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Decrypting the Central Mystery of Quantum Mathematics: Part 4. In What Medium Do Elementary Waves Travel?

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Abstract

We live in a world, half of which consists of invisible Elementary Waves, of which we know very little. They are not electromagnetic waves: they travel in the opposite direction and convey no energy. What is the medium in which they travel? Franco Selleri (1936-2013) of University of Bari, Italy, devoted his career to answering that question. He developed a unique theory of relativity. Zero energy quantum waves travel in Lorentz aether at rest. His relativity differs from Einstein's Theory of Special Relativity (TSR) in terms of Absolute Simultaneity. If two events are simultaneous for one observer, they are simultaneous for all observers. Although this contradicts TSR, international treaties have adopted Absolute Simultaneity as the basis for coordinating all atomic clocks to the nanosecond. Atomic clocks control all other clocks. Absolute simultaneity is essential for commerce and computer networks. Selleri's relativity can be divided into two parts: time and aether. Time can be understood without ever speaking of the speed of light. When it comes to aether, a subject rarely mentioned today, it appears to be Isaac Newton's absolute time and space, modified to fit the Lorentz transformations and the non-Euclidean curved space of Einstein's General Relativity.

Mathematics Subject Classifications (MSC2010): 83A05 Special Relativity, and 81Q65 Alternative Quantum Mechanics

1 Introduction

This is the fourth in a series of four articles about the Theory of Elementary Waves (TEW).[1-4] In the first article we proposed that the unsolved double slit experiment could be solved if we adopted three Axioms:

A. Wave function collapse occurs *before* we measure something,
B. There is *no* wave particle duality,
C. Waves travel in the *opposite* direction as particles.

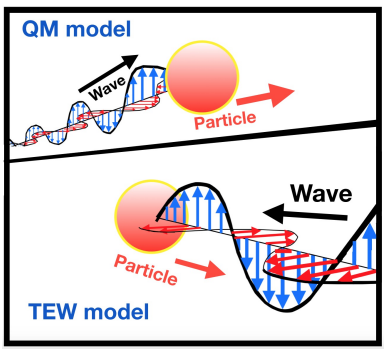

Figure 1: Top: a wave particle. Bottom: a photon (which carries all the momentum) following an Elementary Wave backwards. Such an Elementary Wave conveys probability amplitudes, not electro-magnetic energy. To understand what medium such waves travel in, you need a theory of aether. You cannot avoid it.

The second and third article in this series proposed that these Axioms explain many quantum experiments, including the Bell test experiments.[2,3] But we still don't know much about these Elementary Waves. We need to know more.

Nature can be divided into two parts. On the one hand there is energy and matter, which are interchangeable as in the equation $E = mc^2$. On the other hand there is the half of Nature that contains neither energy nor matter. This has two constituents: Elementary Waves and luminiferous aether (also spelled "ether"). This is evident in the bottom half of Figure 1.

Since aether is not well known today, we need to explain what (if anything) it is, and to state the mathematics of aether, which is the central focus of this article.

The physicist who did more research on Elementary Waves than anyone else was Franco Selleri (1936-2013). He found evidence of zero energy quantum waves that exist in space even before particles come along following them.[5-6] His colleagues said that in order to believe in such waves they would need to know what medium they travel in. For that reason Selleri started in 1994 to investigate aether.

His relativity research focused on time as the central issue. Einstein had rejected simultaneity when developing his Theory of Special Relativity (TSR). In TSR event A might precede event B for one observer, but B precedes A for another observer, or A and B could be simultaneous for a third observer. Selleri's theory of relativity, called "Lorentz aether at rest," or "weak relativity" asserts that if A precedes B for one observer, that is true for all observers. Eventually Selleri's relativity theory became more famous than his research on quantum waves.[7-14]

The key to understanding the two halves of nature is that particles cannot exist or do anything without following Elementary Waves. Therefore, ironically, the waves are in control despite having no energy. Think of Schrődinger waves. They convey no energy. Instead they convey probability amplitudes. The probability amplitudes of Schrődinger waves do not control particles, but they accurately describe how particles are likely to behave. Elementary Waves are Schrődinger waves traveling in the opposite direction as particles: see Figure 1.

Some Elementary Waves are attached to a particle, most are not. No particle ever exists without following at least one Elementary Wave. The waves carry no energy. All momentum and energy is intrinsic to the particles. That's just the way Nature is rigged up.

In this article we are asking the question: In what medium do these waves travel? You need imagination and a sense of adventure to study Elementary Waves. We embark into uncharted territory. So far this article sounds like it is taking on the most obscure and boring subject imaginable (the mathematics of aether). The fact that trillions of dollars of trade and commerce hang in the balance when we discuss simultaneity is not known to the general public. If Einstein's TSR were correct about a lack of agreement about the sequence of events between two observers, then two computers would also disagree about the sequence of events, and computer networks would crash incessantly for that reason. The fact that computer networks, or microwave communication networks do not crash for that reason, is powerful evidence that Einstein's TSR is wrong about simultaneity. If one computer says that A occurs before B, then (in the real world) the other computer says that A occurs before B. One computer does not say to the other, "You are entitled to your own opinion, as Einstein said."

As you read about aether below, keep in mind that a central issue in Selleri's thinking is about time and how international agreements for the past forty years coordinate all clocks so they all tell exactly the same time (divided of course into 24 different time zones), including the four atomic clocks in every GPS satellite above us, including the clocks in the cockpits of all 39 million airplane flights per year, and including the clocks internal to computers trading stock nanosecond by nanosecond on the NASDAQ and other stock exchanges. Selleri's is the only relativity theory that focuses on time as the central issue.

2 Simultaneity and the Syncrhonization of Clocks

Selleri's ideas about relativity can be divided into his ideas about time and his ideas about aether. Let's start with time. We can develop his ideas about time further than he did, if we employ Georg Cantor's set theory, a subject Selleri never discussed.[15] In this section we will do that. When we illuminate Selleri's relativity with Cantor's set theory, we are able to discuss time without ever mentioning velocity or the speed of light. The following ideas about sets do not come from Selleri, but from our reinterpretation of Selleri.

The words "simultaneous" and "synchronized" are related. "Simultaneous" means that two events, no matter how far apart, that are viewed by one observer as occurring at the same time, are viewed by all observers as occurring at the same time. This is a fundamental property of the universe. The word "synchronized" means that humans can set two clocks so they tell the same time, and continue to tell the same time forever, when supervised by a computer that corrects for the local clock ticking too fast or too slow.

We will define the time on clocks α and β as being ordered sets of real numbers that are **similar**. "An ordered set M is **similar** to ordered set N, when the elements of M and N can be put into a one-to-one correspondence in such a manner that when any two elements of M, m_1 and m_2 the relation $m_1 \prec m_2$ holds, then for the corresponding elements n_1 and n_2 of N, the relation $n_1 \prec n_2$ also holds. In this case we write **'N $\simeq$ M'** and say 'N is similar to M.' "

Ordered sets have these properties:

1. **M** $\simeq$ **M**, meaning the similarity is reflexive.
2. If **M** $\simeq$ **N**, then **N** $\simeq$ **M** meaning the similarity is symmetric.
3. If **M** $\simeq$ **N** and **N** $\simeq$ **P**, then **M** $\simeq$ **P**, meaning the similarity is transitive.

Selleri's relativity theory has the following proposition at its core: all clocks tell time based on ordered sets of real numbers that are similar to all other clocks.

We can say more about the set of real times on these clocks. The time on each clock is **"dense"**, meaning that between any two times there is always at least one other time. This means that no time point has a next time point. Such density is an intrinsic property of any set of real numbers.

To define the concept **"right now"** (meaning the present moment), we will say that the time on any specific clock is **"cut"** in such a way that there is a specific time "x_1" after the cut. At time "$t = t_1$" we set x_1 = **"right now"**, but if $t \neq t_1$ then $x_1 \neq$"right now." We are assuming that time "t" is the continuous dense set of real numbers.

Those conditions imply that as quickly as t changes, so also **"right now"** changes. Furthermore, if we call **M** the set of real numbers registered on any clock, and we call **N** the set of real numbers registered on any other clock in the universe, we declare **M** $\simeq$ **N**. Since the elements m_i of **M** are ordered and are similar to the elements n_j of **N**, the flow of time (i.e. the perpetual incremental updating of **"right now"**) changes on clock **N** in a similar way as what happens on clock **M**.

