

# Quantum of Spacetime: Zenon Connection

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## Abstract

The origin of Time and Continuum is addressed with the so-called Zenon Connection (p. 5), with emphasis on (i) the **infinitesimal displacement** of physical objects in 4D spacetime, (ii) Planck's **quantum of action**, and (iii) the quantum of Time (chronon) interpreted as the **atom of geometry** (p. 4 in [test.pdf](#)).

Dedicated to 163rd birthday of [Max Planck](#), 23 April 1858.

## 1. Introduction

To origin of Time and Continuum (outline at p. 5): what binds matter to matter is *not* matter, but a new form of reality, which is **neither matter nor mind**. **It** (not "He") is called here *Res potentia* or **Platonic** reality. Which means that Fig. 1 below, depicting matter being "connected" to matter *exclusively* (Sic!) **by** matter, is in fact **false**. If the origin of Time were any **physical phenomenon** (like the **mainspring** in your old clock), it can introduce energy to run the movie reel (Fig. 1) along 'the time read with a clock' **iff** it is empowered by yet **another physical phenomenon** to get energy from, *ad infinitum*.

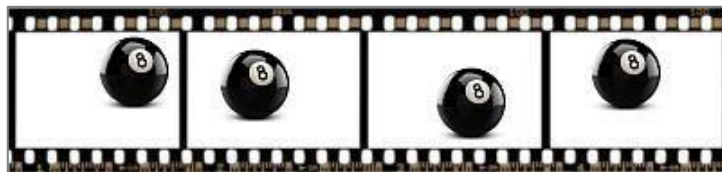


Fig. 1. See Fig. M and Fig. N in [test.pdf](#), pp. 10-13.

I will again introduce the **atom of geometry** (p. 4 in [test.pdf](#)) shown in Fig. 2 below.

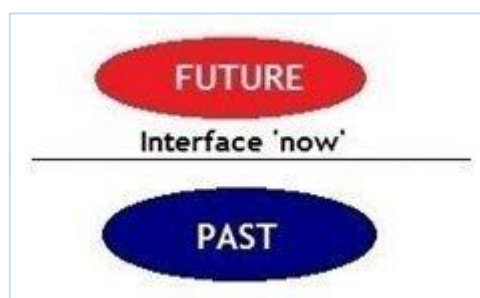


Fig. 2

Let me explain the so-called Zenon Connection (ZC), introduced previously at p. 5 in [gr\\_energy.pdf](#). See Escher's 'drawing hands' and the global **nullified** Heraclitean Time in **4+0** spacetime depicted in [Slide 1](#) and [Slide 2](#), and empowered by the **Unmoved Mover**.

Notice that the **4D** physical world enjoys *perfect* continuum: unlike the inevitable **dark strips** between the consecutive snapshots in Fig. 1, the snapshots along the Heraclitean Time are created exclusively by the *physicalized* states in the *irreversible past* (Fig. 2). These consecutive snapshots are “separated” by the global **nullified** Heraclitean Time, which does *not* exist (Sic!) in the physical, **4D** world: *perfect* Continuum. Again, what binds matter to matter is *not* matter, but the global **nullified atemporal** pregeometric **Platonic** world, which is *neither matter nor mind*. This is the Zenon Connection (ZC).

I will elaborate on ZC by zooming on the **infinitesimal displacement** of physical objects in **4+0** spacetime (Fig. 2), and later on Planck’s **quantum of action** (Sec. 3). Then I will use the **atom of geometry** (Fig. 2) to elaborate on the new Zenon Connection (Sec. 4). Finally, I will offer in Sec. 5 my solution to the problem of time in canonical quantum gravity (J.D. Brown and K.V. Kuchar) and suggest a new *reference fluid* created by the **atom of geometry** (Fig. 2). The latter identifies the fleeting physical content of points of space and their *transient* local instants ‘here and now’, by negotiating them with the **Platonic** state of the Universe (cf. Escher’s ‘drawing hands’): think globally act locally.

