Logical Analysis of Relativity Theory

Abstract for Invited Presentation for "Physics Beyond Relativity 2019"

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The Lorentz transformation (LT) was derived from time dilation (TD)

$$t' = t/\sqrt{1-(v/c)^2}$$

and length contraction (LC)

$$v' = \sqrt{1-(v/c)^2}x$$

and has the following form:

$$x' = (x - vt)/\sqrt{1-(v/c)^2}, \quad y' = y, \quad z' = z', \quad t' = (t - vx/c^2)/\sqrt{1-(v/c)^2}.$$

The proof goes as follows: By applying the effect of length contraction onto the Galilean transformation we get $x' = (x - vt)/\sqrt{1-(v/c)^2}$. Length contraction in the opposite direction is

$$x = (x' + vt')/\sqrt{1-(v/c)^2}.$$

Solving these two equations for t', we get

$$t' = (t - vx/c^2)/\sqrt{1-(v/c)^2}.$$

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A common argument for proving time dilation from the Lorentz transformation

$$t' = \left(t - vx/c^2\right) / \sqrt{1-(v/c)^2}$$

is as follows: Set $x = 0$. Then we have

$$t' = t/\sqrt{1-(v/c)^2}.$$

A more careful logical analysis shows that what this "proof" really showed was that transformed time depends upon the location of the clock! *It did not prove that Lorentz transformation (LT) implies time dilation (TD). Instead, it refuted this claim. To be precise, it showed that when observed at $x = 0$, time dilates with the gamma factor. TD says that, observed from anywhere on the $x-$axis, time dilates with the gamma factor.* This is an interesting instance of the same formula meaning entirely different things depending upon the context it was obtained in. This is possible because there is more going on in physics behind mathematical symbol pushing.

This is a very good example of how the same formula means entirely different things in physics. One cannot say mathematics is just a language. One has to be more careful when we use mathematics in physics.

This puts us in a delicate situation where we have to question the equivalence between Minkowski's special theory of relativity and Einstein's special theory of relativity. This further makes us wonder about the validity of the current belief that the general theory of relativity is a generalization of Einstein's special theory of relativity. The general theory of relativity includes not Einstein's special theory of relativity but Minkowski's special theory (tangentially).

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The Lorentz transformation plays yet other questionable roles. We can show that this transformation fails to respect Newton's law of gravitation, Coulomb's law, Newton's second law and wave equations. For example, despite the "claimed" advantage of conserving wave equations, the Lorentz transformation astoundingly fails to conserve, more fundamentally, the second law and the law of gravitation, as we can see in what follows:

$$F = m\frac{d^2x}{dt^2} \Longrightarrow F = m\frac{d^2}{dt^2}\frac{(x-vt)}{\sqrt{1-(v/c)^2}} \neq m\frac{d^2x}{dt^2}.$$

$$F = \frac{GmM}{(x_m - x_M)^2} \Longrightarrow F = \frac{GmM}{(\frac{(x_m-vt)}{\sqrt{1-(v/c)^2}} - \frac{(x_M-vt)}{\sqrt{1-(v/c)^2}})^2} = \frac{GmM}{(\frac{(x_m-x_M)}{\sqrt{1-(v/c)^2}})^2} \neq \frac{GmM}{(x_m - x_M)^2}.$$

Considering the way how the Lorentz transformation was obtained, it is not surprising that these two major laws of mechanics are not Lorentz-invariant. This means that *the Lorentz transformation is not a relativistic transformation as it violates the principle of relativity.*

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We can further show that the claimed invariance of wave equations under Lorentz transformation is false. To make the argument more articulate, let us discuss the issue under a general situation.

$$\begin{aligned}
\frac{\partial\psi(x',t')}{\partial x} &= \frac{\partial\psi(x',t')}{\partial x'}\frac{\partial x'}{\partial x} + \frac{\partial\psi(x',t')}{\partial x'}\frac{\partial t'}{\partial x} \\
&= \frac{\partial\psi(x',t')}{\partial x'}\frac{\partial\gamma(x-vt)}{\partial x} + \frac{\partial\psi(x',t')}{\partial x'}\frac{\partial\gamma(t-\frac{vx}{c^2})}{\partial x} \\
&= \gamma\frac{\partial\psi(x',t')}{\partial x'} - \frac{\gamma v}{c^2}\frac{\partial\psi(x',t')}{\partial t'}
\end{aligned}$$

Similarly

$$\frac{\partial\psi(x',t')}{\partial t} = -\gamma\frac{\partial\psi(x',t')}{\partial x'} - \gamma\frac{\partial\psi(x',t')}{\partial t'}$$

$$\begin{aligned}
\frac{\partial\psi^2(x',t')}{\partial x^2} &= \left(\gamma\frac{\partial}{\partial x'} - \frac{\gamma v}{c^2}\frac{\partial}{\partial t'}\right)\left(\gamma\frac{\partial}{\partial x'} - \frac{\gamma v}{c^2}\frac{\partial}{\partial t'}\right) \\
&= \gamma^2\frac{\partial^2}{\partial x'^2} - 2\frac{\gamma^2 v}{c^2}\frac{\partial^2}{\partial x'\partial t'} + \frac{\gamma^2 v^2}{c^2}\frac{\partial^2}{\partial t'^2}
\end{aligned}$$

Similarly

$$\frac{\partial\psi^2(x',t')}{\partial t^2} = \gamma^2 v^2\frac{\partial^2}{\partial x'^2} - 2\gamma^2 v\frac{\partial^2}{\partial x'\partial t'} + \gamma^2\frac{\partial^2}{\partial t'^2}$$

This is valid only under the condition $v = c = \omega$. The second equality comes from that ω is the wave speed. The first equation implies that the frame speed is c which is not possible in the special theory of relativity. This means that Einstein's claim that the electromagnetic wave equation is invariant under the Lorentz transformation is invalid. It is a well "understood" fact that there is no reference frame for light at the pain of contradiction. If $v = \omega$ then the gamma factor becomes undefined and there is no Lorentz transformation for such frame.

All of this was well expected logically. Lorentz transformation is defined in terms of the constant c, which is the speed of electromagnetic waves in vacuum. So, there is no convincing reason why this transformation will conserve wave equations which are not electromagnetic wave equations of Maxwell. It is astounding that, for more than a century, theoretical physicists did not notice this serious error.

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In our discussion, we will present a careful mathematical and logical analysis of relativity theory and quantum mechanics, which are the most basic foundation of contemporary theoretical physics. Contrary to the common belief, the latter is very closely tied up with relativity theory through the de Broglie relation, which is a relativistic theory. This means that Schrödinger's wave mechanics is a relativistic theory as well.

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Our journey to re-evaluate the entire development of modern theoretical physics, which started nearly 140 years ago, finally reaches the origin of the relativity theory, i.e., the Michelson-Morley experiment. There are two criticisms of the way this historic experiment was treated in theoretical physics community.

This experiment was interpreted under the assumption that light is an electromagnetic wave, as it was proposed by Hertz. Even to this day, it is not quite clear what light is. Physicists were told to accept the view of Hertz without any substantial proof thereof.

It is a shocking fact that electromagnetic waves are not physical reality as the concept of electromagnetic fields is not a physical reality. This concept is what logicians and philosophers call "modality", "counterfactual modality" to be precise. The spatial distribution of electromagnetic force per a unit charge is not a reality. Such distribution appears in reality only when we place unit charge everywhere in the space. More annoyingly, if we place a unit charge at every point in the electromagnetic field, the source which created such a "field" will be affected and the electromagnetic "field" will not be maintained. To be precise, the so-called electromagnetic wave is an action-at-a-distance transmission of the change in electromagnetism at the source to a charge placed at a certain location in the space. There is no wave. This is precisely why without a wave medium the so-called "electromagnetic waves" travel with speed c. So, there is no need for the fancy concept of "aether". There is no physical realism that supports the counterfactual modality.