We can think of three different varieties of time variables. Past and future time are one dimensional variables, real numbers. The present moment is different. It is a zero dimensional variable: **"right now"**. When clocks are all synchronized, "right now" is exactly the same instant for all frames of reference.

We have just stated the central thesis of Selleri's theory of relativity without use of the variables "c" or "v." In other words, although Selleri calls his ideas a "theory of relativity," it could be regarded as a "theory of time." Seller's primary complaint against Einstein's TSR is that it fails as a theory of time.

2.1 How time is deeply involved with relativity and aether

In Selleri's exploration of relativity he finds strong evidence in favor of simultaneity, and that has implications for many other aspects of relativity. As we said before, time is the central pivot around which Selleri's relativity and aether rotate.

In the Einstein vs. Lorentz debates he favors Lorentz, and he also corrects an error Lorentz made about time. The idea of a space-time continuum disappears when this approach is taken. Hermann Minkowski's four dimensional manifold vanishes. The equation

$$c^2t^2 - x^2 - y^2 - z^2 = 1 \tag{1}$$

disappears, because time is not a dimension like the spacial dimensions. Time is uncoupled from space. Clocks go slower with gravity and velocity. But clocks are not affected by distance nor acceleration.

All this flows from Selleri's ideas about time. Selleri's approach, unlike the TSR, allows the NASDAQ computer to trade stocks, as you will learn.

What does this debate about time have to do with Elementary Waves? It means that Elementary Waves all agree with one another about what time it is. In Einstein's TSR there are no Elementary Waves, but if there were, there would be chaos because of disagreements about time: about whether event A precedes event B or event B precedes A, or whether they are simultaneous.

Since our discussion of Cantor's set theory involves mathematical ideas not used by Selleri, we will not discuss sets further. We return to Selleri's evidence about aether, and what that implies about simultaneity, synchronicity, commerce, and international agreements about coordinating all clocks.

3 Luminiferous Aether

Aether is not spoken of much today. We need to explain what (if anything) it is, and why it has anything to do with the time on clocks.

Prior to the twentieth century people spoke of luminiferous aether as the medium in which light waves undulate. Could this be the medium in which Elementary Waves travel? No other candidate is available. They don't travel the way electromagnetic waves travel, because Elementary Waves travel in the opposite direction, and carry zero energy. Electromagnetic waves follow Elementary Waves backwards (Fig 1).

Aether has a history of controversy. Isaac Newton and Galeleio posited an absolute time and space as the framework for their laws of motion. We would say that space contains Cartesian coordinates, except that Newton hated René Descartes, so Newton would not use Descartes' name.

What are the characteristics of empty space in Newton's universe? If you assume empty space is filled with aether, you might wonder whether it has some motion or immobility, stiffness, wind, etc. Today in particle physics aether is named "the vacuum." In previous centuries aether was thought by most scholars to permeate the earth, passing straight through our planet without ripples, eddies, wake or turbulence. But that was controversial. Augustin-Jean Fresnel proposed in 1818 that the aether was partially entrained by matter, and therefore produced a drag as the earth passed through it.[16]

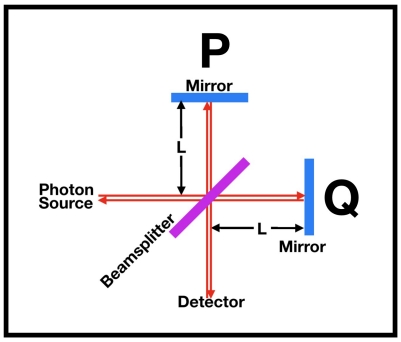

Figure 2: In 1881 Michelson aligned his interferometer such that first the P arm, then the Q arm was aligned with motion of the earth through aether. If light travelled slower in one direction than in the other, there should be wave interference. No wave interference was observed. In 1895 Hendrik Lorentz, who believed in aether, pointed out that these data could be explained if there were "length contraction" with velocity $[x^{'} = (x - vt)/\sqrt{1 - (v^2/c^2)}]$. That equation was adopted by Einstein as a cornerstone of his TSR.

To investigate the speed of the earth through aether Albert Michelson and Edward Morley in 1887 measured the speed of light. The earth travels 30 km/sec around the sun, and the direction of motion reverses every six months, so the direction of the earth through hypothetical aether should change. Michelson and Morley measured the two-way speed of light in the interferometer shown in Figure 2, finding it was the same in each direction. They declared they found "null" results, which astonished aether advocates.[17]

Hendrik Lorentz was interested in the effect of aether on Maxwell's equations. Electromagnetic waves travel through aether at the speed of light. Lorentz was an aether enthusiast who was **NOT** disheartened by the Michelson-Morley results. By developing the transformation equations below, he adapted Maxwell's equations to fit the Michelson-Morley data.[18]

Aside from time, the central focus of this article is the following Lorentz transformation equations as interpreted by Selleri.

$$\gamma = \frac{1}{\sqrt{1 - (v^2/c^2)}} \tag{2}$$

$$x^{'} = \gamma(x - vt) \tag{3}$$

$$y^{'} = y \qquad z^{'} = z \tag{4}$$

$$t^{'} = \gamma(t - \frac{vx}{c^2}) \tag{5}$$

$$m^{'} = \gamma m \tag{6}$$

These equations show what happens as velocity approaches the speed of light. Two things happen: length contraction (equation 3) and time dilation (equation 5). A measuring stick gets shorter and clocks slow down.

With the exception of equation 5, which we will examine in detail, these equations have been exhaustively studied and verified. These equations, invented by Lorentz to explain how light in the Michelson-Morley experiment warped as it sped through aether, were adopted as the cornerstone of Einstein's Theory of Special Relativity (TSR) in 1905. Lorentz was 26 years older than Einstein.

From the beginning there have been two incompatible interpretations of the same equations (the Lorentz transformation equations 2 through 6). According to Lorentz aether exists. According to the Einstein it doesn't. The two men exchanged cordial letters throughout their lives (see Lorentz's letter to Einstein in 1916), each trying to convert the other from his erroneous idea about aether to the truth. Neither prevailed.

Does it matter? Usually it is considered a matter of metaphysical debate whether Einstein's TSR or Lorentz "interpretation" of TSR is correct. Unfortunately that glib idea is wrong. There are a lot of indirect data that are consistent with Lorentz and cannot be explained by Einstein's TSR. More important, there are enormous financial, commercial and

practical differences between the two theories. For example, if you are enthusiastic about Einstein's TSR, then you and the time on your cell phone have diametrically opposite ideas about what is true. Were you aware that you and your cell phone were out of sync vis-á-vis what the word "time" means?

If you travel on an airplane you depend on the Sagnac interferometers in the inertial guidance systems in the form of ring laser gyroscopes. We will show that those inertial guidance systems cannot be explained by Einstein's TSR.

4 Richenbach's epsilon

Selleri developed two numeric measures to distinguish the two conflicting interpretations of the Lorentz equations. The first is Hans Reichenbach's "synchronization parameter" epsilon (ϵ). Reichenbach defined a variable ϵ that would allow us to compare different theories of relativity.[19,20]

$$0 \leq \epsilon \leq 1 \tag{7}$$

Imagine two space ships moving in different inertial frames (Figure 3). How do they synchronize their clocks? Einstein proposed that one space ship sends a light signal toward the other. When the signal reaches the second space ship it bounces off a mirror and comes straight back to the first. If t_1 is the time when the signal was sent and t_2 is the time when the reflection is detected again by the original space ship, Einstein said that the way to establish $t_0 = 0$ is to say it was halfway between t_1 and t_2. Einstein assumed, on the basis of zero evidence, that the speed of light is the same in both directions. The Michelson Morley experiments measured the two way speed of light, but no one in 1905 knew how to measure the one way speed of light. The space ships would agree that they would both adopt $t_0 = 0$ in order to synchronize the clocks on the two ships.

Reichenbach said that light might go faster in one direction than in the other, in which case t_0 would not be located halfway between t_1 and t_2. We define epsilon as the instant of simultaneity:

$$\epsilon = \frac{t_0 - t_1}{t_2 - t_1}. \tag{8}$$

For Einstein's special relativity epsilon is $= 1/2$. But depending on the velocity of light in one direction versus the opposite direction (impossible to measure), ϵ is a continuous real number from zero to one.