## 2. The Infinitesimal

According to Wolfram, “an infinitesimal is some quantity that is explicitly nonzero and yet smaller in absolute value than any real quantity”: the running guys shown in Fig. 3. To understand the **Platonic** axis **W** in Fig. 3 below, read p. 11 in [test.pdf](#).

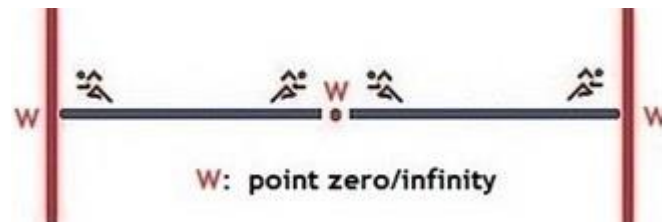


Fig. 3

We may *not* imagine the “size” of the infinitesimal as a dimensionless geometric point — “that which has no part” (Euclid). Zeno was the first to reveal **the paradox of motion**: the limit of the sequence in Fig. 4 below is “obviously” **zero**, but the expression  $0 \times \infty$  makes no sense, because it cannot recover the initial *finite* size (AB) of physical objects.

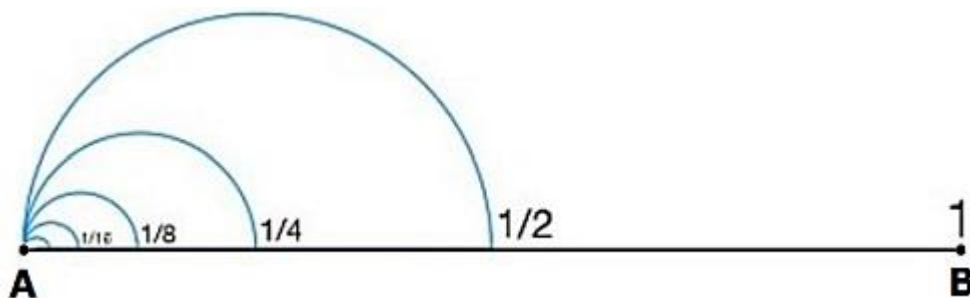


Fig. 4

Some mathematicians may argue that, with *potential* infinity, the ultimate limit *exactly* at point A in Fig. 4 does *not* belong to the sequence, yet the ‘running guys’ in Fig. 3 can try to approach it ‘as closely as desired’, which leads to George Berkeley’s “Ghosts of departed Quantities”. If we instead use *actual/completed* infinity, the limit at point A is *perhaps* included in the sequence (as we know from *calculus*). Recall the two pint beer:

An infinite (*actual* infinity) crowd of mathematicians enters a pub.  
The first one orders a pint, the second one a half pint, the third one a quarter pint... “I understand”, says the bartender – and pours two pints.



Fig. 5

Notice, however, that the [two pint beer] is *embedded* in the pub, and therefore the two endpoints, fixing beer’s *boundaries*, belong to the pub *as well*. Can we pin down the infinitesimal on the *number line*? Yes we can, but only with the atom of geometry (Fig. 2), which works with the absolute precision of *one single* geometric point.

### 3. Planck’s quantum of action

On 14 December 1900, Max Planck *postulated* the *quantum of action*  $h$ . Just like the *atom of Democritus*,  $h$  has finite size but is *not* divisible anymore. Initially, Max Planck considered that the suggested ‘quantisation’ was merely “a purely formal assumption” and did not think much about it, but he opened the door to a new world. Does the atom of geometry (Fig. 2) resemble Planck’s *quantum of action* and the *atom of Democritus*?

If we denote two consecutive *physicalized* states in the *irreversible* past with  $Q_1$  and  $Q_2$ , the *atom of geometry* will create the *infinitesimal*  $Q_2 - Q_1 > 0$  (Slide 1), which now has a finite (not zeroth) size, yet it is *not* divisible anymore: no *physical* stuff can be inserted “between”  $Q_1$  and  $Q_2$ . And the *atemporal* transition from  $Q_1$  to  $Q_2$  is made by ZC (p. 2).