Going back to the Michelson-Morley experiment: they considered light an as electromagnetic wave and, using the interference of light waves, they concluded that $c + v = c$, where v is the speed of the emitter of light.

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Quantum mechanics, which was built upon the special theory of relativity, quantized light as an electromagnetic wave and presented what we now call "photon" as the particle dual of the light wave. To prevent the famous relativistic formula

$$e = mc^2 = \frac{m_0}{\sqrt{1 - v^2/c^2}} c^2$$

from diverging for the photon with $v = c$, Einstein assumed that for the photon the rest mass $m_0 = 0$. This lead to $e = 0/0$, which, Einstein thought, could be any number as the linear equation $0x = 0$ can have any number as its solution.

This is however wrong because $0x = 0$ does not involve division by 0 while $e = 0/0$ involves division by 0, which is impossible. This, rather expectedly, leads to the following contradiction:

$$E = \sqrt{(cp)^2 + (m_0)^2c^4} = cp = m_0vc/\sqrt{1 - vc^2} = (0/0)cv = c^2h\nu = h\nu.$$

Without knowledge of this problem, photons are now introduced as a legitimate particle dual to light wave with rest mass 0 and speed c. What is truly awkward is that a particle that never rests now has a rest mass 0. This is what philosophers and logicians call a category error.

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After all, as photon is now the particle dual to light wave, we are blessed to have yet another interpretation of the Michelson-Morley experiment. "*Assume photons are particles.*" Then it must be the case that when we emit a photon to the vacuum from an emitter that moves with speed v, the speed of the photon must be $c+v$ in the vacuum. So, the emitted photon moves towards the reflecting mirror with speed $v + c$. But as the mirror itself moves with the speed v in the same direction, the effect of v cancels out. When the photon is reflected at the mirror, it comes out with speed $c - v$. But as the receiver of this photon is moving towards the photon with speed v, this v cancels out again. This means that this experiment will not detect the v. In conclusion, $c + v = c + v$ but the experiment, set as it is, cannot detect this v.

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Recently, Wheeler carried out an experiment that used an apparatus very similar to the Michelson-Morley apparatus but used a half-silvered mirror instead. The experiment exhibited an unexpected behaviour of this apparatus that the current quantum mechanics cannot explain. The problem with the so-called "splitter" (half-silvered mirror) is that it had an "explanation" only for a pure wave theory of light, but it has no explanation for light quanta. Better said: if photons are deviated with the probability of 50 %, we have no interference. But on the other side, if they are really split in two directions, this contradicts the Planck-Einstein hypothesis, as well, as the two pieces of a photon are entangled and are evidently waiting for their halves to build a photon together. That is to say, the interference indicates no more some delay, as planned by Michelson-Morley, of a half-ray relative to the other. This makes us wonder if Michelson-Morley's interpretation was correct.

According to the model used by Michelson and Morley, in the second splitter (or by twice passing the same splitter) one should have had again a 50 - 50 distribution, and not a 100 - 0 distribution, as observed by Wheeler. Without intending it, Wheeler shows with his experiment that the Michelson-Morley apparatus contains aspects nobody has thought about. So one cannot claim to have experimental proof of constancy of the speed of light using something that nobody on Earth understands.

This problem shows exactly the same pattern as the Michelson-Morley experiment, which was conducted under the assumption that light was a wave. The irony is that using the Michelson-Morley experiment through the special theory of relativity they introduced the "wave-particle duality" and then the "particle theory of light" offered an entirely different picture. In this way, in the end, the empiricism proved that the wave-particle duality hypothesis is invalid at the pain of contradiction.

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The ultimate product of this highly questionable wave-particle duality manifested itself most dramatically in the quantum field theory of Dirac. Quantum field theory seems to be the ultimate end-product of Einstein's special theory of relativity, which is inconsistent. Here is a summary of the complications we have in all of these issues.

1. *The reflection of light on the mirror is a complex problem of statistical particle physics and only material science can bring us closer to the truth. The problem we have here is that we have not such a material science. Also, a material science that would dig into this kind of problems must come from a satisfactory quantum mechanics, which we have not, because our quantum mechanics is based upon the special theory of relativity, which came from the Michelson-Morley experiment. To make the matters even worse, now the result that Wheeler obtained seems to support the concern that the Michelson-Morley experiment could have been interpreted wrongly.*

2. *Even if the Michelson-Morley experiment is limited to electromagnetic waves, these waves are not physical reality. They are counterfactual modality. Moreover, when we operate under the assumption of the wave-particle duality, the uncertainty principle creeps in and this makes the constancy of the speed of light claim "statistical". When a most fundamental assumption of our theory is of statistical nature, we do have some serious concerns. It is true that the original constancy of the speed of light argument was not statistical. It was based upon abstract (not physical) wave theory. But the recent argument by Wheeler, again, is statistical.*

Early quantum mechanics in principle avoided getting into this kind of nasty but real problems when the problem of a particle enclosed by walls, etc., was considered. Walls are represented not as a complex material, but as potential barriers, which is just a mathematics. Here, they are trying to study the reflection of light at the mirror. Quantum mechanics cannot really handle the reflection of light on a mirror as we do not know sufficiently enough what mirrors are to discuss these issues. To understand it requires perfect quantum mechanics, which we have not.

We use macro materials, which are microscopically incredibly complex, to conduct our experiments. When we do macro-level physics, no problem. But when we deal with micro-level physics, we have no solution. Our experimental instruments belong to the macro-level physics. Cosmology shares the same problem. We can never carry out experiments or measurements at this incredibly large scale level. It is not promising to do physics of the cosmos by looking at stars billions of light years away from us. The only tool we have here is the relativistic Doppler effect and we do not even know what light is.

What is striking is that regardless of the status of quantum mechanics, Wheeler's experiment shows that when passing the second splitter, the light "knows" from which part it came out in the first splitter. In the second splitter we get the Hadamard-Walsh gate, which is an "operator" in quantum computing. This is good for engineering. But it is unfortunate that our theory will not make us understand all of this.

Philosophically, what we are facing is a crisis where the most basic laws of physics are no longer macroscopic laws. In order to make them macroscopic we went through a statistical argument, which makes us wonder what laws of physics are.

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It appears to be that Minkowski's 4D space-time relativity theory was a serious effort to make these consistency problems disappear mathematically.

For Einstein, the Lorentz transformations are transformations from one inertial 3D frame, which is moving with relative speed v, and an associated transformation of time. This immediately lead to the flooding of contradictions which we discussed in the foregoing. Most of such paradoxes originate from the "power line-power pole paradox" that is deeply embedded in the theory of Galilean inertial reference frames. As a logical triviality, consistency problems will not disappear by adding one extra axiom of constancy of the speed of light.

The reason behind Minkowski's "apparent" success is that his theory "appeared" to have little to do with the troubled part of Einstein's special theory of relativity, which is based upon mutually moving 3D reference frames. From this troubled assumption Einstein proved time dilation (TD) and length contraction (LC), which naturally lead to a mountain of paradoxes. Lorentz and Einstein in their own setting deduced Lorentz transformation (LT) from TD and LC. Unfortunately, motion takes place inside a geometric space and so we cannot move reference frames, which is essential for defining such motion. This issue was already philosophically addressed by Aristotle. He pointed out that a point in a geometric space is "not" a part of the space. Modern topologists explicated this warning of Aristotle using topology. They proclaimed that there is no "point" in a geometric space. They said rightly that a point in a geometric space can be "accessed" only thorough limit. *If we cannot reach it in finite means, how can we ""move" it?* This kind of conceptual issues are quite well attended in pure mathematics as mathematicians experienced the horror of contradictions at deep levels. Also lack of empiricism made mathematicians focus on these conceptual problems. Minkowski played a controversial mathematical game that eluded most mathematicians including himself.

