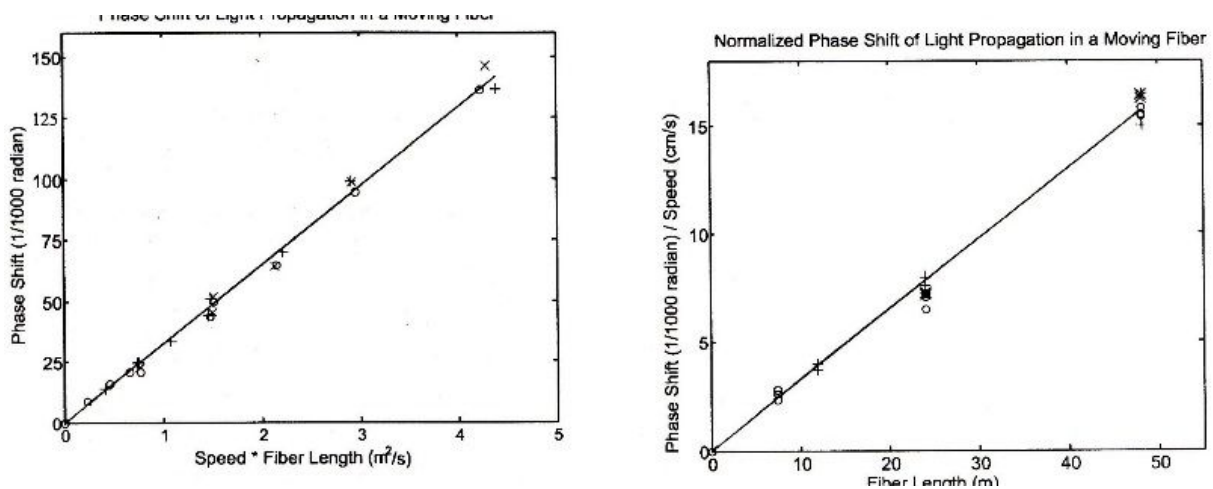


Fig. 5. Phase shift (γ) is proportional to optical path length and conveyor speed (x)in the conveyor frame.

For a fixed length of fiber, the graph shows that when the conveyor is at rest,

$$\text{SoLcon} = c.$$

The linear relationship between phase shift and speed means that

$$\text{Phase shift} \sim v$$

and SoLcon is measured as a linear function of v...

$$\text{SoLcon} = c \pm v,$$

where the plus holds for the co-moving light beam traveling in the same direction as v, the minus for the counter-moving light beam traveling in the opposite direction as v..... a result that corresponds exactly to the Sagnac result.

The speed of light increases/decreases with the speed of aether it propagates in, just as a rowboat moves faster downstream in a river than in a lake.

The last equation is an example of velocity addition in inertial frames ...the Galilean law of relative motion applied to the motion of light and aether.

Lab frame analysis

Wang did not mount the FOC interferometer in the lab frame and measure SoLlab with the conveyor again moving as various speeds. but neither did Sagnac.

However, Dufour & Prunier^{iv} repeated the Sagnac experiment and did measure SoLlab with the interferometer at rest in the lab next to the rotor. They found the same result in the lab frame as in the conveyor frame:

$$\text{SoLlab} = \text{SoLcon} = c + v \quad \dots \text{for the co-moving beam.}$$

The speed of light is not c in either frame but is c ± v in both frames. This is consistent with Sagnac's belief that matter in motion drags aether along at the same speed, which causes the observed change in SoL. In the lab frame the speed of the conveyor, Vcon, drags along the aether at speed Vae.

$$V_{\text{con,lab}} = V_{\text{ae,lab}} = v$$

If the conveyor and aether are co-moving at v in the lab frame, then the aether must be stationary in the conveyor frame...

Conveyor frame: $V_{\text{ae,con}} = 0$

Now, Wang did not record the SoL in the lab frame; had he repeated his conveyor test in the lab frame, by putting all the optical apparatus at rest on the lab table next to the running conveyor belt, then the moving conveyor would drag the aether as before, producing the same results as in the Sagnac test, the rotating case, namely

$$\text{SoLlab} = \text{SoLcon} = c + v \quad \dots \text{for the co-moving beam.}$$

It seems Einstein was correct in one respect – the speed of light is constant in all frames.... but not equal to c ! The SoL is the same as measured in the lab frame..... in all frames. (From here forward, we will analyze the co-moving half-beam; the counter-moving half-beam is similar.)

Prediction

$$\text{SoLlab} = c + v$$

is my prediction for a future Wang test in the lab frame. It is based on

- compliance with the same result in the Sagnac test.
- aether drag as analyzed in both frames.

It provides an experimental test of the aether drag premise.

The graph of phase shift vs. speed in Fig 5 applies to the conveyor frame. But the SoL in the lab frame is the same,

$$\text{SoLlab} = \text{SoLcon} = c + v.$$

So the same graph in Fig 5 can be used for both lab and conveyor frames.

Note: Dr. Wang could not be convinced to repeat the FOC test in the lab frame, or to repeat the linear motion in different horizontal and vertical directions, to confirm the isotropy of the result.