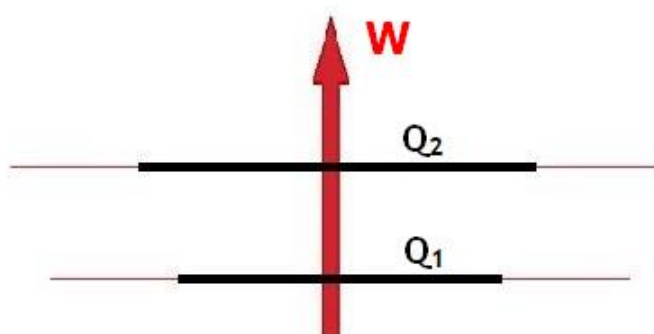
### 4. The Zenon Connection

The Zenon Connection (ZC) is *pregeometric* (p. 2) connection “between” two 4D events ‘here and now’ (Slide 1) in the *irreversible* past of the atom of geometry (Fig. 2). Due to the “speed” of light, it is impossible *in principle* to detect the *future* state in ZC with *physical* observation (p. 20 and p. 9 in GR\_textbook.pdf). The *infinitesimal* shift along the global Heraclitean Time,  $Q_2 - Q_1 > 0$  (Slide 1), will be called ‘quantum of Time’ or chronon (Wikipedia). Unlike the discrete structure of the movie reel in Fig. 1, both the quantum of Time and Planck’s *quantum of action* are *perfectly* continual phenomena: no *physical* stuff whatsoever can be inserted “between” two *consecutive*, along the global Heraclitean Time, 4D events ‘here and now’ (Slide 1). Although the quantum of Time and Planck’s *quantum of action* have *finite* size, the physicalized world, examined as 4D partition of *the Universe*, enjoys *perfect* Continuum: the gaps between the frames in Fig. 1 do *not* exist in 4D spacetime. Their *separation* is in the Heraclitean Time (Fig. 2).

Why? Because of the “speed” of light: read again p. 20 and p. 9 in [GR\\_textbook.pdf](#). For the same reason, no *physical* stuff can be inserted “between” the infinitesimal ([Sec. 2](#)), which is also neither ‘zeroth’ nor ‘finite’. Going back to the [atom of Democritus](#): he was suggesting a gedankenexperiment. Take an apple and cut it with a very sharp knife into two pieces, then take one of the pieces and cut it in half, *etc.* Is there a point at which you will *not* be able to cut the piece of apple anymore? Yes, because it will *not* be an ‘apple’ anymore (compare it with [Thomson’s lamp paradox](#)). This is the ultimate ‘limit’ at which we reach the [atom of Democritus](#) and will have to *stop* there ([Fig. 5](#)). Why? Because the ‘atom’ is *not* an ‘apple’ anymore. It is a *different* form of reality, as Plato suggested [many centuries ago](#). I only added the condition under which the **Platonic** reality in the atom of geometry ([Fig. 2](#)) is hidden *by* the speed of light (p. 5 in [test.pdf](#)).

Now let me explain the **Platonic** axis **W** in [Fig. 3 above](#). I will refer to the irreversible (at least in the past [13.8 billion years](#)) arrow of [cosmological time](#) following the “[expansion](#)” of the *physicalized 4D* universe ([S. Hawking & G.F.R. Ellis](#)).

Why is the axis **W** ([Fig. 3](#) and [Slide 2](#)) unobservable ([Ned Wright](#)) with light? I will have to use only **1D** Euclidean space to show two consecutive instants along the “ladder” below.



[Fig. 6](#). Read p. 12 in [test.pdf](#).