Here is "one possible interpretation" of his work as a mathematical physicist. He used only one 4D space-time as a reference frame (plus time) and from his single reference frame, he derived two reference frames, say F1 and F2. First, he placed F1 as the "mother frame" and defined a LT from F1 to itself where v in the gamma factor is the mutual speed between F1 and F2. In this way he thought he represented the entire relativistic system of F1 and F2 with just F and the LT from F to itself. Unfortunately, his formalism by itself did not explicitly support this interpretation. This is one possible but rather obscure interpretation of his formalism.

Minkowskian relativity theory with the Minkowski distance dominated the entire theoretical physics for nearly a century as the "deepest" theoretical foundation of physics, which "apparently" evaded the contradiction associated with Einstein's STR. When under the "help" from Hilbert, Einstein accepted Minkowskian space-time as a local tangential space-time at each location in the Riemannian space-time theory of the general theory of relativity (GTR), the "consistency" of STR and GTR was "established" and relativity theory became the "ultimate truth" in theoretical physics.

What is interesting here however is that this Minkowskian 4D space-time approach can be adopted to formulate the issue of Fitzgerald contraction (LC) by considering the unique 4D space-time as the universe and the LT as a representation of a specific observer frame and v representing the speed of the observer frame inside the universal frame. So, Minkowski's theory integrates the issue of relativity in the setting of electromagnetic field theory. However, all we could do for this new formulation of Einsteinian STR was to hope that the equivalence of LT and (TD,LC) will hold. *It is unfortunate that this hope was denied as we have shown in the foregoing.*

After all, all of this is an empty discussion as (TD, LC) pair deduced "physical paradoxes". Deducing (TD, LC) from LT simply removes an apparent capacity of Minkowski theory to be a consistent alternative to Einstein's relativity theory. Moreover, if LT did not deduce (TD, LC) and saved itself from inconsistency, we ended up with the question of the relevance of such a theory in theoretical physics. Under the standard interpretation of inertial reference frames, as we have discussed, LC implies TD.

As Einstein's original STR is plagued by inconsistency, the uncertainty of the status of LT in Minkowski's theory seems to be the only "hope" left. The apparent discrepancy between LT and (TD, LC) is still giving us some hope.

The problem here is that we do not know what LT means physically if v is not the relative speed of two reference frames and Minkowski did not define LT using two reference frames. Nevertheless, there is an understandable reason why he did not use two 4D space-time frames. If we use two then there is not much point in using a 4D space-time. Einstein's theory is easier to handle. In Einstein's theory, 3D space and time are independent and separate. So, technically it is easy to consider a 3D space move inside the other and vice versa. The only problem with this is that this leads to the geometric paradox which killed Einstein's STR. But there is yet another question here. It is mathematically impossible to discuss the motion of 3D space inside the 4D space-time. All we can do is to express motions in the 3D space as geodesics inside the 4D space-time. But is this not all we need?

It is not quite clear how theoretical physicists reason. We are sure that this issue gets rather delicate and complex as physicists ought to take the other aspect of physics, namely empiricism, seriously. These issues are absolutely essential to build satisfactory theories. We hope that we have shown that there is more to mathematics and philosophy than just a language for physics. An opposite direction warning should also be issued to mathematics community and philosophy community. Main stream mathematicians played a different kind of elitism ignoring physics limiting our own activity to increasingly narrower domain. In the end there seems to be no more substantial challenge left for mathematics. Mathematics is reduced to occasional "success" in solving rather irrelevant "open problems".

We have a mountain of extremely challenging deep non-technical problems on the border of physics, mathematics and philosophy. Literally, nothing has been done.

One of the most important contribution of Minskowski was the "metric" on his 4D space-time. This came from the mathematical argument that his "metric" $d\tau$ such that

$$(d\tau)^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

is invariant under the LT. It was understandable that Minkowski had to look for such a "metric" because LT changes the metric on [time] and that on [length] relative to the [speed] v. Luckily, he found one. It is not a space metric nor time metric as LT operates upon 4D space-time. But there are some issues:

1. This metric does not form a topological metric space over the 4D space-time and this is totally expected as Minkowski adopted the irregularity inherent in relativity theory that [speed] = [length]/[time] redefines [time] and [length], which leads to contradiction. That LT conserves this metric is yet another indication of the highly questionable status of LT.

2. This metric could be negative, which makes no sense at all. There is no such thing as distance that is negative. Regardless of the direction of an arrow, the length of the arrow is always positive. However, of course an inconsistent theory can produce any result. This is why such a theory is useless.

3. Minkowski's metric is appreciated as it defined a light cone interpretation. Light cone is formed inside absolute space-time. thus, after the introduction of the light core, relativists stop using relativity theory and just stick to the absolute frame. A very distorted absolute frame.

It is an open question what this metric means mathematically and philosophically. It means that "maybe" Minkowski relativity theory is consistent but with the cost that it has no relevance to anything at all, including physics. After all LT came from TD + LC, which are inconsistent. There are more questions than answers.

By the way, there is an interesting thing to ask. The famous equation of Minkowski

$$(d\tau)^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

is invariant under the Lorentz transformation. Is it so under the TD and LC as well? The answer is NO. A proof goes as follows:

$$dt' = \sqrt{1 - v^2/c^2}dt \quad dx' = \frac{1}{\sqrt{1 - v^2/c^2}}dx \quad dy' = dy \quad dz' = dz$$

Therefore

$$\begin{aligned} & (dt')^2 - (1/c)((dx')^2 + (dy')^2 + (dz')) \\ = \; & (1 - v^2/c^2)(dt)^2 - (1/c)(\frac{1}{1 - v^2/c^2}(dx)^2 + (dy)^2 + (dz)^2)) \\ \neq \; & (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2). \end{aligned}$$

This reconfirms that Einstein's STR and Minkowski's STR are different theories. There is no such thing as the Minkowski distance in Einstein's STR. There is no light cone either. This is a good news in a sense as the inconsistency of Einstein's STR will not kill Minkowski's STR. However, as we said many times, nobody knows what Minkowski's STR is and what it is for. There is no "ontology" associated with it. Furthermore, we now have to cleanly detach Minkowski's STR from Einstein's STR. It is a lot of work especially because most of popular results in STR came from Einstein's version. This is totally expected as we have no idea what Minkowski was talking about. It is quite certain that he did not know it either. Physicists should learn a lesson from this. Minkowski was an algebraist and physical reality requires a little more than algebra.

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11.1 Principle of equivalence

Out of frustration, Einstein crossed a line violating the most basic principle of relativism, namely the principle of relativity which asserts that relativisation must be restricted to only inertial frames.