Analysis of the conveyor frame - a stunning result

Going unnoticed by Wang and many others is the outstanding evidence in this experiment of the dynamically motionless Earth. To see this, recall that a dynamical law, Galilean velocity addition, is presumed to be valid in all reference frames, if the principle of General Covariance is true.

Galilean velocity addition has been tested in the lab frame for covariance and found to be so. The conveyor frame is in constant linear motion compared to the lab frame. As Sagnac did for rotation, Wang has tested motion of translation for covariance.

The dynamical law for velocity addition in the conveyor frame is

$$\text{SoLcon} = V_{\text{ph,ae}} + V_{\text{ae,con}} = c + V_{\text{ae,con}}$$

and from Wang's result of measurement,

$$\text{SoLcon} = c + v.$$

This implies that

$$V_{\text{ae,con}} = v \quad \dots \text{the conveyor frame conclusion.}$$

But lab frame analysis found that

$$V_{\text{ae,con}} = 0! \quad \dots \text{the lab frame conclusion.}$$

If the conveyor moves with speed v in the lab frame, $V_{con,lab} = v..$
 And aether is dragged along with the conveyor at the same speed, $V_{ae,lab} = v..$
 Then the aether must be co-moving with the conveyor
 if the conveyor is a valid frame of reference, $V_{ae,con} = 0.$
 But measurement - the ultimate decision-maker - says that $V_{ae,con} = v.$
 If the conveyor is a valid reference frame, then this should be true:

$$Sol_{con} = c + V_{ae,con} = c + 0 = c$$

But the Wang FOC result is:

$$Sol_{con} = c + V_{ae,con} = c + v$$

The conveyor frame dynamics are not covariant, because they disagree with the validated lab frame dynamics!

Conclusion: The conveyor frame is an INVALID reference frame.

The result is quite general; the conveyor stands for any aether-dragging mass moving relative to the lab frame.

But what is the correct dynamics when not in the lab frame...in the conveyor frame?
 ... and what can cause $V_{ae,con}$ to equal v in the conveyor frame, instead of zero?

Comparison of the SoL measurements in lab and conveyor frames,

$$\begin{aligned} SoL_{lab} &= c + v, \\ SoL_{con} &= c + v, \end{aligned}$$

seems to indicate the lab value of aether speed, $V_{ae,lab}$, replaces the conveyor value of $V_{ae,con}$. The dynamical law found by Lagrangian analysis prefers the lab values over the conveyor values. The inference is really stronger than just a preference; the conveyor frame dynamical law absolutely must use lab values over the conveyor values, to agree with the experimental results.

In other words the lab frame is the absolute ref frame in which to apply the laws of dynamics.

Kinematics vs. Dynamics

The kinematic law of relative motion....

$$\text{kin}V_{a,b}(t) = - \text{kin}V_{b,a}(t) \text{ is always true.}$$

Dynamic relative motion....

$$\text{dyn}V_{a,b}(t) = -\text{dyn}V_{b,a}(t) \text{ is never true.}$$

For example, $V_{\text{lab},\text{con}}$ implies $V_{\text{lab},\text{nlab}} = 0$ in any law of physical motion (dynamics),

$$\text{nlab} = \text{any non-lab frame.}$$

This DOES NOT MEAN that $V_{\text{lab},\text{nlab}}$ will be measured as zero, as measurements are kinematic, not dynamic. In fact that would violate an axiom of kinematics,

$$\text{kin}V_{a,b} = -\text{kin}V_{b,a},$$

the principle of relative motion. ...which is always true...but says nothing about future motion, as dynamics does.

Confusion is guaranteed if one doesn't discern definitions and descriptors of motion - kinematics - from the prediction of future motion - Lagrangian dynamics.

N.B. From here forward, kinematic V is designated with a k prefix...

$$kV = \text{kin}V.$$

With no prefix, V represents a dynamic velocity

$$V = \text{dyn}V.$$

We now will examine the consequences of an absolute lab frame to establish logical consistency, keeping in mind that the lab frame must always be used in dynamics, as a consequence of the Wang FOC (and Sagnac) result.

$V_{\text{ae},\text{con}}$ uses $V_{\text{ae},\text{lab}}$ in the dynamic laws:

$$V_{\text{ae},\text{con}} = V_{\text{ae},\text{lab}} = v$$

The v in this equation is the absolute value of speed, the only value that can be used in the laws of dynamics.

$$V_{\text{lab}} = V_{\text{a}}$$

$V_{\text{lab},\text{con}}$ uses $V_{\text{lab},\text{lab}} = 0$ in the dynamic laws:

$$V_{\text{lab},\text{con}}(t) = 0$$

When applying the laws of dynamics in the conveyor frame the lab speed is always zero...This reconfirms that....

The lab frame is always at rest according to a dynamic law of physics!

Let's reinforce this concept.