Imagine we raise the dimensions to 2D space:  $Q_1$  and  $Q_2$  will be solid **black** 2D circles, but we still can picture, in 3D, the axis **W** as the “thickness” of the two **black** 2D circles along the **Platonic** axis **W**. But if we switch to 3D space,  $Q_1$  and  $Q_2$  will be solid **black** 3D spheres, and the axis **W** will *completely* disappear in 4D spacetime, being both “inside” the atom of geometry and “outside” the expanding 4D universe ([Fig. 3](#) and [Slide 2](#)). In this sense, the global Heraclitean Time is going both **up** and “sideways” ([Fig. B](#), p. 21 in [BCCP.pdf](#)) along the “ladder” in [Fig. 6](#). Not along the movie reel in [Fig. 1 above](#). This is why I suggested on 21 September 2008 two *modes* of spacetime: local (physical) mode pertaining to ‘change in space’ (coordinate time, as read with a clock) and *atemporal* global (**Platonic**) mode pertaining to ‘change **of** space’ (p. 10 in [test.pdf](#)). This is the crux of so-called *quantum of spacetime* made by the Zenon Connection ([Sec. 4](#)). Back in February 1987 (p. 4 in [Penrose\\_diagram.pdf](#)), I repeated the old idea of *two* types of distances in spacetime (p. 12 in [test.pdf](#)), which now I can explain as (i) *metric distance* (local mode of spacetime) and (ii) *pregeometric Platonic* “distance” (global mode). The latter is **zero**: see the “vertical” shift in Heraclitean Time along the “ladder” in [Fig. 6](#).

This is how photons (p. 9 in [GR\\_textbook.pdf](#) and p. 5 in [test.pdf](#)) travel in spacetime, via the **Platonic** Ether (p. 6). The end result is a *perfectly* continual “lattice” of 4+0 D spacetime (p. 20 in [GR\\_textbook.pdf](#)) with *two* types of distances, as explained above. This is the crux of [Quantum Spacetime](#). I will be happy to elaborate with the [proton](#).

Let me briefly repeat what has been written above. First, we start with Zeno’s [paradox of motion](#) (Fig. 4): the elementary chunk of spacetime, called *quantum of spacetime*, is neither ‘zero’ nor some *finite viz. divisible entity*. Secondly, we suggest a new type of ‘quantum jump’ connecting two consecutive *physicalized* states in the *irreversible* past, denoted  $Q_1$  and  $Q_2$  (Sec. 3) in the ‘atom of geometry’ (Fig. 2). This new *quantum jump*, called Zenon Connection (ZC), builds up the *perfect Continuum* of 4D spacetime along the global Heraclitean Time (Sec. 4 and Fig. 6). And thirdly, we suggest that the new **future** potential state in the *atom of geometry* (Fig. 2) is (i) the **Platonic pregeometric** state of the **entire Universe as ONE**, which (ii) *cannot* be observed with light (p. 4 and p. 5 in [test.pdf](#)). The theory has unique predictions, one of which is [spacetime engineering](#). It is not “magic”. If I am on the right track, [you](#) could make a *revolutionary* discovery!

Next, I will offer my solution to the problem of physical time read with a clock (Sec. 1). Physically, we can see (with [light](#)) only the perpetual sequence (Fig. 1) of *physicalized* 4D “jackets” from the underlying *atemporal Platonic* reality called ‘John’, explained at p. 20 in [facts.pdf](#). It is like an invisible (with [light](#)) **Platonic** hand in a physical 4D glove: read p. 3 in [gr\\_energy.pdf](#), p. 10 in [test.pdf](#), and p. 7 and pp. 18-19 in [facts.pdf](#).

This is [Physical Theology 101](#). The problem of Time can be resolved only and exclusively only by including its Aristotelian “engine”, the [Unmoved Mover](#) (p. 1) – the *atemporal Platonic* hand in a 4D glove. It is impossible to explain the origin of Time by examining the ‘glove’ alone. As Max Planck stressed in his 1944 speech [Das Wesen der Materie](#):

There is no matter as such! All matter originates and exists only by virtue of a force which brings the particles of an atom to vibration and holds this most minute solar system of the atom together. We must assume behind this force the existence of a conscious and intelligent Geist (bewußten intelligenten Geist). This Geist is the matrix of all matter.