Einstein thought that if an accelerating reference frame can be reduced to an inertial frame in which acceleration induces "gravitational field", it is possible to treat accelerating frames as inertial frames inside the theory of relativity, which rejects reference frames under acceleration for a legitimate reason. He called this the **principle of equivalence.** Towards this he proceed as follows:

Assume a spaceship is in inertial motion in our reference frame. Moreover, a force accelerates this spaceship with a rate $\boldsymbol{\alpha}$. A body m in the spaceship experiences a force $\mathbf{f}$ due to the acceleration of the spaceship, which makes the body m move with an acceleration of rate $\mathbf{a}$ in the frame of the spaceship. Putting aside what the force $\mathbf{f}$ is, this means $\mathbf{f} = m\mathbf{a}$. Then from our perspective, m in the spaceship experiences the acceleration with a rate $\boldsymbol{\alpha} + \mathbf{a}$. So, m will experience $\mathbf{f} = m(\boldsymbol{\alpha} + \mathbf{a})$. Therefore,

$$\mathbf{f} - m\boldsymbol{\alpha} = m\mathbf{a} \qquad \text{(IF)}$$

This means that "from our perspective" the acceleration $\boldsymbol{\alpha}$ on the spaceship induces an "additional" force $-m\boldsymbol{\alpha}$ on m, which he called "inertial force" upon the mass m. The equation (IF) yields the force m experiences in the accelerating spaceship. This Einstein called the second law in the accelerating frame of the spaceship. According to Einstein, upon the modification of $\mathbf{f}$ to $\mathbf{f} - m\boldsymbol{\alpha}$, the second law is conserved under the choice of accelerating reference frames.

There are several issues to be considered here.

1. Putting aside the invalidity of the special theory of relativity as we discussed in the foregoing, some issues were overlooked here. According to the special theory of relativity, even addition of speeds is not classical addition. One has to use the so-called relativistic addition of speeds $v \oplus v'$. So, how can the addition of acceleration be the same as classical addition, hoping that for Einstein acceleration still is the time derivative of speed. This confusion is closely bound up with the issue of the disjointedness between acceleration and relativistic reference frames. For that reason the special theory of relativity does not consider acceleration, as we have been told.

2. As an important example, this inertial force is also closely bound up with the issue of "fictitious force" on a mass inside an orbiting object. Fictitious force means it is not reality. The reason why we have a problem with the fictitious force for an orbiting spaceship is because an orbiting spaceship is under centripetal acceleration. It is not an inertial frame. It is wrong to say that just because inside the orbiting spaceship the fictitious force, called centrifugal force, is "created(?)", therefore the orbiting spaceship becomes an inertial reference frame, is it not?

3. This fictitious force is the creation of the relativistic interpretation of the second law of Newton. This law can be interpreted in two ways. First, when a force $\mathbf{f}$ is applied to a mass m , it accelerates the mass with the rate $\mathbf{a} = \mathbf{f}/m$. Second, when m is accelerating with a rate $\mathbf{a}$, a "fictitious force" $\mathbf{f}$ appears. Ontologically, the second interpretation is invalid. It is always the case that a force applied to a mass causes the acceleration of the mass. It becomes clear when we consider the case of an accelerating train. Assume that a stationary train accelerates. Then a passenger in the train will feel that he is pushed back (against the direction of the train's

acceleration). This is simply because he tries to stay where he is in the train due to the first law of Newton. If he could see the outside, which is not moving, he would see that it is not him but the train that is moving under the force.

4. Now it is clear that the problem of inertial force (fictitious force) is caused by the relativistic interpretation of the second law of Newton, which is a wrong thing to do. This is to say that the second law is not "relativistic", further confirming that the "ideology" of relativism as per Galilei and Einstein is untenable. It now is not only the third law but also the second law that is violated by the relativism.

5. It also is important to notice that the fictitious force violates the third law of Newton.

11.2 Violating the point mass assumption

An even more fundamental issue here involves the consideration of a spaceship (or a train). In the theory of dynamics, as Newton made it clear, theoretically there is no such thing as a spaceship. All physical bodies must be point masses, as Newton rightly said. For this reason, there is no such thing as a mass m inside a spaceship. In dynamics, there is no such thing as a spaceship to begin with, for very good mathematical reasons, as Newton incisively explained. A spaceship is an issue of engineering, pure pragmatism!

Remark 1 *Here it is important to notice that there are two kinds of the violation of the point mass assumption in post-Newtonian physics. First, a mass as a solid with a volume. This situation can be dealt with ease by reducing the mass to a point mass, as we are used to. Second, a mass with inside space such as a spaceship or a train. This case is a lot more complicated as it may allow other masses in the inside space. When we collapse the outer mass, what happens to the inside mass?*

Moreover, a body attached firmly to the wall of a spaceship will "not" experience any special force upon it. This is because when we consider the dynamics of the spaceship it is just a point mass and there is no "inside" of it to which this extra mass could be attached. Even if we very reluctantly allow spaceships, according to the law of inertia without force exerted, a mass will continue its constant speed motion in a frame. So, what force is supposed to be exerted upon this body "inside" the spaceship? Does this firmly attached mass move inside the spaceship?

The usual response is that we experience such force even if we are firmly attached to the inside wall. This again is a typical failure to be articulate in the situational analysis. Our body is not just a solid. Our body is beyond the category of physical objects. Our body has incredibly complex internal system for feel. This is why we feel such pressure.

The most fundamental reason why Newton correctly reduced all moving masses to point masses is simple. It is for purely mathematical and conceptual reason. Newton correctly observed that the best we can do is to consider a physical body as a point object with the size of a geometric point. Without this assumption, how can we define motion mathematically? With this assumption Newton found a solid mathematical representation of motion in a space as a function from time to space. With this he got the legitimate concept of speed as the first order derivative of the motion function, and the legitimate concept of acceleration as the first order derivative of the speed function. Without all of this basics, we have no theory of motion upon which we build dynamics.

Moreover, for dynamics, we have yet another important reason to reduce a mass to a point mass; it is because force is a vector, a pointed entity. So, the only entity to which we can exert a force is a point object (mass).

11.3 Acceleration-induced gravitational field

There are some more issues to be discussed regarding the "gravitational field" Einstein introduced to a space that is under acceleration. As discussed in the foregoing, a force field exerts a force to a body placed in a location in the field. But the body does not exert any force to the field. In this sense force field violates the law of action-reaction. Therefore it violates the principle of relativity. Moreover, the gravitational field that Einstein introduced to an accelerating space is a force field which has no source for the gravitational forces spreading all over the space. This is yet another violation of the third law in a different sense. The "uniform gravitational field" near the surface of our planet is a gravitational field in "approximation".

More seriously, the "force field", whatever it may be, which Einstein introduced to the frame under acceleration is not gravitational at all. Gravitational fields are to be the modal representation of the effect of gravitational force created by Newton's law of gravitation. So, it is not a uniform field. The "well expected" response that near the surface of the earth the gravitational field is "almost" uniform is not acceptable in precise science such as theoretical physics, which attempts to reveal the truth about the universe. Almost uniform is not uniform. Universe is not approximate!

It appears that this idea of associating "acceleration" with "gravitational force" (beyond the connection as per acceleration-force as in Newton's second law) seems to come from the old idea of "aether" by Descartes. Descartes wrongly considered a spaceship under acceleration containing an object and identified the fictitious (inertial) force with gravitational force. As the name "fictitious force" clearly indicates, such a force is just an imaginary force. It is not that the acceleration exerts such a force but as the object in the accelerating frame is not a part of the frame (spaceship) it appears that everything in the spaceship moves with acceleration relative to the object. It is not a real force. It is a fictitious force.

11.4 Red shift and the issue of energy

Einstein assumed a laboratory that is free falling under the gravitational force. Assume we emit a light beam upward from the floor of the laboratory to the ceiling. Due to the acceleration, by the time the light reaches the ceiling, the ceiling is moving faster than the source on the floor was when the light beam left it. In other words, the receiver at the ceiling is approaching the source (where it was when the light left). Therefore, we should expect a blue shift due to the Doppler effect. *Therefore, the observer in the lab notices the blue shift.* This will make this observer notice the downward acceleration. This however contradicts the equivalence principle which says that a free falling body will not notice it is free falling. So, Einstein postulated that there must be a red shift due to the light moving upwards against the gravitational force to compensate for this blue shift. Unfortunately, it is not the observer in the lab who sees that the ceiling is moving towards the floor. It is an observer outside of the falling lab who will see that the ceiling is falling towards where the floor used to be. So, the observer inside the lab will not observe the blue shift. This is how Einstein obtained the red shift effect.