In the lab frame:

$$V_{\text{ae},\text{lab}} = v ..$$

when measured AND when applying a law of dynamics, in this case, Galilean velocity addition. That is,

$$\text{measVae,lab} = \text{dynVae,lab} = v$$

In the conveyor frame:

$$\text{dynVae,con} = v$$

when measured using the same dynamic law of physics - Galilean velocity addition. BUT dynVae,con should be zero - to be consistent with the lab frame result.

$$\text{Vae,con} = \text{Vae,lab} + \text{Vlab,con}$$

implies

$$v = v + \text{Vlab,con}$$

or

$$\text{Vlab,con} = 0 \neq \text{Vcon,lab} = v$$

when applying the same law of dynamics. Again, only the lab frame is covariant.

The lab frame graph, where the origin clearly displays the zero speed of the conveyor in the lab frame, when contemporary interpreters of dynamics have the Earth rushing in various directions, around the Sun and Milky Way center, toward the Virgo cluster, etc.

Wang Test Conclusion

The ALFA model is not restricted only to photons in rotating aether, but also holds for aether in linear motion - that is, to all aether motions.

Vlab,nlab must be set equal to zero in dynamical laws for them to be valid (= covariant). There are no restrictions, however, on the MEASUREMENT OF Vlab,nlab .

SoL = $c + v$ is valid

1. for the co-moving beam in the Wang test
2. for the co-rotating beam in the Sagnac test
3. in the lab and conveyor and rotor frames
4. independent of source and detector motion
5. *but dependent on aether motion.*

Formal analysis and summary

The conveyor is a specific case of any reference frame moving relative to the lab, a nlab frame. We are justified here in generalizing conveyor frame assertions into nlab frames, since all mass in motion will entrain a co-moving aether.

Premises/Axioms

Assumptions in metaphysics that are self-evident and falsifiable yet not falsified.

1. The Lagrangian derivation of dynamics assumes general covariance/frame indifference
2. Principle of General Covariance: The laws of dynamics are valid in all reference frames.
3. The lab frame is the only reference frame known to be covariant
(dynamical laws are valid)

4. Light speed in the aether frame (aether is at rest) is always c , the vacuum value.

$$V_{ph,ae} = S_{oLae} = c$$

where 'ph' represents the photon frame, 'ae' is the aether frame

5. Aether Drag Axiom $V_{ae,lab} = V_{obj,lab}$
Aether near a moving object is dragged or entrained to co-move with the object.

6. The conveyor speed is $V_{con,lab} = v$; the conveyor frame has a co-moving aether, implying the aether is at rest in the conveyor frame.

$$\text{kin}V_{ae,lab} = v \Rightarrow \text{kin}V_{ae,con} = 0$$

7. The kinematic law of relative motion....

$$\text{kin}V_{a,b}(t) = -\text{kin}V_{b,a}(t)$$

8. No frame moving relative to the lab frame (nonlab frame) has ever been formally and rigorously tested and validated for covariance.

9. Galilean Relativity Axiom of Dynamics:

$$V_{a,b} = V_{a,c} + V_{c,b}$$

a,b,c are inertial frames

10. Identity axiom $V_{x,x} = 0$

Measurements

- 1- Velocity addition: $V_{ph,con} = S_{olcon} = c \pm v$ (co-moving half beam)
- 2- Conveyor speed: $V_{con,lab} = v$
- 3- Aether speed in the conveyor frame: $V_{ae,con} = v$

Prediction

1. By analogy with the Dufour & Prunier result:

$$\text{SoLlab} = c + v$$

2. According to relativity, if aether and conveyor are co-moving,

$$\text{Vae,con} = 0$$

Theorems/laws

Laws are derived from the premises and test data.

- 1) **The Principle of Absolute Covariance:**

The laws of dynamics are valid only in the lab/Earth reference frame.....
replaces the Principle of General Covariance.

- 2) **An object is at rest if its lab frame speed is zero...**

$$\text{Vobj,lab} = 0$$

- 3) If the conveyor is a valid frame of reference,
But measurement says that

$$\text{Vae,con} = 0.$$

$$\text{Vae,con} = v.$$

The conveyor frame dynamics are not covariant,
because they disagree with the validated lab frame dynamics!

Conclusion: The conveyor frame is an INVALID reference frame.

- 4) **Dynamic relative motion**

$$\text{dynVa,b(t)} \neq - \text{dynVb,a(t)}$$

Only true if $a = b = \text{lab frame}$

- 5) **Absolute Rest or Geostatic Absolutism law:**

$$\text{dynVlab,nlab(t)} = 0$$

The lab frame is always dynamically at rest

- 6) **In the lab frame:**

$$\text{measVae,lab} = \text{dynVae,lab} = v$$

- 7) **In the conveyor frame:**

$$\text{measVae,con} = \text{dynVae,con} = v$$

- 8) **Absolute Frame Substitution**

$$\text{Vx,y} \Rightarrow \text{Vx,lab}$$

- 9) **Absolute velocity addition**

$$\text{Vx,lab} = \text{Vx,b} + \text{Vb,lab} = v + \text{Vb,lab}$$

Specifically, the Speed of Light in any reference frame x is

$$\text{SoLx} = \text{Vph,ae} + \text{Vae,lab} = c + \text{Vae,lab}$$

- 10) **Light speed only depends on the aether speed in the lab frame.**

The ALFA model

ALFA is an acronym for Absolute Lab frame + Flexible Aether. All predictions of this model are based on:

AL: The lab frame is the absolute/preferred/required frame for applying the laws of motion. The Earth is always dynamically at rest.