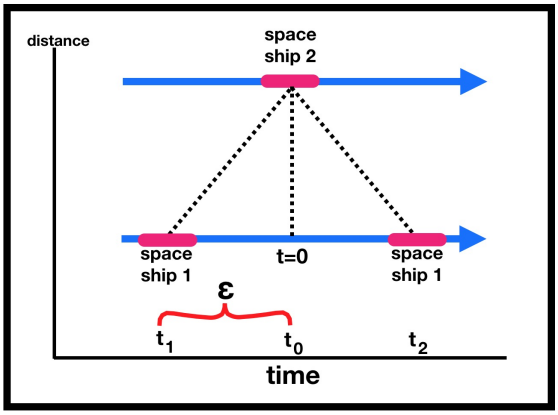

Figure 3: Einstein defined "simultaneous" by space ship 1 sending a light signal to 2, where it bounces off a mirror and returns. They both agree that t_0 will be defined as time zero. Because of the **assumption** that the speed of light is the same in both directions, t_0 is half way between t_1 and t_2. Richenbach defined epsilon $0 \leq \epsilon \leq 1$ based on where t_0 fell between t_1 and t_2. For TSR $\epsilon = 1/2$.

Therefore ϵ defines an infinite set of relativity theories, each with a different ϵ. We will call it the "Reichenbach set." Physicists find mountains of empirical data that confirm the equations of TSR, and therefore they conclude "Einstein's TSR is correct." However that same mountain of data confirm **all** the relativity theories in Reichenbach's set.

If you have an infinite set then it would be useful to know which theory is closest to Nature. Obviously the mountains of empirical data supporting TSR could not answer that question since those data merely define the set. They do not differentiate between members of the set.

Selleri was a maverick. He said "History teaches that in science the majority is usually wrong." Selleri had a habit of sniffing out obscure empirical data to test obscure hypotheses, which is what makes him charming. He reviews a lot of empirical data that indicates that the only correct value for Reichenbach's epsilon is zero.[See reference 11]

$$\epsilon = 0 \tag{9}$$

When we investigate the Sagnac interferometer experiment (below) we will find support for $\epsilon = 0$. Think of the space ships in Figure 3. If $\epsilon = 0$ that means that the two vehicles have synchronized clocks from the beginning. There is Absolute Simultaneity from time zero. When we examine the CCDS below, you will learn how our civilization has been synchronizing clocks for the past forty years. Although synchronization of clocks was a headache for Poincaré and Einstein, it is no longer a problem today, as you will learn.

4.1 Five equivalent themes in this article

In this article five themes will emerge as equivalent:

1. There is Absolute Simultaneity.
2. Richenbach's epsilon (ϵ) is zero.
3. The simultaneity variable (e_1) is also zero, a variable we will define soon.
4. Lorentz aether is at rest.
5. S_0 is the "preferred" inertial frame (S_0 will be defined soon).

Selleri's idea is that if you have any one of these, you have them all, and they are all desirable. Knowing that will allow you to more rapidly get oriented about where this article is headed. You may not agree, but at least you will know what we intend to say.

Selleri uses various names for his home grown theory of relativity:

- Inertial transformations;
- Lorentz aether at rest;
- Weak relativity (in contrast to Einstein's strong relativity). Weak relativity means we cannot measure the speed of the earth through aether. Strong relativity means that the laws of physics are the same in all inertial frames, and especially the speed of light is the same.

Selleri also has mathematical symbols to denote his theory:

$$S_0 \quad \exists$$

and

$$\epsilon = e_1 = 0.$$

5 Simultaneity of a moving train car

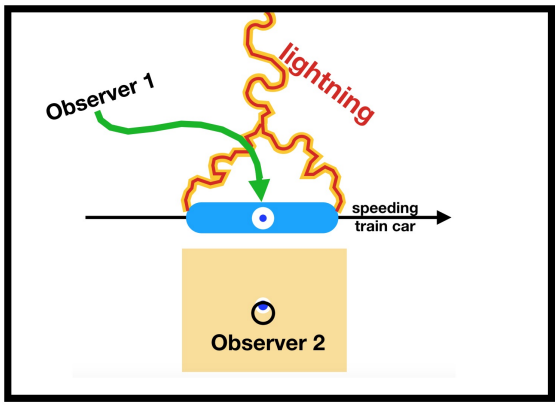

Figure 4: Assume a blue train car is moving rapidly to the right. This idea is vividly displayed in a 2 minute YouTube video.[21] One observer is seated in the center of the car while observer #2 is standing on a platform (a beige rectangle in center). Just when the observers are in juxtaposition a bolt of lightning strikes both the front and back of the train car, harming no one. Based on your theory of relativity observer 1 and 2 have different experiences of simultaneity.

There is a two minute YouTube video that allows you to see why a lack of simultaneity is a core feature of Einstein's TSR, to the point that if you affirm simultaneity then you must reject TSR. It is worth watching.[21] A train car (see the blue object in Figure 4) speeds down a railroad track. There are two observers: a woman seated in the center of the train car, and a man standing on the platform watching. They are observer 1 and 2 respectively. Just as the car passes, a bolt of lightning strikes both ends of the car. The question is, Were those lightning bolts simultaneous or not?

According to observer 2 standing on the platform both bolts of lightning strike simultaneously. He also hypothesizes that observer 1 will notice the front strike before the rear strike, because the train is moving toward the front and away from the rear strike.

But what does observer 1 see? Indeed she notices the front lightning strike before the rear strike of lightning, but that leads her to conclude that the front strike actually preceded the rear strike in time. She says the two bolts of lightning were not simultaneous.

Which observer is correct: #1 who says the front precedes the rear strike, or #2 who says they were simultaneous? According to Einstein all observers are equally valid. Therefore with TSR there can never be agreement about simultaneity. This is the primary teaching of the YouTube video. This is what it means that $\epsilon = 1/2$.

The TEW view, $\epsilon = 0$, is also evident in the same YouTube video, but the video never comments on it. TEW defines "reality" to be that which actually happened in the real world, regardless what the observers saw or didn't see. The reality is both strikes of lightning were simultaneous. This is what it means to say that Reichenbach's $\epsilon = 0$. Furthermore, it is what our common sense tells us.

The YouTube video agrees with scholars who say that TSR is incompatible with Absolute Simultaneity. Yet simultaneity is what all civilized people have been living with for the past forty years. The primary constituency that is unaware of this reality are the scholars who support TSR.

6 Another Simultaneity Equation

Since simultaneity is the primary focus of Selleri's theory of relativity (unlike anyone else's theory of relativity), he developed another equation to define it. Selleri is an ardent follower of Lorentz in all respects but one. It is easy, by the way, to get the two men's names mixed up because their ideas were so similar. Selleri was born eight years after Lorentz's death. Selleri was Italian, Lorentz was Dutch.

Lorentz made a mistake putting the variable "x" into the upper right of equation 5, which is called the "time dilation" equation. Although it is clear that time slows down ("dilates") with velocity, it is also clear that position "x" has no effect on the rate at which a clocks tick. Lorentz made a mistake.

$$t' = \gamma(t - \frac{vx'}{c^2}) = \frac{1}{R}(t - \frac{vx'}{c^2}) \tag{10}$$

That tiny "x" tucked away in the upper right corner has caused no end of havoc. The variable "R" is introduced here (Eq 10) because Selleri insists on using "R" rather than "γ" as his velocity transformation variable.

$$R = \frac{1}{\gamma} = \sqrt{1 - \left(\frac{v^2}{c^2}\right)} \tag{11}$$

Selleri's ideas about relativity developed over many years, starting in 1994. His ideas about time dilation in the Lorentz transformations evolved. He defines a new variable e_1 as follows:

$$e_1 \equiv \frac{t' - Rt}{x - vt} \tag{12}$$

He names e_1 the "simultaneity parameter." Rearranging this equation, we get a more useful form:

$$t' = \frac{t}{\gamma} + e_1(x - vt) = Rt + e_1(x - vt). \tag{13}$$

The Lorentz equation for time dilation is recovered if

$$e_1 = -\frac{v}{\gamma c^2} = -\frac{v}{c^2}R \tag{14}$$

The "x" in equation 5 means that the time dilation of a clock that is moving depends not only on time, but also on the position of the clock within S the moving inertial system, relative to the stationary system S_0. The variable e_1 is introduced to quantify how important "x" is. Selleri says, "Most experts in relativity consider e_1 a free parameter to be fixed by convention." He disagrees. He says e_1 cannot be arbitrarily set to any value. He methodically reviews six experiments (of which one is the Sagnac interferometer below) to demonstrate that in Nature $e_1 = 0$. Absolute Simultaneity is the cornerstone upon which Nature is built, or at least Selleri's idea of "Nature".