The situation is rather complex and we have to consider many elements involved in this apparently simple thought experiment. This is an instance of the confusion coming from the ambiguity that a rest point in a frame F1 is also a moving point in a reference frame F2 that is moving relative to F1. The problem that haunted the special theory of relativity in the form of the "power pole-power line paradox" in the context of time dilation and length contraction came back to haunt the general theory of relativity, this time in the context of accelerating frames. As inertial frames and accelerating frames are both moving frames, the same problem hits both of them. So the equivalence principle, which is to reduce an accelerating frame to an "inertial frame" with induced gravitational frame, has no capability to avoid this fatal contradiction.

Moreover, the connection between relativistic dynamics and the general theory of relativity is not clear at all. Are they equivalent? Both of them are supposed to be the relativity theory of dynamics dealing with more than relativistic kinematics, which is known as the special theory of relativity. We know that the former is inconsistent because it violates the restriction to only non-accelerating frames that badly needed to avoid the contradiction against the third law of dynamics. And the third law is an absolutely essential assumption for any dynamics.

Putting aside this problem associated with the inconsistency of the relativistic dynamics, we have some more lessons to learn from using inconsistent theories such as the special theory of relativity, relativistic dynamics and the general theory of relativity. Neither the special theory of relativity nor relativistic dynamics can handle energy (we have left out the question of energy in the context of the general theory of relativity). So, what about the general theory of relativity based upon the equivalence principle? Unfortunately the answer is negative. As we have discussed at the beginning of this section, the special theory of relativity claims that the addition of speeds should not be $v + v'$ but

$v \oplus v'$. This contradicts the second law of dynamics.

All of this clearly suggests that Newton's dynamics is a theory of dynamics in the absolute frame only. Relativity is introduced not in the way Galilei and Einstein did in their relativity theory. Relative motions are defined as the difference of two absolute motions. All attempts to relativize Newton's dynamics failed rather acceptedly.

11.5 Centre of masses in the general theory of relativity

As discussed above, when we represent a constant speed motion in 3D Euclidean space as its graph, it becomes a straight line in the 4D space-time. If the motion is accelerating, then the graph becomes a curved line in the 4D space-time. Einstein represented gravitational force field, which will cause accelerating motions, as the 4D space-time manifold so that all motions caused by the gravitational field will appear as straight lines (geodesics) in the manifold. By applying this idea to gravitational fields created by a system of masses, Einstein obtained the so-called gravitational field theory. In this theory the spatial distribution of masses determines the 4D space-time manifold representing all possible "motions".

According to the classical dynamics, when we have a system of masses in a space, the mutual gravitational pull make them converge to a single point called the *centre of gravity. It is curious to know how this process of convergence is dealt with in the gravitational field theory of Einstein.* This question is asking about the capacity of this theory to express dynamic processes.

11.6 Light bend

Einstein studied the rest mass 0 photon under constant acceleration. He considered a photon moving with speed c in the x-direction while it is in a frame that is under acceleration a in the y-direction. So, we have

$$x' = ct \qquad y' = -(at^2)/2......(1)$$

If θ is the angle made by a tangent of the light ray to the x-axis, we have

$$\tan(\theta) = -ax'/c^2,$$

and we can assume that θ is very small. So we have

$$\theta \doteqdot -ax'/c^2.....(2)$$

But the general theory of relativity predicts otherwise, i.e.

$$\theta = -(3a/2c^2)x'^2......(3)$$

Eddington "proved" experimentally that GTR's prediction (3) is correct.

It is clear that *all of this uses nothing but the kinematic concept of acceleration and in kinematics there is no concept of mass.* Putting aside the issue of inconsistency coming from the assumption of the mass 0 point mass as discussed in 3.4.3 *Einstein's ambitious leap*, the concept of photon belongs to dynamics. Photon is a point mass of mass 0. Having no mass and having mass 0 are entirely different categories. *The problem with considering a point object whose mass is* 0 *is that the second law fails for the mass* 0 *point object. So, it makes no sense to say that the light (trajectory of photon) bends due to the gravitational force of the Sun.* So, Einstein's argument here "diverted" this difficulty by replacing the "gravitational force upon mass 0 photon" with the "reference frame of photon accelerated by the Sun's gravitation". It is truly astounding that this even worse confusion was never detected till now. *The reference frame of this photon cannot be accelerated unless there is some mass stationary in it!* The second law was never meant to be applied to mass zero objects.

So, the only "apparently" appropriate thing to say here is that the light bend due to the acceleration of the reference frame caused by the gravitation force is also false. In the end, we do not know what is really happening here. If the curved 4D space-time GTR predicts the equation (3), clearly something went wrong in the development of 4D space-time GTR. Unfortunately, Einstein's rest mass 0 particle which moves with speed c was brought in to physics with serious consequences.

11.7 "Induced gravitational field" revisited

As discussed in the foregoing, the concept of any force field in general violates the action-reaction law, and in turn violates the principle of relativity. Moreover, the gravitational field Einstein introduced to an accelerating space is a force field that has no "external source" creating the "gravitational forces per unit mass" spreading all over the space. This is yet another violation of the third law in a different sense. The "uniform gravitational field" g near the surface of our planet is a gravitational field in "approximation". It is "not" a gravitational field. So, it is wrong to call Einstein's "induced" force field a gravitational force field.

To simplify this already confusing situation, let us put it in this way. In classical "post-Newtonian" dynamics, they considered a field of gravitational force applied to each location on a unit mass placed there. This concept itself fundamentally violates the law of action-reaction and must therefore be abandoned. The situation here with Einstein's gravitational field created by the empty reference frame under acceleration makes things even more appalling. The former ignored the source mass which created the force field. Here such source mass to be "ignored" does not exist at all.

We must stop identifying entirely different things in approximation as they do in quantum field theory. In engineering, this is fine as engineers are not interested in categorizing things. They just want to obtain an engineering product that performs a certain task to a certain degree of accuracy. When the approximate becomes the "truth", we have a problem which the tradition of theoretical physics chose to ignore. Truth and functionality are different categories. Physics may deal with material issues to be called material science. But the way we deal with material issues is "metaphysics" rather. Without a solid build-up in metaphysics, we will never build an appropriate theory of matter. In essence, theory is never material but it is metaphysics. As Popper and Russell warned, there is a lot more going on at deeper levels of physics than just empiricism. More over, the force field which Einstein introduced to the frame of the spaceship is not gravitational at all. Gravitational fields are to be the field representation of the effect of the gravitational force created by Newton's law of gravitation. So, it is not a uniform field.

It was Minkowski's 4D space-time theory of relativity which taught Einstein that the motion line (geodesic) in the 4D space-time bends in the presence of acceleration. Combining this with the second law of dynamics, which connects acceleration and force through mass, and the law of gravitation, Einstein concluded that through gravitational force masses distributed in the 4D space-time curve the 4D space-time. Now the 4D space itself is curved and, relatively, the motion line is a straight line (geodesic) in this curved 4D space-time. So, there is no need for time dilation, length contraction and Lorentz transformation. This makes life easier for relativists. But then what is Einstein's claim that Minkowski space-time is a local tangential space-time in the curved space-time?