FA: The primitive substance of aether that fills all space can be forced to move (flexibility) by mass in motion through it.

The principal axioms of the ALFA(Absolute Lab -Flexible Aether) model are:

- 1. Aether is flexible ...either dragged by matter or having natural autonomous motion.**
- 2. Dynamic laws must be in the lab (Earth Centered Earth Fixed) frame,**

$$SoLx = c + Vae,lab$$

ALFA application

1. The fluid model of aether and its ubiquity lead to a re-consideration of the fundamental Lagrangian derivation of the dynamic laws of physics. If aether is everywhere – a universal continuum - then the Lagrangian approach has to be modified to include the energy contribution of aether in free space – free aether containing no ‘particles’ , aka the physical vacuum. The mechanical models of mass particles – either as extended or as points - must also be replaced by bound states of aether. In this sense aether unifies physics by providing the single substance from which all reality is formed; the prime matter of scholastic philosophy is given thereby a scientific breath of life.

Unfortunately research into aethereal properties has been bypassed for the last century by the relativistic wrong turn in 1905. To derive the measured speed of aether in the lab frame, Vae,lab , the Lagrangian must have a kinetic energy term for aether, $T(A(t),i,j)$, $A_{i,j}$ being a general tensor field representing the contribution of free aether. In general the Lagrangian must have additional terms for aether kinetic and potential energy, as well as the particle model energy based on mass....

$$L(m,A) = T(m)-V(m) + T(A)-V(A)$$

This is a particle–field model which usually requires an interaction term that couples the mass to the field. No coupling term is needed because of the universality of aether...the mass energy is due to the stable bound states of the aether, which means all the energy is aethereal – either bound or unbound. In other words, the mass term is a deviation from the unbound aether properties. There is no clear and precise boundary

between a particle and the free aether, only a smooth and continuous transition between the two.

So the mass m is really an average for the internal properties of the bound form of aether...

$$m = m(A)$$

The Lagrangian now looks like this:

$$L(A_b, A_u) = T(A_b) - V(A_b) + T(A_u) - V(A_u)$$

A_b is the bound aether field, A_u the unbound one.

Ultimate unification of the laws of dynamics will result when a single aether field, A_t , represents both bound and unbound states.

$$L(A_t) = T(A_t) - V(A_t)$$

This is the research program as planned. It will need research into past aether testing and the scheduling of more tests, to compensate for time lost while pursuing the failed theory of relativity.

2. The second axiom of absolute covariance requires that all dynamical predictions be based on the laws of dynamics derived from the Lagrangian method... as applied in the lab frame.
Instead of using generalized coordinates in the Lagrangian, the lab frame must be used for valid predictions in reality... reality being the world of measurement.

$$L(A_{lab}) = T(A_{lab}) - V(A_{lab})$$

Applying the laws of dynamics in a non-lab frame

What if the observer's frame of reference is not the lab frame and moving relative to the ground?

How do we use the measurements of $V_{lab, nlab}$ in the laws of dynamics... to make correct predictions of motion on a non-lab frame?

The measures of motion in a non-lab frame ... velocity, acceleration, etc... turn out to be only phenomenal or apparent, like a stick bent at the water surface.

As a sample consider a car of mass M accelerating past a man of mass m standing on the side of the road. The measured acceleration of the car in the road or man's frame is

$$A_{car, road} = +a;$$

the measured acceleration of the road in the car frame is

$$A_{road, car} = -A_{car, road} = -a.$$

This also is the kinematic law of relative motion.

Earth frame

The man uses the second law of mechanics to predict that objects in the car frame will be subject to a force

$$F_{\text{car,road}} = MA_{\text{car,road}} = Ma,$$

which testing confirms. Objects moving with the car, like passengers, will feel a forward inertial force equal to their mass times $+a$.

Car frame

The second law of mechanics is used to predict that the man in the road frame will measure a force

$$F_{\text{man,car}} = mA_{\text{road,car}} = -ma,$$

which **testing disproves**...there is no inertial force on the man or on any object outside the car.

$$\text{Measured } F_{\text{man,car}} = 0 \neq -ma$$

The second law of Newton's dynamics is valid in the road (or earth or lab) frame, but not in the car frame which is a non-lab frame.

This is another dynamical law - like Galilean velocity addition - which is covariant in the Earth frame only.

Non-lab frame dynamics

Assume we have a Law of Lagrangian-derived Dynamics, LoD, which is a generic function of motion ...

$$\text{LoD}_{x,y}(R_{x,y}, V_{x,y}, A_{x,y}).$$

x is the reference frame of the massive object in motion and y the observer's reference frame, R the coordinates, V the velocity and A the acceleration of reference frame x observed in reference frame y .