Selleri demonstrates that Einstein's TSR is unstable, meaning that a small change in any of the variables (such as e_1) destroys the idea that all inertial frames are equivalent, and forces us to admit that there is one inertial frame that is more important, or "privileged" than the others. Selleri cites masses of empirical data, from starlight aberration to the Sagnac interferometer, to thought experiments about the aging of twins during space travel.

He finds zero empirical evidence supporting the inclusion of the variable "x" inside Lorentz's time dilation equation. Other relativity researchers did not investigate that data. Therefore other researchers don't know what they are talking about when they say that "e_1 is a free parameter to be fixed by convention."

The only equation that fits the empirical data is $e_1 = 0$, so equation 13 becomes

$$t' = \frac{t}{\gamma} + 0 \cdot (x - vt) = R\, t + 0 \cdot (x - vt). \tag{15}$$

and therefore.

$$t = \frac{t}{\gamma} = R\, t \tag{16}$$

Equation 16 is astonishingly simple and beautiful. John von Neumann used to say that if an equation is simple and beautiful, it is more likely to be true to Nature.

Thus Absolute Simultaneity in Selleri's mathematics means $\epsilon = e_1 = 0$. He wrote an entire book (***Weak Relativity***) in order to demonstrate that many experiments and physical observations require that $e_1 = 0$. No other authors focus on simultaneity as the pivotal variable in relativity.

7 Mathematics is not enough

We live in a culture where physicists tend to trust equations, if the equations are verified by empirical data. One of the central ideas in Selleri's mathematics is that equations alone don't tell the whole story. Here is what he wrote:

"One should never forget that behind the equations of a theory there is a huge qualitative structure made of empirical results, generalizations, hypotheses, philosophical choices, historical conditionings, personal tastes, conveniences. . . . The correctness of the mathematical formalism is not enough to validate a scientific structure."[1]

Here is an example. If you limit your focus to the equations of TSR you might convince yourself that "Einstein's TSR is correct" because there is a mountain of empirical data that says that the speed of light in a vacuum is 299,792,458 m/sec for all observers. But Einstein paid a **high price** in order to purchase his special relativity: the loss of simultaneity.

If it were still 1905 then you might learn how to live with that. Today is more than a century later, and the **price that you have to pay is much higher.** You have to avoid thinking about the commercial world. The stock market and all atomic clocks today are coordinated on the basis of Absolute Simultaneity, as we will show, and that is incompatible with Einstein's rejection of simultaneity.

In his 1905 paper on the *Electrodynamics of Moving Objects*, Einstein defined what he meant by "time" as follows: "We have to take into account that all our judgements in which time plays a part are always judgments of *simultaneous events.* If, for example, I say 'That train arrives here at 7 o'clock,' I mean something like this: 'The pointing of the small hand of my watch to 7 and the arrival of the train are simultaneous events' "

That idea of time "is no longer satisfactory when we have to connect in time series of events occurring in different places, or to evaluate the times of events occurring at places remote from the watch."

7.1 Temps Atomique International (IAT)

It is not clear how scientists manage to partition their brains into one part that endorses TSR and rejects simultaneity, while another area of the same brain embraces the atomic clocks and stock market of our world, which require Absolute Simultaneity. The right hand rejects simultaneity. The left hand embraces it. Let's be specific.

Commercially we live in a world defined by an international agreement, as we said before, the IAT. This is the system of atomic clocks, synchronized around the world. It is based on a document written in French in 1980, called the "Comité Consultatif pour la Définition de la Seconde" (CCDS) by the Institute of Navigation, which gives directions about how to synchronize clocks.

Without fanfare the CCDS agreement corrected Einstein's error about simultaneity. It provides two methods for setting the time on two clocks, and three adjustments to be made no matter which method you use. The two methods are to take one clock physically to where the other clock is located and set them to the same time. The other method is to send a signal from one to the other.

No matter which method is used, three adjustments need to be made:

First, adjust for the amount of gravity because General Relativity correctly predicts slower time with more gravity. They use the equation

$$g(\phi)h/c^2 \tag{17}$$

[1] Selleri, Apeiron, 11, 246 (2004), op. cit.

where g is the total acceleration (gravitational and centrifugal) at sea level at latitude ϕ, and h is the height above sea level.

Second, adjust for the speed of the satellite or airplane carrying a clock, because the Lorentz transformation equations correctly predict time dilation with velocity. The CCDS uses the equation:

$$v^2/2c^2 \tag{18}$$

where v is the velocity of the airplane.

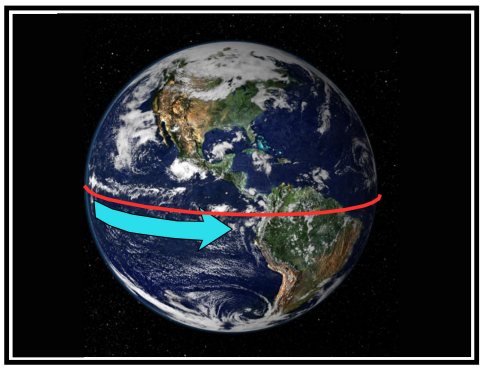

Figure 5: In this Sagnac interferometer, if microwave signals were sent both ways around the equator at light speed, it would take 0.135 seconds, during which time the earth would rotate 62 meters eastward. Then the signal sent westward would have 62 meters less distance to travel and would arrive 207 nanoseconds ahead of schedule. The signal sent eastward would have 62 meters more distance and arrive 207 nanoseconds behind schedule. From a human point of view the speed of light is not the same west versus east. This contradicts Einstein's declaration: the speed of light is the same for all observers.

Third, adjust for the Earth's rotation, proportional to:

$$2A_E\omega/c^2 \tag{19}$$

The explanation of this third equation is purposefully obscure. They went out of their way to make it unintelligible. They said, "Where A_E is the equatorial projection of the area enclosed by the trajectory traveled by the clock (or by the signal) and by the lines connecting the sites of the two clocks with the center of the Earth and ω is the angular velocity of the Earth."

Why would the people who wrote the CCDS hide what they were actually doing inside this third equation? It is a covert adjustment for the Sagnac effect caused by the spin of the earth (see the caption to Figure 5). People who negotiated the CCDS were cautious to avoid ruffling the feathers of scientists who devoutly believe in the TSR.

If you want an international agreement then you have to avoid controversy. Nations tend to mistrust one another. Any controversy would lead someone to refuse to sign the CCDS agreement. To avoid controversy means never saying out loud that the speed of light westward is faster than the speed of light eastward (especially since it is true). **They had to fly under the radar of the scientific community.** That meant burying their meaning inside an equation that no one could decipher, like saying that clocks should be synchronized according to equation 19. By this clever maneuver the CCDS was universally adopted despite the fact that it is based on the Sagnac interferometer data that are incompatible with Einstein's TSR. The scientific community remains unaware of what kind of world they have been living in for the past four decades, and continues to have scholarly discussions endorsing Einstein's ideas about no simultaneity in different inertial frames.

7.2 Is it important?

Does it matter that your cell phone tells exactly the same time as the cell towers, which tell the same time (split into 24 time zones) as the clocks in the cockpits of the 39 million airplane flights that occur every year?

If you are a scientist who embraces TSR because you love its mathematical equations, then you cannot explain "High Speed Trading" (HST) of stocks. Today computer algorithms buy and sell stocks in a matter of nanoseconds, and thereby are more profitable than the computer that buys and sells stocks in a matter of milliseconds. If the investing computer and the NASDAQ computer were not synchronized, **if each computer marched to a different drummer, as Einstein would have you think,** then the stock market would instantly crash.

When time is counted in nanoseconds, then you are surrounded by many inertial frames in your local environment, and the nearby and distant computers could be in different inertial frames and marching to different drummers. If your

computer said "I bought that stock before I sold it," but the NASDAQ computer said "No, you sold that stock before you bought it," how much electronic trading would transpire?

If there were no simultaneity between such computers and the NASDAQ computer, then why are stock market traders so excited about the word "colocation"? That refers to the advantage one computer has over another if it is closer to the NASDAQ computer. The computer that is geographically closer wins because every nanosecond counts, and every meter of distance costs 3.3 ns.