## 5. The problem of Time

Quote from [J.D. Brown and K.V. Kuchar](#): “Unfortunately, there is no natural candidate for the intrinsic time, and the procedure is beset by a number of conceptual and technical difficulties [5]. (...) The particles of the reference fluid identify the points of space, and clocks carried by these particles identify the instants of time. In this way, the fluid fixes the reference frame (the space) and the time foliation (the time).”

In the first place, there is no candidate for the intrinsic time in QM ([Charles Wilson](#)), nor in classical GR ([Carlo Rovelli](#) and [J. Butterfield & C.J. Isham](#)). Physicists will need a new ‘reference fluid’ endowed with “nondynamical time parameter” ([W. Unruh & R. Wald](#)).

Again, the Heraclitean Time is always and *inevitably nullified* (R. Wald). To incorporate the Heraclitean Time in quantum gravity and apply its variable *rate* (Sic!) to *create* gravity (forget spacetime “*curvature*”: read p. 10 in [gr\\_energy.pdf](#)), you will need new numbers called hyperimaginary numbers – see Fig. 7 and my endnote at [this http URL](#).

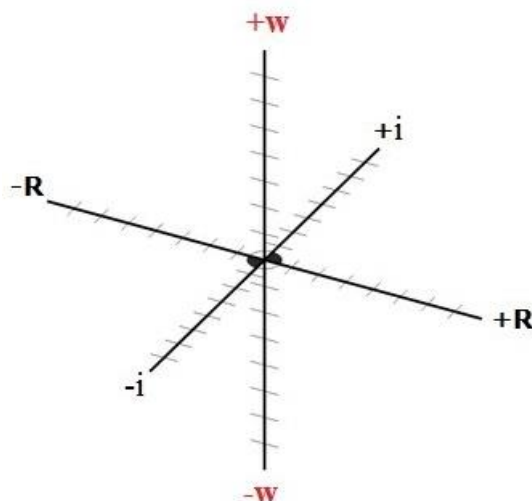


Fig. 7. In the physical world,  $|\mathbf{w}|^2 = 0$ .  
Read [Sec. 4](#) and p. 12 in [test.pdf](#).

The intrinsic Heraclitean Time has an **imaginary** component (p. 5 and p. 12 in [test.pdf](#)) left from the **nullified** hyperimaginary axis **W** in Fig. 7 above. This component has to be **squared** in order to enter the physical 4D world (local mode of spacetime), hence we can see with **light** only the physical (**local**) time (physical “glove”, p. 5) with **negative** sign in the **squared invariant spacetime interval**. Needless to say, there can be no **flow** of events in the **time-symmetric** 4D world: you can’t derive the **Platonic** “hand” from its 4D “glove”. In order to observe with **light** the **flow** of Heraclitean Time (Fig. 6), the latter must be *relational*, but then the **Ether** (p. 3 and pp. 11-12 in [test.pdf](#)) will be a physical observable, which will demolish the Theory of Relativity (*ibid.*, p. 3) and the doctrine of **trialism**.

Thus, the intrinsic global Heraclitean Time – *Die lebendige Kraft* or Leibniz’s *vis viva* – is **completely nullified** in the physical world. Read closely my gedankenexperiment from September 2011 at [this http URL](#). You will only need **Mathematics**. Got your interest? Read p. 13 in [test.pdf](#). As **Max Planck** pointed out in 1936:

An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out and that the growing generation is familiarized with the idea from the beginning: another instance of the fact that the future lies with youth.

## 6. Acknowledgements

This report, aimed at understanding Planck's [quantum of action](#), is rooted on the speech *Das Wesen der Materie* by *Geheimrat Max Planck* in 1944. His "intelligent Geist" (p. 5) is the [Unmoved Mover](#) (p. 1), pictured in [ZC \(Sec. 4\)](#) as an *atemporal Platonic* 'hand' in 4D 'glove' (p. 5). I dedicate my efforts to Planck's 163rd birthday. May God bless his Soul.