12 Einstein's general theory of relativity (II)

12.1 General coordinate system

Judging from the argument to claim the validity of equivalence principle, it appears that Einstein was considering only local situations, such as a spaceship, as an accelerating frame. In this local setting it "looks like" possible to treat all accelerating frames as inertial frames. Without knowing the unfortunate truth which we have explained above that the equivalence principle is false, Einstein made a move to represent all accelerating reference frames as "local inertial frames" in which acceleration is replaced by the induced gravitational field. *This ill-fated idea lead Einstein to consider the general coordinate system upon which all accelerating frames are treated as local inertial frames with induced gravitational field.* Hence, Einstein moved on to develop the concept of general absolute reference frames to which we will turn in what follows.

Einstein assumed that the whole cosmos is occupied by a fluid whose molecules are "clocks" of any variety. This fluid can flow in any manner except that it will be assumed that there is no turbulence, so that neighbouring molecules always have almost equal "speed" and the velocity of the flow is a continuous function.

Remark 2 *This means that Einstein assumes a universal time and a universal space upon which clocks move.*

Each clock is allocated three coordinates (x_1, x_2, x_3) in such a manner that:

1. No two clocks will have the same coordinates, and

2. Neighbouring clocks have neighbouring coordinates, therefore, coordinates are also continuous with respect to spatial displacement.

3. It is understood that the coordinates of each clock remain the same through time. As time elapses at each clock, its readings assumed to increase but the rate of increase is not necessary uniform as compared with a local standard clock. No attempt is made to synchronize distant clocks, neighbouring clocks are assumed to be "sufficiently synchronized" so that the clocks' readings are continuous with respect to spatial displacement.

4. The reading of a clock will be denoted by x_0.

It is unfortunate that this paradigm is not possible for the reasons we present below:

a) No clock has any specific coordinate as it is not a point object.

b) In a continuum, there is no such thing as a point next to another point. So, the concept of a "neighbouring point" to a point is an invalid concept. Lack of basic understanding of what "continuum" means is sticking out its ugly head. There is no such thing as a real number next to a given real number. This is because in between two real numbers we can always find another real number. This property is called the density of the set of real numbers.

c) As pointed out in **b**), there is no such thing as the coordinate of a clock in this setting. Clocks themselves are made by continuumly many points. They are by themselves very complex infinitary physical structure. In **a**) Einstein assumes the fluid of clocks and in **c**) he says that the coordinate of each clock remains the same.

More generally, the following further questions remain to be answered.

(1) Upon what time and space the mechanics of such molecule clocks are defined? Each clock is a physical system and so it is operating in a space-time which is not the same as the space-time defined by the clock. This is to say that the space-time (x_0, x_1, x_2, x_3) does not define the inside dynamics of the clock at (x_0, x_1, x_2, x_3). Moreover, where is the clock that governs the space-time in which this clock operates? According to the general theory of relativity, the time of this space-time (x_0, x_1, x_2, x_3) and that of the space-time in which this clock operates are not the same and how much they are synchronized depends upon the location of the clock that defines the space-time that defines the clock. This problem is bound up with a more general problem associated with the instrumentalist view of time as clocks. This view falls into the following vicious circle: The clock, which is supposed to define time, must operate as a dynamical system upon some time and space. Then how this time and space are supposed to be defined?

(2) It is a common sense among researchers in “dynamical system theory” that time has a special status that is different from all other coordinates of the system. This is in agreement with the idea of Newton in his classical dynamics. He said that time, unlike other coordinates, has a natural flow which only “moves” forward. This makes it impossible to consider time as a reading of clocks. Time is an entity that transcends empiricism and operationalism. The super-creativity of modern physicists seems to defy this scientific common sense. This is how they consider things like “time travel” with a straight face as pure scientists serving the appetite of the popular science. We wonder “how long” does it take to travel from now to 250 years ago? Once we violate the most fundamental assumption on time, anything can happen, and relativity apparently made it happen.

(3) Clocks are physical entities. There are at most countably many clocks in this universe. No mater how closely we put clocks together, we cannot form a continuum of clocks. No matter how one puts countably infinite particles together, they will not make a mathematical continuum. This is mathematically the same problem as the problem of photons that are supposed to exist for each frequency: as the frequency has a continuous spectrum, there must be uncountably infinite particles called photons. Countably infinite points will never form a real continuum. We need continuumly many points to form mathematical continuum.

(4) What does it mean to be sufficiently synchronized? The concept of synchronization presupposes an external absolute time which contradicts the concept of relativism. Here, we have to check time of each clock at precisely the same moment in the absolute time.

12.2 Minkowskian local frame

Suppose, at a point P in a “gravitational field”, which is a fluid of “infinitely many” clocks, a freely falling non-rotational (relative to distant stars) local inertial frame is “constructed”. We further assume that the axioms of the special theory of relativity are valid within this frame as it is supposed to be an inertial reference frame. So, we can set up a Cartesian coordinate system *(Px,Py,Pz)* at this point P. Furthermore, we can distribute clocks over the frame, all synchronized with the clock at P.

As we assumed that the universe is a sea of clocks that are not over all synchronized, this implies that such coordinate system (Px, Py, Pz) is not universal. It is a local coordinate system around P.

Using this frame and clocks, events which occur in the vicinity of P over a suitably restricted time period can be allocated space-time coordinates (t, x, y, z).

It is not quite clear why the time period must be restricted.

Now suppose that in this local inertial frame a pair of neighbourhood events have space-time coordinates (t, x, y, z) and $(t + dt, x + dx, y + dy, z + dz)$. Then, if $d(\tau)$ such that

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

is Lorentz invariant, it also is called the *Minkowski distance*. This serves as the correct metric on the 4D Minkowskian space-time.

Remark 3 *As we will discuss in 1.7.15, unfortunately Lorentz transformation is irrelevant to theoretical physics as the claim by Lorentz that this transformation maps wave equation to wave equation is false and Einstein's claim that all equational axioms of Maxwell are Lorentz invariant. So, the Minkowski distance also is irrelevant to physics. Mathematical relevance of such transformation is highly questionable either.*

There are some mathematical problems regarding this "metric" on the "local" 4D space-time. (1): It is not a topological metric which topologists use. This is to say that Minkowski 4D space time is not a metric space. (2): The Minkowski distance between two events which happen at the same time is zero regardless of the 3D geometric distance between these two events. (3): Here, Einstein is assuming that in this "freely falling" local inertial frame, in which a gravitational field "is induced" by the "equivalence principle", all clocks are synchronized. The inertial frame local must be accompanied by a gravitational field. So, all of these clocks are under gravitational acceleration. How is it possible that all of these clocks are synchronized? It is him who also claims that all clocks under acceleration slow down. Do they slow down uniformly? As the acceleration is inertial "locally", and time dilation is relative to the inertial speed, this slowdown is not uniform at all.

After all, as we have shown in the foregoing, the Minkowski distance has no relevance to theoretical physics. It is mathematically irrelevant too as it is not a topological metric. This clearly shows where relativity theory should be placed in science. It is neither physics nor mathematics. It appears that it belongs to itself.