8 Absolute Simultaneity and a preferred inertial frame

What would it mean if there were Absolute Simultaneity in the universe, even in the distant galaxies? Relativity would crumble. Mathematically it means that $\epsilon = e_1 = 0$ everywhere. There must be some preferred inertial frame S_0 somewhere in the universe, which provides the foundation for the Absolute Simultaneity ($\epsilon = 0$). Galaxies are flying in one direction or another, but they are all embraced by inertial frame S_0 which is stable, does not move, and provides the foundation for Absolute Simultaneity.

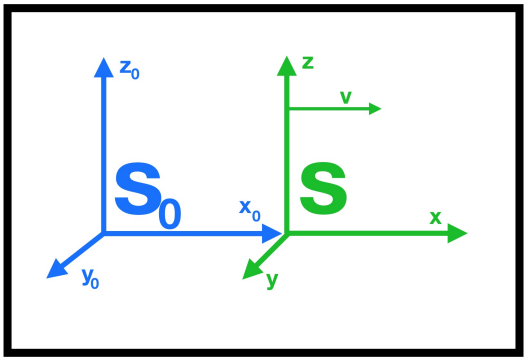

Figure 6: Selleri's preferred inertial frame S_o (in blue) and another inertial frame S (in green) moving at speed "v" relative to the blue frame. S_o represents "Lorentz aether at rest" and is the basis of Absolute Simultaneity. We live in the green frame. Because of Lorentz length contraction [$x^{'} = \gamma(x - vt)$] we cannot measure the velocity "v." The measured speed of light is the same "c" in both S and S_o.

According to Selleri's thinking, time, distance and velocity all have absolute values determined vis-á-vis S_0. If our intertial frame S is moving at velocity $\overrightarrow{v}$ (shown in green in Figure 6) relative to S_0 (blue color), then the speed of light to the left is $c - v$ and the speed of light to the right is $c + v$ in our inertial frame because the true speed of light is determined in the blue frame S_0. The preferred frame S_0 is the only place in the universe where the speed of light is the same in all directions and for all observers. We cannot measure variations in light speed in our inertial frame S, because of the Lorentz transformations. But it is true as proved by indirect evidence. Just as distance and velocity in our frame S is actually defined and controlled by S_0, the same is true of time. Across all inertial frames there is absolute simultaneity.

Selleri cites a mountain of empirical data that supports the Reichenbach ϵ being zero. Remember what we said earlier about five ideas being equivalent:

Reichenbach's ϵ equals zero

$\iff$ The simultaneity variable (e_1) is zero.

$\iff$ Lorentz aether is at rest

$\iff$ Absolute Simultaneity

$\iff$ S_0 is the preferred inertial frame

We have illustrated that if you restrict your attention to the mathematical equations of TSR it might be possible to maintain the illusion that the system works. However if you remember that Einstein's TSR requires us to renounce simultaneity, the system is not workable.

This article is written by a mathematician who trusts mathematics. We will interpret familiar equations in an unfamiliar way. This article provides the mathematical foundations for understanding aether, i.e. the medium in which Elementary Waves travel. It is the Elementary Waves that are our primary concern.

9 A Sagnac interferometer

Georges Sagnac (1869-1928) invented an interferometer for the purpose of proving that aether exists and Einstein's TSR was wrong in discarding aether. Today Sagnac interferometers are used in inertial guidance systems in airplanes and rockets, in the form of ring laser gyroscopes. When Sagnac published his three articles on his experiments in 1913-14, he was, with two exceptions, completely ignored.[22-24]

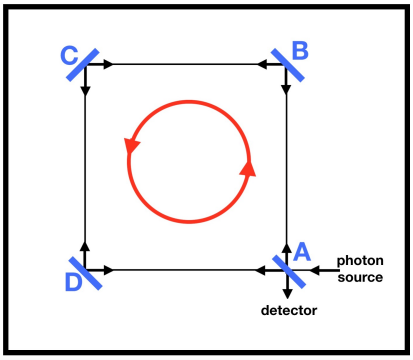

Figure 7: In a Sagnac interferometer photons travel both directions and the final mirror shows whether both photons arrived simultaneously; meanwhile the platform is spinning more than twice per second. The detector does find interference, and the amount of interference varies with the speed of rotation and with the direction of rotation.

Selleri was the first exception. He paid attention to Sagnac's remarkable data. Engineers developing inertial guidance systems were the second exception. But the TSR enthusiasts simply ignored Sagnac's data, since Sagnac had definitive proof of the existence of aether, contradicting Einstein's TSR. Here is the title of one of Sagnac's articles: "On the proof of the reality of the luminiferous aether by an experiment with a rotating interferometer."

In a Sagnac interferometer (Figure 7) a photon comes from the source and is divided in two by beam splitter A, so that one photon goes around the square clockwise, and the other counterclockwise. They both converge at A where they cause an interference pattern if they don't both arrive at A simultaneously. If they do arrive simultaneously, there is no interference pattern.

The entire interferometer is on a platform that rotates counterclockwise at two or more revolutions per second. Therefore the photon traveling counterclockwise has further to travel than the other photon. Another way of saying the same thing is that the target, A, is moving toward one photon and away from the other, so we would expect that one photon would take more nanoseconds than the other one to complete the circuit. Equations will be provided shortly.

The results of this experiment are dramatic. There is an interference pattern, which can only be explained if the photons take a different number of nanoseconds to complete the course. If the speed of rotation is increased the interference pattern increases. If the platform is stopped there is no interference pattern. If the platform rotates in the opposite direction, the interference pattern is reversed.

This sounds like common sense. Mark that previous sentence as important. It means, as you will see, that Selleri makes common sense and Einstein's TSR does not.

If Einstein's TSR were true then the platform would be an inertial frame which should obey the same laws of physics as every other inertial frame. If the speed of light is the same for all observers, then an observer standing on the rotating platform should observe that the speed of light is the same for a photon going clockwise versus counterclockwise. The detector inside the interferometer is such an observer. It says that the speed of light is not the same in both directions inside that inertial frame. Therefore the detector inside the interferometer contradicts Einstein's TSR, unless of course you say that a rotating frame of reference is not an inertial frame, in which case you must also veto the surface of the earth as an inertial frame (see Figure 5 and its caption).

9.1 A circular turntable with a continuous mirror on the edge

In order to develop equations, we will replace the square Sagnac interferometer with a circular platform of radius r that has a circular mirror wrapped around its periphery (Figure 8). The platform turns around on its axis with angular velocity ω and velocity $v = \omega r$. The platform has a clock C_Σ initially set at time t = 0 vis-á-vis the time in the stationary frame of reference S_0. Naturally as the platform turns the clock C_Σ will be delayed by an amount $t' = tR$, where $R = 1/\gamma = \sqrt{(1 - v^2/c^2)}$ is the Lorentz transformation parameter used by Selleri. If L is the length of the circular mirror attached to the periphery of the circular turntable, the length will be shortened by $L' = RL$.

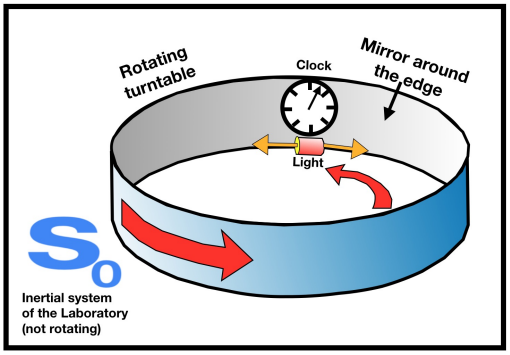

Figure 8: A rotating Sagnac turntable with a continuous mirror at the edge, a clock C_Σ and lamp Σ that flashes light in both directions.

There is a source of light Σ close to the clock C_Σ, and that light sends photons in both directions. These photons slide along the mirror, skirting the periphery of the turntable. We will treat these flashes of light as if they were in a vacuum, traveling at speed c.

The pivotal question is obvious, "Who is the observer that determines the speed of light? Is she standing on the rotating platform, or is she standing in the lab (inertial frame of reference S_0)?" We will measure the time it takes for each photon to make its circular route as determined at the clock. We will compare the observations of those two observers (one rotating with the platform versus the other standing in the laboratory), and discover that they are different vis-á-vis the speed of light being the same for all observers.