23 April 2021, 10:30 GMT

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## ADDENDUM

What is the *origin* of gravitational energy (p. 2 in [gr\\_energy.pdf](#))? Can geometry produce [work](#)? If yes, it must be some physical field, so the answer is a resolute 'no'. But it is not some [ghost](#) either. Is there anything about [gravity](#) that we *know* that we do *not* know?

The alleged spacetime "[curvature](#)" (Fig. A) cannot *in principle* explain the [gravitational rotation](#) and Earth tides (Fig. B). How can spacetime metric [rotate](#) and pull up [rocks](#)?

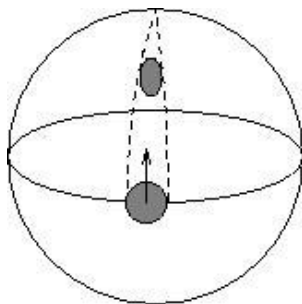


Fig. A

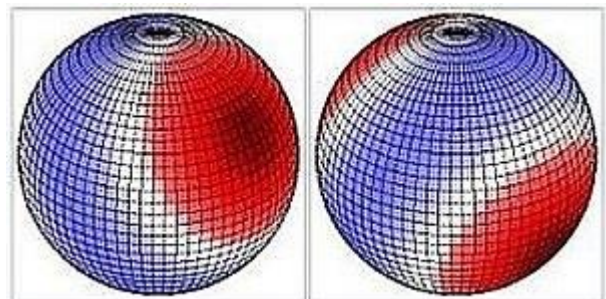


Fig. B

**NB:** What if the *origin* of "gravitational" energy is the [Platonic Universe as ONE](#) (p. 5) living along the hyperimaginary axis [W](#) (Fig. 6 and Fig. 7)? Let me try [Slide 2](#) and Fig. C.



Fig. C. Compare it with Fig. 6 [above](#).

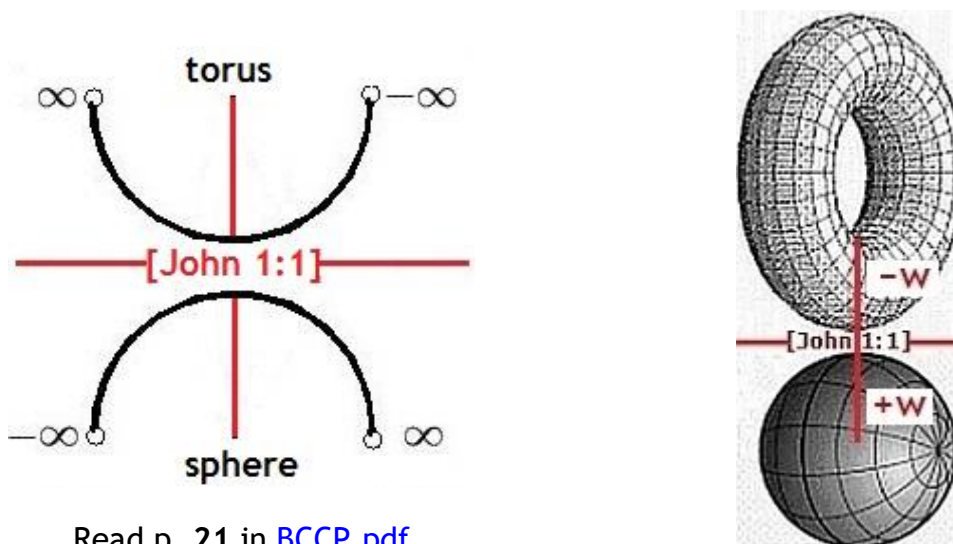
Imagine that ‘3D space’ is the set of all possible [world lines](#) tracing your *history* along your 1D [proper time](#)  $\tau$  matching the [cosmological time](#). (This thought experiment will be impossible in GR (p. 9), so I will ask you to postpone the issue of [gravity](#).) Here comes the first off question: If you can travel indefinitely in arbitrary direction in the 3D space above, will you come back at *the same* place but in the **past** ([closed timelike curve](#))?