Only when the lab frame measurements are substituted into the LoD function is the function equal to zero. So when x is any non-lab frame (nl) and y is the lab frame (l),

$$\text{LoD}_{\text{nl,l}}(R_{\text{nl,l}}, V_{\text{nl,l}}, A_{\text{nl,l}}) = 0.$$

Anticipating further simplification, we break the dynamic law into a function dependent on position, $f_{\text{pos}}(R_{\text{nl,l}})$, and one dependent on the motion descriptors, $f_{\text{mot}}(V_{\text{nl,l}}, A_{\text{nl,l}})$.

$$\text{LoD}_{\text{nl,l}}(R_{\text{nl,l}}, V_{\text{nl,l}}, A_{\text{nl,l}}) = f_{\text{pos}}(R_{\text{nl,l}}) + f_{\text{mot}}(V_{\text{nl,l}}, A_{\text{nl,l}}) = 0$$

From the law of relative motion,

$$\mathbf{R}_{nl,l} = -\mathbf{R}_{l,nl} \quad \text{and} \quad \mathbf{V}_{nl,l} = -\mathbf{V}_{l,nl} \quad \text{and} \quad \mathbf{A}_{nl,l} = -\mathbf{A}_{l,nl}$$

and the dynamic law of geostatic absolutism,

$$\mathbf{V}_{l,nl} = 0 \Rightarrow \mathbf{A}_{l,nl} = 0,$$

$f_{\text{mot}}(\mathbf{V}_{nl,l}, \mathbf{A}_{nl,l})$ becomes

$$f_{\text{mot}}(0, 0) = 0$$

and $LoD_{nl,l}(\mathbf{R}_{nl,l}, \mathbf{V}_{nl,l}, \mathbf{A}_{nl,l})$ becomes

$$\underline{LoD_{l,nl}(-\mathbf{R}_{l,nl}, 0, 0) = f_{\text{pos}}(-\mathbf{R}_{l,nl}) = 0}$$

The laws of dynamics in a non-lab frame only depend on the position of the frame relative to the lab frame $\mathbf{R}_{nl,l}$.

E.g., The second law in the lab frame would be

$$LoD_{\text{lab}} = F - m\mathbf{A} = 0$$

where there is no position dependence in LoD .

In any nlab frame,

$$A_{\text{lab},n\text{lab}} = 0$$

and

$$F_{\text{lab},n\text{lab}} = 0$$

This was shown in the car example above.... The road observer detects no force from the accelerating car.

Alternate proof

that if $f(\mathbf{R}(t), \mathbf{V}(t), \mathbf{A}(t)) = 0$ are the equations of motion derived from a Lagrangian, then they are only valid in the lab frame...

$$f(\mathbf{R}_{\text{lab}}(t), \mathbf{V}_{\text{lab}}(t), \mathbf{A}_{\text{lab}}(t)) = 0$$

and not valid in a non-lab frame...

$$f(\mathbf{R}_{\text{lab}}(t), \mathbf{V}_{\text{lab}}(t), \mathbf{A}_{\text{lab}}(t)) \neq 0$$

The motion of an object in the lab frame is given by

$$\{\mathbf{R}_{\text{obj},\text{lab}}(t), \mathbf{V}_{\text{obj},\text{lab}}(t), \mathbf{A}_{\text{obj},\text{lab}}(t)\}$$

but the observer is in the nlab frame, where

$$\mathbf{R}_{\text{obj},n\text{lab}}(t) = \mathbf{R}_{\text{obj},\text{lab}}(t) + \mathbf{R}_{\text{lab},n\text{lab}}(t)$$

or

$$\mathbf{R}_{\text{obj},\text{lab}}(t) = \mathbf{R}_{\text{obj},n\text{lab}}(t) - \mathbf{R}_{\text{lab},n\text{lab}}(t)$$

IF the lab frame motion can be measured by the nlab observer....

then this equation for $\mathbf{R}_{\text{obj},\text{lab}}(t)$ can be substituted into the dynamical equations .

$$f(\mathbf{R}_{\text{lab}}(t), \mathbf{V}_{\text{lab}}(t), \mathbf{A}_{\text{lab}}(t)) = 0$$

becomes

$$f(\mathbf{R}_{obj,nlab}(t) - \mathbf{R}_{lab,nlab}(t), \mathbf{V}_{obj,nlab}(t) - \mathbf{V}_{lab,nlab}(t), \mathbf{A}_{obj,nlab}(t) - \mathbf{A}_{lab,nlab}(t)) = 0$$

As example, consider Newton's bucket, where the origin of the lab and bucket frame is the bucket center; the bucket is of radius a and rotating in the lab frame with angular speed $\omega_{bkt,lab} = \omega$An object m is located on the bucket wall, at $R_{obj,lab} = a$.

The dynamic law in the lab frame is

$$f(\mathbf{R}_{lab}) = 0$$

so

$$F_{lab} - m \cdot R_{obj,lab} \cdot \omega_{obj,lab}^2 = 0 = F_{lab} - m a \omega^2$$

As expected, the centripetal force of dynamics is valid in the lab frame.