As the local inertial frame is suitable only for the description of very limited situations, for a larger scale (temporal, as well as spatial) issues, it is necessary to use one of the general reference frames. If x_i are space-time coordinates relative to such a general frame, transformations of the form $x'_i = \pi(x_0, x_1, x_2, x_3)$ must exist relating (x_0, x_1, x_2, x_3) to (t, x, y, z) [the local inertial frame] such that

$$\begin{aligned} t &= \theta(x_0, x_1, x_2, x_3) \\ x &= \pi(x_0, x_1, x_2, x_3) \\ y &= \psi(x_0, x_1, x_2, x_3) \\ z &= \gamma(x_0, x_1, x_2, x_3). \end{aligned}$$

Then, if x_i are subjected to increments dx_i, the corresponding increments in t, x, y, z will be given by

$$dx = (\partial(\theta)/\partial(x_0))dx_0 + (\partial(\pi)/\partial(x_1))dx_1 + (\partial(\psi)/\partial(x_2))dx_2 + (\partial(\gamma)/\partial(x_3))dx_3$$

etc., and the substitution in equation of proper time interval

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2)$$

will results in an expression $d\tau^2$ which is quadratic in the increments dx, i.e. whose terms will either involve squares of the dx_i or the product of two different dx_i. Thus

$$d\tau^2 = \sum_{i=0}^{3}\sum_{j=0}^{3}(g_{ij})dx_i dx_j \qquad (R)$$

where the coefficients (g_{ij}) will be the functions of x_i

Now, a continuum in which the interval between neighbouring points is given by a quadratic form like (R) is called a "*Riemannian space*" and the quadratic form like (R) is called its *metric*. Thus, the space-time continuum is a four-dimensional Riemannian space whose interval is everywhere identified with the proper time interval between neighbouring events in a local inertial frame.

Unfortunately, what we have seen here is an exhibition of "pseudo-mathematical elitism" or "proof by intimidation" for which the authoritarian Göttingen School under Hilbert is solely responsible.

Here are some issues to be discussed:

1. For physics what is important is not that we use 4D space-time manifold of Riemann. What has been questioned here is the relevance of such mathematical structure to physics. This structure (R) is obtained by substitution

   $$dx = (\partial(\theta)/\partial(x_0))dx_0 + (\partial(\pi)/\partial(x_1))dx_1 + (\partial(\psi)/\partial(x_2))dx_2 + (\partial(\gamma)/\partial(x_3))dx_3$$

   etc. in the equation of proper time interval

   $$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2).$$

   As we have shown, this whole mathematical argument makes little physical sense. A most serious flaw in all of this flashy mathematical "show off" is that the theory of general relativity was obtained from the special theory of relativity which is mathematically and ontologically inconsistent. So, no matter how the general theory is decorated to look impressive, it is false. To make the matter even more entertaining, as we discussed above, the special theory of relativity yields the relativistic addition of speed which contradicts the addition of acceleration of a mass which is governed by the second law of Newton. The equivalence principle, which is the most fundamental assumption of the general theory of relativity, is based upon the second law of dynamics. This makes us seriously wonder what kind of a reasoning system theoretical physicists use. Einstein explains the curved space in the general theory of relativity using a rotating disc; the radius of the disk does not contract as the motion of the disk is not along this direction. It comes under the influence of the length contraction around the perimeter of the disk as the motion is in the direction of the tangential speed of the point on the perimeter of the disk. There are two errors in this argument. First, the tangential speed of a circular motion is not inertial, it is under acceleration and so, the length contraction "should not" apply. Moreover, length contraction is false.

2. More fundamentally, as we pointed out in [8] General Coordinate System, Einstein was clearly not aware of the difference between countably infinite and continuum, just like all other theoretical physicists. Cantor's diagonal argument clearly shows that there are more points in the geometric continuum than discrete collection of points. The Lebesgue integral of the Weierstrass function over $[0, 1]$ shows that the geometric continuum has unimaginably more points than "space" of countably many points has. For example, on the real number line almost all points are irrational points. So, one cannot cover the entire global space with clocks as there are only finitely many clocks. This makes the most fundamental assumptions of Einstein's general theory of relativity untenable. There is no such thing as the "global space-time" prescribed by Einstein. Mathematics at this level is way more complex than theoretical physicists think. It is not just about solving differential equations through mechanical symbolic equational calculations without understanding what we are doing at all. Physicists should learn that without correct continuum, we cannot define either differentiation nor integration. The problem we have in today's education is that virtually nobody teaches how to define a^x when x is an transcendental number such as π. As Euclid said, there is no emperor's way to geometry. Mathematics is not mechanical calculation. It is deep understanding. We tend to use mathematics without understanding mathematics, and at the advanced stage it backfires big like this. Likely, the general theory of relativity is the first attempt by theoretical physicists to touch the depth of mathematical analysis and its theoretical base, the theory of continuum. It is clear that virtually none of them really understands the concept of continuum without which there is no mathematical analysis (calculus).

3. Also, Einstein's description of the clocks used to define the global space-time is off. To begin with it must be required that the neighbouring clocks are of infinitesimal distance and the time difference between each neighbouring clocks must be infinitesimally small. Otherwise we cannot use calculus to calculate on such a structure. Physically, it is impossible to make enough clocks to do this and place them in the way expected, as we stated above. If physicists understand that an infinitesimal means a number which comes in between 0 and any positive number, they will realize that what they are trying to do is ontologically untenable. Clearly Einstein did not know what infinitesimals are as this concept was articulated in the 1960s by Abraham Robinson. Even in pure mathematics, the work of Robinson is understood only by a small number of mathematical

logicians. The general theory of relativity was developed before the development of Robinson's infinitesimal calculus and so it is understandable that the Hilbert school of mathematics and physics did not know what infinitesimals are. By the time Robinson's work came in, the separation between pure mathematics and theoretical physics became material and communication between these two communities became non-existent.

4. In short, the universe is not a sea of clocks, contrary to what Einstein proposed. At this deep level of understanding everything physicists are accustomed to must be re-examined. In addition to this topological problem the general theory of relativity suffers from, there is an even more fundamental issue of logical deficiency in this idea of the general reference frame which is the sea of clocks. Clocks are physical entities and it requires physics to make them. One cannot use clocks to define clocks at the pain of vicious circularity. So, there is no such thing as metaphysical clocks though time is certainly a metaphysical entity as Newton thought. It were the special and the general theories of relativity that tried to use empirical clocks, which lead the world of physics to the current confusion about time. Contemporary leaders of theoretical physics such as Hawking and Penrose argue that theoretical physics made us understand the universe very well "except what is time". This clearly shows the illness of this discipline too arrogant to listen to the input from outside disciplines such as mathematics, logic and engineering. Logically speaking, modern physics started with the wrong idea of what is time. Contrary to the special theory of relativity, time cannot be defined in terms of speed as speed is defined in terms of time. And as we have discussed here, universe is not a sea of clocks contrary to the general theory of relativity. From the combination of these fatally wrong assumptions, it is totally expected that we ended up with scratching our head questioning "By the way, what is time?" It is astounding that the "top physicists" of today are saying that although we now understand almost all about this universe, we don't understand what time is. Our understanding of time as in relativity theory is completely wrong and how can we say that we understand everything but time. The lack of rational reasoning is sticking its ugly head here. We wonder if these scientific elites who call themselves the King have the concept of causation. Even elementary school students will understand that as physics is a theory of dynamical systems, time is the most fundamental concept. Then a naturally asked question is how the superior scientists with the name of theoretical physicists think that they understand everything in physics except time.

Some theoretical physicists say that maybe the special theory of relativity is false but the general theory of relativity must be correct. We made it clear that the general theory came from the special theory, which is false, and so this argument is false. Any theory which contains an inconsistent theory is inconsistent.

12.3 Geodesics

When we express a linear function of one variable on a 2D space, then the function becomes a straight line graph. The coefficient of the first order variable is the slope of the line. This idea was extensively exploited by train companies to visualize train operation on a 2D space where one coordinate is the time coordinate and the other coordinate is the location coordinate expressed at the distance from the station of origin. It is called "operational diagram" and it were pure mathematicians who glorified it as 4D space-time with a fancy name for the simple concept. In the 4D space-time all constant speed 3D motions should be just straight lines and the slope of the line is the constant speed 3D motion.