The light flashes at time t_{01} and the photons that move opposite the rotation of the disc is seen at time t_{02}. That light travels less distance by a quantity $x = \omega r(t_{02} - t_{01})$, because while the light travels, the target or endpoint also travels toward the light. So the length $L_0 - x = c(t_{02} - t_{01})$

If we define a new variable $\beta = \omega r/c$ then

$$(t_{02} - t_{01}) = L_0/c(1 + \beta) \tag{20}$$

The opposing flash of light, traveling in the same direction as the disc rotation travels a distance greater than L_0 by a quantity $y = \omega r(t_{03} - t_{01})$ due to the change of position of Σ while the light was enroute. Therefore $L_0 + y = c(t_{03} - t_{01})$.

This leads to

$$(t_{03} - t_{01}) = L_0/c(1 - \beta) \tag{21}$$

Taking the difference between equations 20 and 21, we obtain:

$$(t_{03} - t_{02}) = \frac{2L_0\beta}{c(1 - \beta^2)} \tag{22}$$

This equation is the time delay of the Sagnac effect found in laboratory experiments.

We can also calculate:

$$\frac{(t_{02} - t_{01})}{R} = \frac{LR}{c(1 + \beta)} \tag{23}$$

and

$$\frac{(t_{03} - t_{01})}{R} = \frac{LR}{c(1 - \beta)} \tag{24}$$

Now if we define $\tilde{c}(0)$ and $\tilde{c}(\pi)$ as the velocities of light relative to the side of the disc for the flash that moves in the direction of rotation and for the one that moves in opposite direction, from the viewpoint of an observer standing on the rotating platform, then one has:

$$\frac{1}{\tilde{c}(\pi)} = \frac{(t_{02} - t_{01})}{L} = \frac{R}{Rc(1 + \beta)} \tag{25}$$

and

$$\frac{1}{\tilde{c}(0)} = \frac{(t_{03} - t_{01})}{L} = \frac{R}{Rc(1-\beta)} \tag{26}$$

This leads to our most important result:

$$\frac{\tilde{c}_1(\pi)}{\tilde{c}_1(0)} = \frac{1+\beta}{1-\beta} = \rho \tag{27}$$

If TSR were correct ρ should equal 1, Selleri says. But it does't. Empirical data tells us $\rho \neq 1$.

Since so many readers get confused at this point, we will restate it in plain English. Einstein declared in TSR that the speed of light is the same for all observers. The detector standing on the rotating Sagnac interferometer is such an observer. The experience of that observer is that the photons sent clockwise around the periphery in (opposite the direction of rotation of the apparatus) arrive at the detector sooner than the photons sent counter-clockwise. Therefore this observer violates Einstein's declaration of how Nature should work, because light going to the right goes at a different speed than light going to the left vis-á-vis that observer.

10 Newton's spinning bucket of water

The Sagnac interferometer is reminiscent of Newton's spinning bucket of water, which also violates Einstein's TSR.

Isaac Newton speaks in *Principia*[25] of a bucket of water hung by a twisted rope, that gradually spins to untwist the rope, so that the water begins also spinning and seeks to move away from the axis of rotation by climbing the sides of the bucket (see Figure 9).

"If a vessel, hung by a long cord, is so often turned about that the cord is strongly twisted, then filled with water, and held at rest together with the water; after, by the sudden action of another force, it is whirled about in the contrary way, and while the cord is untwisting itself, the vessel continues for some time this motion; the surface of the water will at first be plain, as before the vessel began to move; but the vessel by gradually communicating its motion to the water, will make it begin sensibly to revolve, and recede by little and little, and ascend to the sides of the vessel, forming itself into a concave figure."

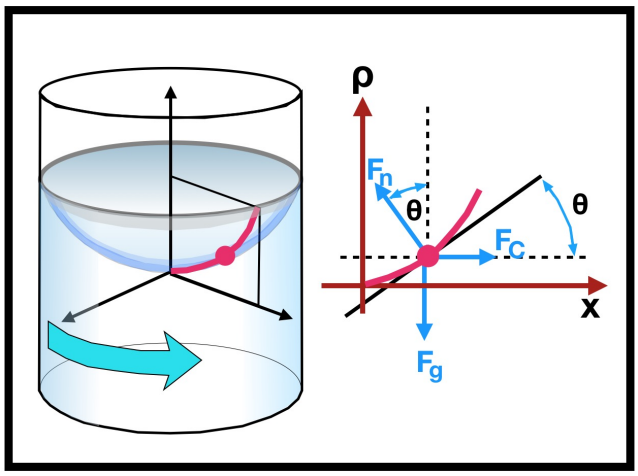

Figure 9: Newton describes a bucket of water spinning around axis ρ, with the water forming a curved surface as it climbs the sides of the bucket; the angle θ is tangential to the surface of the water.

In Figure 9 there are three forces in equilibrium, Fn the force normal to the surface, Fc is centrifugal force, and Fg is the force of gravity. The water revolves around the axis ρ and x is the distance from the axis of rotation. The variable h(x) is the height of the water, depending on the distance x from the central axis. The variable g is the acceleration due to gravity. The angle θ is tangential to the surface of the water. These are the equations per unit mass:

$$Fc = m\rho^2 x \tag{28}$$

$$Fg = mg \tag{29}$$

$$\tan\theta = Fc/Fg = (\rho^2 x)/g = \partial h/\partial x \tag{30}$$

so, integrating, we get

$$h(x) = h(0) + (\rho x)^2/2g \tag{31}$$

where h(0) is the height of the bottom of the concave of water.

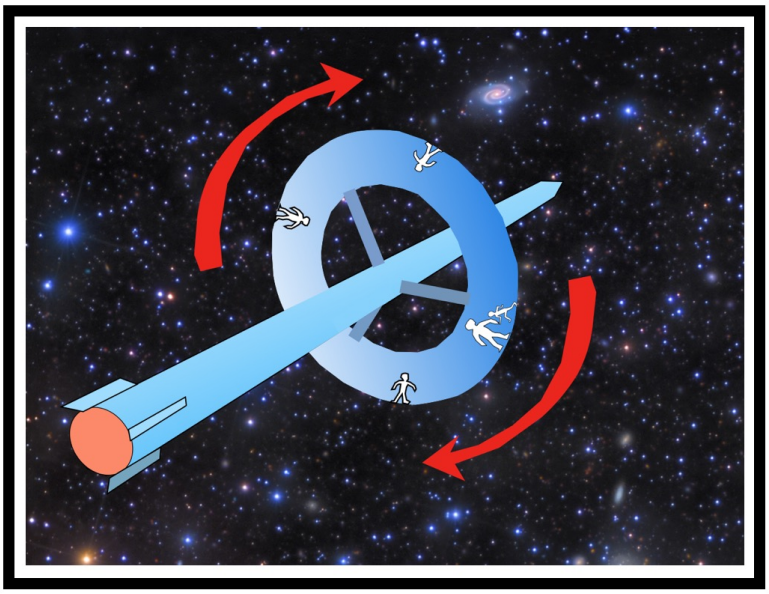

Figure 10: Spinning torus simulates gravity during a three year journey to a distant location.

So the surface of the water is parabolic (some experts say "paraboloid"). Newton's point is that the movement of the water up the sides of the bucket is not due to local inertial frames (such as the earth), but it indicates the presence of an absolute inertial frame.

If you are unsure whether to endorse Einstein or Newton on the bucket, consider the following thought experiment. You are watching a Sci-Fi video about people living on a space ship during a three year journey (Figure 10). The ship has a gigantic torus that rotates, so that humans living inside the torus have simulated gravity based on centrifugal force. They are asked to vote whether they want to live in Einstein's or Newton's universe. Since Einstein has so much prestige, 95 % of them vote for Einstein. Suddenly there is no more centrifugal force. Everyone is floating midair without gravity. Why? Because Einstein says all inertial frames obey the same laws of physics, including the inertial frame consisting of our torus. If our space ship were still rotating, it would not be obeying the same laws of physics as every other inertial frame. If we look out the window we see all the stars rotating twice a minute around our space ship (like the stars rotating around the earth, only faster). But our space ship is stationary, not rotating, solid as a rock. Did we vote the wrong way? Our simulated gravity is gone. If we pour a cup of coffee it won't stay in the cup.