In the bucket frame, from the kinetic law of relative motion,

$$\omega_{lab,bkt} = -\omega$$

so

$$\omega_{obj,bkt} = \omega_{obj,lab} + \omega_{lab,bkt} = \omega - \omega = 0$$

Let's first verify that the centripetal force law is NOT TRUE if we just use $R_{obj,bkt}$ in the $bkt = nlab$ frame. Does $f(\mathbf{R}_{bkt}) = 0$??

$$F_{bkt} - m \cdot R_{obj,bkt} \cdot \omega_{obj,bkt}^2 = 0 = F_{bkt} - m a 0^2 \Rightarrow F_{bkt} = 0$$

False... there is a non-zero centripetal force in the bucket frame,

$F_c = m a \omega^2$, the lab frame value.

For valid dynamic equations, we must use lab frame values ...

$$f(\mathbf{R}_{lab}) = 0$$

becomes

$$f(\mathbf{R}_{obj,bkt} - \mathbf{R}_{lab,bkt}) = F_{bkt} - m(\mathbf{R}_{obj,bkt} - \mathbf{R}_{lab,bkt}) \omega_{lab,bkt}^2 = 0$$

$$F_{bkt} - m(a - 0)(-\omega^2) = 0 \Rightarrow F_{bkt} = m a \omega^2$$

in the bucket frame.....as measured!

Measurement of speed in non-lab frames.

Let the Moon be a specific $nlab$ frame: The Moon's orbital speed in the Earth frame is about 27 km/s.....the period is 24 hrs, 53 min.

(This orbital speed will be detected when a FOG apparatus with a linear segment (FOG+L) stationary on the Moon is oriented along a lunar latitude (E-W)).

The FOG+L will detect no speed/phase shifts when oriented in the Earth's direction or along a longitude. The FOG+L reads c in the lab frame; on the Moon the SoL_{moon} will be $c + v$, where $v = 27$ km/s. In an LEO satellite the FOG+L will read from 5 to 8 km/s.

Other absolute frames?

The answer requires no testing...just rational evaluation of multiple absolute frames. Consider the Moon as another absolute covariant reference frame, like the Earth, in which the laws of dynamics are valid. Like the Earth, the Moon frame will be at absolute rest ... two covariant dynamical reference frames.

From law #5 - **Absolute Rest** -

$$V_{\text{abs},x} = 0$$

and assuming the Moon is also an absolute frames of reference ...

$$V_{\text{moon},x(t)} = 0$$

where x is any non-Moon ref frame, including the Earth.
Choosing x = Earth,

$$V_{\text{moon,Earth}(t)} = 0$$

which is contrary to the observed relative motion of Earth and Moon.

In brief: Earth and Moon are in relative motion, so both can't be at absolute rest. All objects in the universe are in motion relative to Earth.... So only the Earth is at rest.

How can the speed of an object in a non-lab frame be greater than zero, but zero in the laws of dynamics? How can $V = 0$ and also $V > \text{zero}$?

V can represent different values , so it's crucial to distinguish them correctly

There are three types of motion:

- | | |
|--|----|
| 1- As described or modeled in kinematics... | kV |
| 2- As predicted by laws or equations of dynamics.... | dV |
| 3- As actually measured in reality.... | mV |

The kinematic Principle of Relative Motion is always true...

$$kV(A,B) = -kV(B,A).$$

It's a metaphysical truism, like $2 + 2 = 4$; we cannot conceive how it could possibly be false. But as a relation between TWO reference frames it tells us nothing about motion in a single frame but dynamics does.

Why is covariance even necessary.... Why not have different dynamic laws for different ref frames, not just the lab frame?

The answer lies at the very foundation of science – its purpose is to unify the complexity of nature into rules that have the broadest application possible. In fact, unification of the current physical laws was the goal of Einstein and modern string theorists.

If there were different dynamical laws for each distinct ref. frame then there would be no unification but chaos. There would be separate laws of motion for cars, trains, planes, spacecraft...on the Moon and planets, etc.

Scientific laws are intended to **summarize** a large collection of facts or range of phenomena determined by experiment into a single statement. If dynamical laws differ by their state of motion relative to the lab frame, then they are simply facts, not laws. This is pure empiricism - truth is found only by specific testing; there are no predictions by deduction from general laws. If covariance does not apply anywhere, then there are no dynamic laws. If there are no dynamic laws that predict motion, then there is no dynamics as a science.

Galileo's ship and relative inertial motion

Galileo's 1632 book *Dialogue Concerning the Two Chief World Systems* proposed the case of a ship moving at constant velocity relative to the shore to show the classical principle of relative velocity. Galileo asserted there is no internal observation made below deck (i.e. without looking out the window at an external reference) by which one can distinguish between a system moving uniformly from one at rest. Hence, any two systems moving without acceleration are equivalent, and non-accelerated motion is relative. The principle was stated only for mechanical motion. Later its application to the behavior of light led Einstein to formulate the special theory of relativity.

Update: With a FOG+L Galileo could not only find the ship's speed but also the heading, by rotating the FOG+L in a horizontal plane to detect the maximum speed.

The key to understanding the revision of Galilean and special relativity is the ALFA theory....

Summary

The dynamical Euler-Lagrange equations are derived from a classical Lagrangian model that's completely abstract. Its generalized coordinate system contains no reference to the reality of a reference system, containing an observer/detector at the origin. Such an model assumes that ALL REAL REFERENCE FRAMES ARE EQUIVALENT (frame independence). The derived laws are valid for all observers..... this is the Principle of General Covariance, as promoted by Einstein in general relativity.