So, in 4D space-time geometry of 3D motions, the "Euclidean geometric distance" between two points $P_1(t_1, x_1, y_1, z_1)$ and $P_2(t_2, x_2, y_2, z_2)$ in the 4D space-time is:

$$\overline{P_1P_2} = \sqrt{(t_1 - t_2)^2 + (x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}.$$

The slope of the line segment P_1P_2 is given as

$$((x_1 - x_2)/(t_1 - t_2),\ (y_1 - y_2)/(t_1 - t_2),\ (z_1 - z_2)/(t_1 - t_2))\,.$$

In the general theory of relativity, this changes: the distance, as per Minkowski, between P_1 and P_2 is

$$\widetilde{P_1P_2} = \sqrt{(t_1 - t_2)^2 - (1/c^2)\left\{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2\right\}}.$$

It can be shown that this distance is smaller than any other "Euclidean distance" along any connecting curve between P_1 and P_2 in the 4D space. It follows then that

$$\widetilde{P_1P_2} < \overline{P_1P_2}.$$

But for any path l_{P_1,P_2} between P_1 and P_2,

$$\overline{P_1P_2} \leq \overline{l_{P_1,P_2}}$$

where $\overline{l_{P_1,P_2}}$ is the Euclidean length of l_{P_1,P_2}.

From this, relativists concluded that the 4D space-time with the Minkowski metric is not an Euclidean space but a Riemannian space which is curved.

There are some unclear issues to be addressed here.

1. In Euclidean geometry, we define the distance between two points P and Q using the Pythagorean formula and show that the length of any path connecting two points P and Q is longer or equal to the distance between them. We have not seen how to define the length of a curved path between P and Q in Minkowski 4D space-time.

2. Putting this purely mathematical issue aside, the only reasoning for admitting $\widetilde{P_1P_2}$, the Minkowski distance between P_1 and P_2, is because this

distance is invariant under Lorentz transformation. There are two questions to be answered here. (1) Why Lorentz transformation is the issue in the general theory of relativity? This transformation belongs to the special theory of relativity. (2) This transformation is said to be essential for the special theory of relativity as it is said to preserve all wave equations and axioms of Maxwell's electromagnetic field theory. (3) We have shown that this claim is false in our paper "*Reference Frame Transformations and Quantization*" [KWP]. We discussed this issue in 1.7.10 too.

Nonetheless, under the guidance of Hilbert's School at Göttingen, Einstein continued to develop his theory as follows: Under the equivalence principle,

$$d\tau^2 = \sum_{i=0}^{3}\sum_{j=0}^{3}(g_{ij})dx_i dx_j = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2).$$

From this, he concluded that the free fall in the gravitational field is a geodesics [in the 4D space-time]. This is called "*geodesic principle*". Under this principle we obtain equations of motion for bodies falling freely in a gravitational field.

Using Riemannian geometry for the "general metric"

$$d\tau^2 = \sum_{i=0}^{3}\sum_{j=0}^{3}(g_{ij})dx_i dx_j$$

we can show the following "general equation of a geodesic"

$$\frac{d}{d\tau}\left(\sum_{j=0}^{3} g_{ij}\frac{dx_j}{d\tau}\right) = \frac{1}{2}\sum_{j=0}^{3}\sum_{k=0}^{3}\frac{\partial g_{ik}}{\partial x_i}\frac{dx_j}{d\tau}\frac{dx_k}{d\tau} \qquad (i = 0, 1, 2, 3).$$

For the metric

$$(d(\tau))^2 = (dt)^2 - (1/c)((dx)^2 + (dy)^2 + (dz)^2),$$

these equations reduce to

$$\frac{d^2x}{d\tau^2} = \frac{d^2y}{d\tau^2} = \frac{d^2z}{d\tau^2} = \frac{d^2t}{d\tau^2} = 0.$$

which is equivalent to

$$x = \frac{dx}{d\tau}t + a, \quad y = \frac{dy}{d\tau}t + b, \quad z = \frac{dz}{d\tau}t + c$$

where a, b, c are constants.

Remark 4 *According to the general theory of geodesics, light coming from a distant star passing near our sun has a geodesic (4D) which bends near the sun due to the gravity of the sun. As it is a 4D bending, we cannot graphically express this bending. But when we drop the time bending, the light path is bending in* *our 3D space. This is what we see in science museum exhibitions everywhere. Then we have a problem to think about. This 3D bending is a phenomenon that takes place in our 3D Euclidean space. This can be observed only from outside our 3D space. As we are inside the 3D space, in theory, we will be unable to observe this bending of the light path. This was precisely what Gamow warned us about. He basically said that unless we are in the position of Newton out of the universe observing, we will not observe this bending. This valid question was never answered scientifically. The late Prof. Marmet presented a classical explanation of this observation using no bending space but bending light in unbent space interpretation. It was ignored. This means that we still do not know if space really bends as Einstein predicted due to the gravitation of earth.*

12.4 Einstein's equation of gravitation

The discussion above shows that g_{ij} determines the motion (geodesic) in the general relativity theory. Given the energy-momentum tensor T_{ij}, which describes the distribution of mass, energy and momentum of the system Einstein's equations of gravitation yield corresponding g_{ij} enabling us to calculate the geodesics of the system. It was Schwarzschild who first obtained an exact solution of Einstein's equations for a spherically symmetric field. He used the solutions to calculate the motion of a planet in the field of a sun.

Putting aside the problems of the general theory of relativity as discussed above, this "impressive" result of Einstein and Schwarzschild has some issues to be considered. The question is what this momentum-energy tensor is about. There are several issues to be cleared.

1. The momentum-energy relation is a problem. The former is a predicative concept but the latter, as the potential to do work, is a modal concept and so, connecting them at the same category is not the right thing to do. Of course, Einstein and his contemporaries had little idea that energy is a modality, not a physical reality.

2. Logically speaking waves in wave mechanics have no momentum. This is because momentum is the product of a mass and its speed. In wave mechanics, no mass moves in the direction of the wave. What is moving towards the direction of the wave is the local vibration of the medium. So, waves have no momentum. When it comes to energy, as the work needed to accelerate from $m0$ to mv is not necessarily $(1/2)mv^2$, the concept of kinetic energy is false. The work needed for this acceleration depends upon how we accelerate from $m0$ to mv.Unfortunately, what we have seen here is an exhibition of "mathematical elitism" or "proof by intimidation" for which the Göttingen School under Hilbert is solely responsible.

3. So, the energy-momentum relation does not represent the state of a physical system properly. Then how is it possible that the energy-momentum tensor will describe the physical system properly?

4. Is the energy-momentum relation as energy-momentum tensor used here classical or relativistic? If it is relativistic, the entire argument by Einstein is viciously circular at best. If not, what about that we were told by relativists that the classical physics is invalid. This is a contradiction, is it not? Where is logic in theoretical physics. Again, we have to ask the same question. To make the matter even worse, classically we have some tension between momentum and energy. Moreover, the relativistic energy-momentum relation is also false. It is because $e = mc^2$ is false, as we discussed in Section 1.6. This equation came from the false assumption that the v in the gamma factor in m is time-dependent, which is not allowed in relativity theory. Considering that the concept of energy is not a physical reality but a modality and understanding the trivia of philosophy that the modality and reality are of different category, it is astounding that the momentum-energy tensor plays the most fundamental role in general relativity theory. In serious mathematical sciences, coherent conceptual understanding is way more important than pushing formal symbols. Mathematics is not just a language for physics. It is the only way to understand physical nature around us. It is the most articulate way of thinking correctly.

5. What is the most fundamental issue here is that the practice of *bootstrapping* classical mechanics to relativistic mechanics is not a legitimate thing to do.