It makes sense to say that a rotating torus produces centrifugal force. But that implies there is a reference frame S_0 that is not rotating. Apparently all frames of reference are not equal. A rotating and a non-rotating frame are different in terms of centrifugal force. That is why the water in Newton's bucket is climbing the walls. If the water were not climbing the walls, then Einstein would be correct that all observers, even those who live in a rotating frame, experience the same laws of physics. The Coriolis effect is another measurable phenomenon found in a rotating frame of reference, but absent in a non-rotating frame of reference.

11 The Big Picture

This article proposes the following:

1. Aether today is the same as what Newton assumed, if we make two adjustments:
   (a) At high velocity we need Lorentz transformation equations. This means we cannot measure the speed of the earth through aether.
   (b) The geometry of space is non-Euclidean, defined by the Einstein tensors of General Relativity, such as:

$$R(x, y; u, v) = \begin{bmatrix} s(x,u) & s(x,v) \\ s(y,u) & s(y,v) \end{bmatrix} \tag{32}$$

$$= \sum_{k=1}^{r} \begin{bmatrix} a_{ip}^{(k)} x_i u_p & a_{iq}^{(k)} x_i u_q \\ a_{jp}^{(k)} x_j u_p & a_{jq}^{(k)} x_j u_q \end{bmatrix} \tag{33}$$

2. Newton's aether is what Selleri calls S_0
3. There is no "space-time continuum." Time is independent of space (to be discussed in Section 14 (below)).
4. Selleri calls S_0 "Lorentz aether at rest" because it is the only inertial frame that doesn't move; it is the only inertial frame in which the speed of light is the same in all directions, and for all observers.
5. The S_0's location is probably anchored in the CMB

where "CMB" refers to the Cosmic Microwave Background radiation. Due to anisoptry in temperature of the CMB (slightly above or below 2.7^o K across the sky) we know we are moving at about 630 km/sec toward the constellation of Leo, relative to the stationary CMB.

12 Inelastic collisions support Einstein's relativity

Selleri points out that physicist's commitment to Einstein's TSR is based on empirical data. We will consider data obtained in high energy physics labs. In such labs they study the threshold energy needed to produce new particles from inelastic collisions. Energy can be converted into matter. They accelerate particle P_1 and collide it into particle P_2 at high energy. The particles have respective masses of m_1 and m_2 and the collective mass of all output particles is M.

They find that the threshold energy $\overline{T}$ for every reaction is predicted by this equation:

$$T > \Big(\frac{M^2 - (m_1 + m_2)^2}{2m_2}\Big)c^2 \tag{34}$$

where T is the kinetic energy of the process. You might recognize the format of equation 34, where $T = E = (m)c^2$. They conclude that these inelastic reactions can occur for every value of T that satisfies Equation 34. This result is based on the relativistic formula (# 34) of the energy and mass. Here is an example (also shown in the top row of Table One):

$$P_1 + P_2 \rightarrow P + P + \pi^0 \tag{35}$$

in which two colliding protons (P_1 and P_2) produce another two protons identical to the initial ones and a meson π^0 whose mass is created by the condensation of the kinetic energy of the incident proton P_1. Proton P_2 (the target proton) is stationary in inertial frame S. The mass m of the proton P_1 is $m = 938MeV/c^2$, and the mass of neutral pion is $\mu = 135MeV/c^2$.

$$m_1 = m_2 = m \qquad \text{and} \qquad M = 2m + \mu \tag{36}$$

They find that the inelastic collision $P_1 + P_2 \rightarrow P + P + \pi^0$ can occur if the kinetic energy T satisfies equation 37:

$$T \geq \overline{T} = \Big(2\mu + \frac{\mu^2}{2m}\Big)c^2 = 280MeV \tag{37}$$

This is exactly what experiments confirm. Under 280 MeV the reaction never occurs, and over 280 MeV it often occurs. So $\overline{T} = 280MeV$ is the threshold for that particular reaction.

The data in Table One are based on several hundred inelastic collisions observed in laboratories all over the world. The agreement of lab data with the predictions of equations is why physicists trust the laws of the conservation of energy and momentum.

Selleri says the physicists conclude that "Einstein's TSR is correct," without stopping to think that there are alternative theories of relativity that are also proved by these data. What you should bear in mind is that the actual experience of physicists in high energy labs conforms to the data in Table One, and, according to Selleri, the physicists are not open to thinking about another interpretation of those data. Such "interpretations" would be considered to be "metaphysics" and therefore of zero interest to physicists.

Selleri was a loner, an independent thinker. While other scientists seek to fit into the expert consensus, Selleri says (we repeat), "The history of science teaches that the majority opinion is usually wrong." In a culture where Big Money is at stake, and where physics experiments are expensive, the maverick is not going to get funded, whereas those who adhere to the expert consensus are more likely to. This influences which issues scientists are or are not motivated to think about.

Table 1: Inelastic Collision Thresholds for a Reaction to Occur

Reaction	**Threshold** $(\overline{T})$
$P + P \rightarrow P + P + \pi^0$	280 MeV
$P + P \rightarrow P + \Lambda + K^+$	1585 MeV
$P + P \rightarrow P + \Sigma^+ + K^0$	1790 MeV
$P + P \rightarrow P + \Xi^- + K^+ + K^+$	3743 MeV
$\pi^+ + P \rightarrow \Lambda + K^+ + \pi^+$	1013 MeV
$\pi^- + P \rightarrow \Sigma^- + K^+$	904 MeV
$K^- + P \rightarrow \Xi^- + K^+$	662 MeV
$K^- + P \rightarrow \Omega^- + K^+ + K^+ + \pi^-$	3086 MeV

12.1 Experiments that can discriminate between different theories of relativity

As we said before, our disagreement with the physics consensus about experimental data confirming Einstein's TSR, is that we say those data have defined an infinite set, which we called the "Reichenbach set," but have not provided data to allow us to discriminate among different members of that set.

Selleri cites many experiments that cannot be explained by TSR, but can be explained if there is Absolute Simultaneity (Reichenbach's $\epsilon = 0$). Selleri appears to be the only scientist interested in determining which members of the infinite Reichenbach set are consistent with Nature.

13 Selleri's ideas about Mass-Energy

Here are Selleri's equations for energy in the privileged frame S_0 compared to the equations for energy in another frame, such as ours. The subscript zero implies the privileged frame.

$$P_{0x} = \frac{P_x + (v/c^2)\tilde{\mathrm{E}}}{R} \tag{38}$$

$$P_{0y} = P_y \quad ; \quad P_{0z} = P_z \tag{39}$$

$$E_0 = \frac{\tilde{\mathrm{E}} + vP_x}{R} \tag{40}$$

where

$$R = \frac{1}{\gamma} = \sqrt{(1 - \frac{v^2}{c^2})}$$

Equations 38 to 40 are exactly the same as the Lorentz transformations for energy:

$$P'_x = \frac{P_x + (v/c^2)E}{R} \tag{41}$$

$$P'_y = P_y \quad ; \quad P'_z = P_z \tag{42}$$

$$E' = \frac{E + vP_x}{R} \tag{43}$$

It is as if WE were the occupants of the preferred inertial frame S_0.

That last fact reminds us of Selleri's definition of "weak relativity" as meaning: We cannot directly measure the speed of the earth through aether.

13.1 Mass - Energy is the most important thing in any relativity theory

Selleri said that any theory of relativity should be evaluated in terms of its ability to quantify matter-energy, since matter-energy is the "coin of the realm", i.e. it is the primary building block for construction of the universe. We should have some metric that everyone can agree about. TSR flunks that test. Because every observer is treated as equal to every other observer, therefore they cannot agree on how much matter-energy there is.

First example: Imagine you have a gold coin weighing 31 grams. That is 90 teraJoules of energy. But your cousin Nancy is in a rocket traveling at 99 % the speed of light. She says the same coin contains 500 times more energy than you think.

TSR says that all observers are equally correct. Therefore you and your cousin cannot agree how much matter-energy is in the same gold coin. This is not a trivial problem. If mass-energy is the basic stuff of the universe, then we need to be able to have a solid and trustworthy way to quantify it. We need a gold standard.

Second example: In his TSR paper of 1905 Einstein says that the amount of energy contained in a sphere moving through space changes, depending on the velocity of the sphere vis-á-vis the observer. He gives this formula:

$$\frac{E'}{E} = \sqrt{\frac{1 - v/c}{1 + v/c}}$$

Once again we are confronted with the variability of the amount of matter-energy, within the TSR viewpoint.

One advantage of having a preferred reference system S_0 is that we can calculate a stable measure of matter-energy. Selleri accomplished that in his 2003 book *Lezioni di Relativitá*, pages 178-184.