However..... the results of the Wang FOC and Sagnac and Newton's bucket tests have pointed to only one ref frame that satisfies the Euler-Lagrange equations.... the lab frame. The Lagrangian variational principle is valid/covariant - if and only if the observer is in the lab frame.

The conclusion is that kinematic laws are always valid for kV, but the dynamic laws for dV are only valid in the lab frame. Confuse the two at your own risk....

Conclusion

When the Copernican model was proposed five centuries ago, the Occam's Razor argument for its adoption was solar system simplicity with the Sun at the center. But there were no decisive tests for heliocentrism based on the scientific method's testability rule.

Electromagnetic theory in the 19th century demanded an aether medium for wave propagation, so Michelson & Morley tried - unsuccessfully - to detect the Earth's motion through the aether, which itself was assumed stationary. Although one obvious conclusion was that the Earth was not moving, the response of the physics community was one of desperation. To avoid the reality of the geostatic model, Einstein proposed a special theory of relativity in 1905, which had two axioms: first, that the laws of physics are valid in inertial frames and second, that the vacuum speed of light was always constant.

Relativity was an odd name for this theory, indeed, as light speed was defined as absolute, not relative to anything. And the first axiom, having nil to do with relative motion, was actually a statement about covariance - the validity of dynamics in inertial frames of reference. The proper name for axiom two is really the "Covariance of Inertial Frames", which is what Galileo stated in his ship at sea parable.

Despite contradictions in its premises and practice, the irrational special theory of relativity was adopted by mainstream physics as a reply to the Michelson & Morley null result. ...until the Sagnac test of light speed on a rotating platform was performed in 1913. Sagnac found light speed was affected by rotation of ambient matter, disproving STR's axiom of constant speed. He also surmised that aether was not rigid, but was stirred up into a whirlpool by the spinning mass, as air does in a fan. Aether not only existed, but was flexible and pliant, like a fluid.

Sagnac's result was universally ignored, usually on the basis that STR does not apply to accelerating motion.... even though Einstein gave several examples of STR applications to circular motion.

In 1937 Dufour and Prunier revisited the Sagnac test and found light speed in the lab frame was the same as on the rotor....light speed = $c \pm v$. This supported the aether drag hypothesis, since the laws of dynamics were tested and validated in the lab frame.

Belief that the Sagnac result of 1913 only applied to rotational motion was discounted when Ruyong Wang found the same results for linear motion in 2004. The Wang test analyzed above removed the objection to the Sagnac test; STR does not apply in the rotating frame. (This claim was always specious... in the rotor frame, the lab rotates around the rotor. Yet the lab is the one frame that has been thoroughly tested dynamically!).

The Sagnac result has never been credibly explained, despite its wide application in modern technology. In turn the Wang paper has been virtually ignored in the last ten years, but remedied by this paper, which establishes the test as a critical sentinel of striking new concepts.

Kinematic and dynamic motions were carefully distinguished and the neglected topic of covariance was reviewed and applied to the Galilean dynamical law of velocity addition. Analysis of Wang's result in the conveyor and lab frames with the premise of aether drag logically leads to identification of preferred motion in an absolute frame of reference ... the Earth-bound laboratory frame!

Relativists often challenge dissidents to offer a credible theory to replace STR. That light speed in the lab frame will be the same as for the conveyor is a testable prediction of this paper and the ALFA model. We predict the same test result as the Doufour-Prunier test.

The profound conclusion for light speed in a non-lab frame being $c + v$, where v is $V_{\text{lab,lab}}$, was that the lab frame is the absolute frame of reference for all laws of dynamics. After all, light speed should be c , not $c + v$, in the non-lab frame, since conveyor and aether move together.

The ALFA theory summarizes this conclusion with an:

1. Absolute Lab frame and
2. Flexible Aether co-entrained by moving matter.

Discovery of the absolute lab reference frame and a flexible aether - the ALFA model - refutes relativity and its alleged consequences, such as: both postulates of special relativity - general covariance in general relativity - Lorentz transformations - Minkowski space - length contraction - time dilation.... all linchpins of relativity - disproven by ALFA theory via the Sagnac and Wang tests.

It turns out relativity was misstated from the very beginning. There IS a law of relative motion that applies only to kinematics ...to the relative motion of 2 reference frames, not one...and makes no prediction about future motion (dynamics). There is no law of relativity in dynamics, only the law of absolute lab frame covariance.

If one were allowed to distort the real measurements of space and time with Lorentz transformations, then one could force light speed to be the same for all observers. But physicists with common-sense belief in philosophical realism reject the distortion of

sense images in this way. To a realist, space is what a ruler measures; time what a clock ticks away. Such is the valid testimony of the senses.

Reflection on the last century in physics leads one to wonder how such self-defined intelligent modern scientists could wander so far astray, as do drivers in unfamiliar country whose male ego refuses to admit they made a wrong turn.... or to permit retreat to the point of the errant turn. The counter evidence to relativity was the Michelson & Morley test itself, with the static Earth interpretation as evident as the emperor with no clothes or an elephant in the living room. Evidence afterwards includes the experiments of Sagnac, Dufour & Prunier, Ruyong Wang, plus all the light anisotropy results when done in a non-vacuum. Could there be in the establishment's rejection of geocentrism hint of a struggle transcending mere science...of confusion borne by delusion, not just ignorance...a battle that deals with the highest level of human concerns.... truth vs. lies – life vs. death?

*Once to every man and nation comes the moment to decide,
In the strife of Truth with Falsehood, for the good or evil side;
Some great cause, God's new Messiah, offering each the bloom or blight,
Parts the goats upon the left hand, and the sheep upon the right,
And the choice goes by forever 'twixt that darkness and that light.*

...
*Though the cause of Evil prosper, yet 'tis Truth alone is strong,
And, albeit she wander outcast now, I see around her throng
Troops of beautiful, tall angels, to enshield her from all wrong.*

....
*Careless seems the great Avenger; history's pages but record
One death-grapple in the darkness 'twixt old systems and the Word;
Truth forever on the scaffold, Wrong forever on the throne,-
Yet that scaffold sways the future, and, behind the dim unknown,
Standeth God within the shadow, keeping watch above his own.*

....
*'Tis as easy to be heroes as to sit the idle slaves
Of a legendary virtue carved upon our father's graves....*

...
*New occasions teach new duties; Time makes ancient good uncouth;
They must upward still, and onward, who would keep abreast of Truth...*

J.R. Lowell

Appendix

Contrarian opinions of the Wang FOC test

Claim 1: What explains the Wang result is that light moves along a closed circuit, and that an observer is in motion with respect to that circuit.

Reply: This is what the Wang test shows:

- 1- An object moving in the lab frame drags along aether at the same speed.
- 2- Only the lab frame can be used to apply the laws of dynamics.

Claim 2: The equation

$$\Delta t = 2vL/c^2$$

is based on the constant speed of light.

Reply: The measured speed of light was $c \pm v$, not c .

Claim 3 : The Wang experimental results agree exactly with the predictions of special relativity.

Reply: The principle of the constancy of the velocity of light everywhere,

$$\text{SoL} = c,$$

is refuted by the result that SoL on the conveyor is

$$\text{SoL}_{\text{con}} = c \pm v,$$

where v is the speed of the conveyor AND the entrained aether.

Claim 4: The reflected light will be red-shifted from one mirror and blue-shifted from the other, depending on the state of motion of the source/receiver relative to the optical fiber.

Reply: There is no relative motion between the emitter/receiver and the fiber cable in the measured conveyor frame; everything is at rest in that frame. .

Claim 5: The optical path lengths are different in the conveyor and lab frames.

Reply: The SoL results in both frames are equal so the phase shifts in time are equal and so the optical paths traveled by the light in both frames are equal.

Claim 6: Dr. Wang linearly moved a straight section of the fiber while the rest of the device was held stationary.

Reply: The source, detector and FO cable all moved together in the lab frame. The Sagnac detector – the FOG – reads

$$\text{SoL} = c$$

when translating and not rotating in the lab frame.

The whole interferometer is in linear motion in the lab frame, but only the linear segment produces phase shifts because of the linear motion through the aether.

Claim 7: It has not been demonstrated that linear motion of the entire device can register a signal.

Reply: In fact, the graphic results say this is exactly so... When the conveyor moves in the lab frame, a phase shift is registered.

Claim 8: The phase shift occurs due to and at the time of velocity change.

Reply: The shift is constant at constant speed, as the graph of shift vs speed shows. The cause of the phase shift is velocity, not velocity change = acceleration.

Claim 9: We have proved that the Wang effect originates from the closure of the two space paths as seen in the frame co-moving with the emitter/receiver, and from relative motion between the emitter/receiver and the optical fiber (or physical device).

Reply: In the co-moving frame everything is at rest except the light beam and the surrounding laboratory. The beam paths are always closed!

There is no relative motion between the emitter/receiver and the optical cable; everything is at rest. Why is this concept so difficult?

References

ⁱ <http://vixra.org/abs/1409.0145>

ⁱⁱ <http://gsjournal.net/Science-Journals/Historical%20Papers-Astrophysics/Download/2638>
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2639>

ⁱⁱⁱ Generalized Sagnac Effect, R.Wang
<http://arxiv.org/ftp/physics/papers/0609/0609235.pdf>

^{iv} On a Fringe Movement Registered on a Platform in Uniform Motion (1942),
A. Dufour and F. Prunier
[http://www.conspiracyoflight.com/Dufour%20and%20Prunier%20-%20On%20the%20Fringe%20Movement%20Registered%20on%20a%20Platform%20in%20Uniform%20Motion%20\(1942\).pdf](http://www.conspiracyoflight.com/Dufour%20and%20Prunier%20-%20On%20the%20Fringe%20Movement%20Registered%20on%20a%20Platform%20in%20Uniform%20Motion%20(1942).pdf)
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2468>
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2470>
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2472>
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2476>
<http://gsjournal.net/Science-Journals/Historical%20Papers-Mechanics%20/%20Electrodynamics/Download/2474>