14 Say goodbye to the space-time continuum

Hermann Minkowski took the "x" that Lorentz erroneously put inside the Lorentz time equation (Eq. 5), and ran with it, creating a four dimensional manifold, which we refer to as the "space time continuum." Minkowski wrote that space by itself and time by itself were "doomed to fade away into mere shadows," and in the future we would only speak of space-time.[26]

In Minkowski's equations time was a dimension the same way that distance was a dimension.[23] Minkowski said that if "c" was a positive parameter,[27] then:

$$c^2t^2 - x^2 - y^2 - z^2 = 1 \tag{44}$$

There is a kind of Pythagorean Theorem for calculating distance:

$$\text{distance from A to B is } = \frac{1}{\gamma}\sqrt{(\sum_{i=1}^{3}(a_i - b_i)^2) - c^2(t_A - t_B)^2} \tag{45}$$

$$= R\sqrt{(\sum_{i=1}^{3}(a_i - b_i)^2) - c^2(t_A - t_B)^2} \tag{46}$$

Einstein was one of Minkowski's students, being 15 years younger than Minkowski. Einstein incorporated Minkowski's ideas in TSR, and praised Minkowski's manifold.

To reiterate, Selleri pointed out that there are NO DATA supporting the use of "x" in Lorentz's time dilation equation (Eq 5). He proposed a much simpler equation (# 16), one that is supported by the empirical data:

$$t^{'} = \frac{t}{\gamma} = Rt$$

With speeds approaching the speed of light there is length contraction and time dilation, but they are unrelated phenomena. The fourth dimension of Minkowski space vanishes! We do NOT live in a space time continuum. Therefore the spacial distance from

$$\text{A to B is } = \frac{1}{\gamma}\sqrt{\sum_{i=1}^{3}(a_i - b_i)^2} \quad = R\sqrt{\sum_{i=1}^{3}(a_i - b_i)^2} \tag{47}$$

and the time distance between A and B is:

$$= \frac{(t_A - t_B)}{\gamma} = (t_A - t_B)R \tag{48}$$

14.1 Four dimensional hyper-determinism

Minkowski's ideas about the 4 dimensional manifold (included in TSR) forces a hyper-determinisim.

Here is Selleri's description. "It leads to a very strange conception of the universe, in which a single reality fills uniformly past, present, and future. At my present other observers no less legitimate than I consider my personal future as given in all detail. According to them there is not the slightest freedom which I can use in order to influence the course of events. The impression I have of a reality evolving sometimes in a casual (nondeterministic) way would therefore be entirely subjective, a limitation (due to my poor means of observation) to a fixed time section of the complete four dimensional reality. Relativity therefore leads one to accept a hyper-deterministic universe in which the

whole future is completely pre-established in the minutest details and in which all sensations of individual freedom (even those limited to very simple events, like the choice between holding and dropping a stone) are pure illusions."[28]

That paragraph explains why you need Absolute Simultaneity, if you want to have any control over your own future. In his autobiography Karl Popper said that Einstein himself believed in such a hyper-determinism and that belief was inflicted on him by the four dimensional space-time manifold.

If you are going to build a prison cell to incarcerate Minkowski or Einstein, you can do it if you start with a four dimensional manifold. But your prison loses its roof if you adopt Absolute Simultaneity. You cannot build a cage or cell from three Cartesian dimensions and the time **right now!**

15 Conclusions

In 1905 Einstein discarded the idea of events being simultaneous. Each observer marched to a different drummer. For one observer event α preceded β whereas for another β preceded α, and both observers were equally correct.

In other words, the emphasis was placed on the observer, whereas in TEW the emphasis is placed on Nature. With TSR the main questions are "What do you see?" and "In what sequence did you see the events occur?" With TEW the main questions are "What is true?" and "What is reality, independent of the observer?"

Since 1980 a non-Einstein approach to simultaneity has been adopted everywhere on earth, excluding the brains of relativity experts. A system called the Temps Atomique International (IAT) has coordinated the time on all atomic clocks, so they all agree down to the nanosecond, although they display the time in 24 different time zones. Atomic clocks control all other clocks. This system has been extraordinarily successful.

Today trading stock on the NASDAQ stock exchange is one of many places where agreement about the sequence of events is essential. It is inconceivable that this system would work flawlessly for decades if Einstein had been correct about simultaneity. If one computer says the sequence of events is A, B, C, D, E whereas another computer says with equal confidence that the sequence of events is B, A, E, C, D, then the computer network would crash. In your experience you have seen networks crash, but never for that reason. If Einstein's TSR were correct, that type of network crash would be frequent.

Selleri built a mathematics around Absolute Simultaneity, as signified by his variables $\epsilon = e_1 = 0$. He proved that a relativity system based on simultaneity is coherent and self-consistent. It is the same as Lorentz aether at rest, except for the disagreement between Selleri and Lorentz about that "x" in the time dilation equation (Eq. 5).

Probably Lorentz aether at rest is the same as Newton's absolute space adapted to the non-Euclidean geometry of Einstein's Riemann tensors, and, at high speeds, to the Lorentz inertial transformation equations. The location and movement of the S_0 is probably anchored in the CMB, which is the archaeological fingerprint of the Big Bang. This means that we are moving at 630 km/s through the aether of S_0, heading toward the Lion nebula (Sh2-132). That is not fast: it is 0.2 % the speed of light.

We are calling it "aether," and we claim it is the medium in which Elementary Waves travel. It is the Elementary Waves that are our primary focus. They are the reason we are motivated to follow Selleri's lead in curiosity about aether.

15.1 Living in the present

When mathematicians and physicists think about time, they are careful to avoid thinking about their own experience. That is how "time" got to be defined as a continuous variable of one dimension "t", as it might appear in a kinetics equation. But perhaps we should be open to thinking about reality as we actually experience it. We all live in the present moment. We focus our attention by training ourselves to ignore the past and the future, and put all of our attention into "right now." "Now" is the only time that is available to us. If we take an exam or fight a battle, the decisive moment is "now," not the future and not the past. Anyone who forgets that will flunk or die.

Our theory of time should recognize these realities. We need therefore to define a variable "now" that is a zero dimensional time variable. This is not something that Einstein, Lorentz nor Selleri spoke of. Nevertheless, perhaps it is time for mathematicians to be open to reality as we humans actually experience it. We can define "now" as being that time which does not belong to the sets $t < 0$ and $t > 0$. It is a time which does not appear on any clock, but occurs perpetually in the experience of we humans. That time which is neither $t < 0$ nor $t > 0$ has no duration. It is different in quality than any other time. "Now" is the ONLY time known to infants and animals. Many wise teachers claim that the time sets sets $t < 0$ and $t > 0$ are irrelevant.

What is the mathematics of "now"? Just because that is a hard question does not mean that mathematicians should avoid thinking about it. Topology was an impossible problem. But we created a mathematics of topology. "Now" is no more difficult, we expect. Just as topology is a geometry that is more amorphous than Riemann's manifolds, so "TORA-ology" ("tora" is the Greek word for "now") would be more amorphous than the chronologies based on Cantor's set theory. If "now" is not a valid subject for mathematical investigation, how would you prove it?

15.2 Axiomatic change

This author's way of thinking about these issues is so far outside the realm of mainstream quantum mechanics and relativity, that most people find our thinking too absurd to bother discussing. "He is talking gibberish," they say. They wonder if we have been eating mushrooms. This author prefers to think that TEW is not insane. It is a change of Axioms, and therefore it is not possible for those habituated to the old Axioms to understand what we are talking about. To be a mathematician means that one is battle hardened to the earthquakes caused by Axiomatic change.

Consider an example. It took centuries for the lay public to reluctantly agreed to tolerate the concept of infinity (∞). Then Georg Cantor proved there are more irrational numbers than the infinity of rational numbers, and furthermore there are transfinite cardinal numbers, transfinite ordinal numbers, and an infinite number of rank ordered infinities. Lay people found Cantor's set theory absurd. "He is talking gibberish," they said.

Since Axiomatic earthquakes are routine in mathematics, and are a defining feature of new mathematics, therefore TEW should not be evaluated on whether it is "true" or "false." From the viewpoint of old Axioms, the new ones are usually "false." That is precisely why new Axioms are so exciting and valuable.

The parameter that should be used to evaluate TEW is whether it is an interesting or a boring rabbit hole to tumble down into.

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