Suppose you were a Flatlander, meaning a 2D creature living in “inflating” 2D space ([Ned Wright](#)) endowed with *positive* curvature, like the surface of a **3-sphere**. Locally, in the infinitesimal neighborhood of your instant ‘here and now’, your 2D space may look effectively flat ([Fig. C](#)), so you cannot determine whether your 2D space has actually *negative* curvature, like a [saddle](#) (p. 8 in [GR\\_textbook.pdf](#)). I suggest **both** ([Fig. D](#)).



Fig. D

Let me explain the hyperimaginary axis ([Fig. 7](#)) of sphere  $\Leftrightarrow$  torus transitions ([Fig. E](#)). I will argue that if you start from  $Q_1$  ([Fig. 6](#)) and complete the sphere  $\Leftrightarrow$  torus transitions below, you will *not* wind up at the same initial point (like circling the Earth along the equator), but will reach the **next** point ‘here and now’ at  $Q_2$ , such that  $(Q_2 - Q_1)$  will define the *infinitesimal* displacement ([Wolfram](#)) in *asymptotically flat 4D spacetime* depicted with the area “around” the horizontal **red** line in [Fig. D](#). In Quantum Theory, the *infinitesimal* is called ‘[quantum of action](#)’ ([Max Planck](#)) – read the last paragraph in p. 12 in [test.pdf](#) and my thought experiment from September 2011 at [this http URL](#).



Read p. 21 in [BCCP.pdf](#)

Fig. E

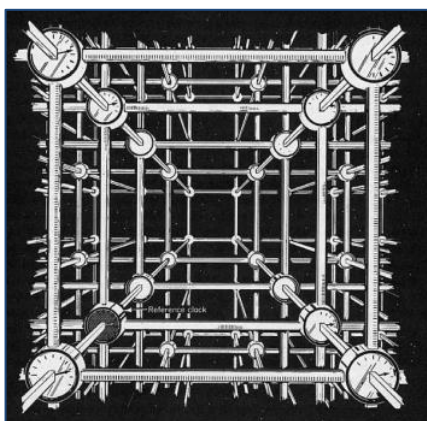
Later I will come back to the ideas at p. 12 in [test.pdf](#), and will mention the major [unclear issues](#) in this exercise. Perhaps one day we will find out many more unclear points, but at this moment I can say nothing about them, as they are residing in the ‘unknown unknown’.



Before making any further steps, let me put my cards on the table and declare the conditions under which the reader can *immediately* reject my theory of spacetime: all you have to do is to **refute** my statement about spacetime “[curvature](#)” (Fig. A) in [p. 7](#).

Namely, I claim that there is *nothing* in the mathematical formalism of GR, which could (i) recover the [proper time](#)  $\tau$  read with a clock ([Carlo Rovelli](#) and [Butterfield & Isham](#)), (ii) define the variable *rate* of time creating gravity (pp. 5-6 in [GR\\_textbook.pdf](#)), and (iii) fix the *boundaries* of 4D spacetime ([Hawking & Ellis](#)). **Nothing**. Forget “[curvature](#)”.

Is any of the claims (i) - (iii) true or false? Please go ahead. Here is an example of the hidden, by the “speed” of [light](#), hyperimaginary axis **W** ([p. 6](#)): see Fig. 9 in *Spacetime Physics* by E.F. Taylor and J.A. Wheeler (1965, [p. 18](#)), reproduced in Fig. F below.



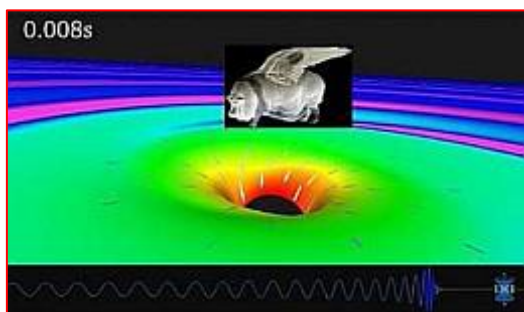
What phenomenon could possibly “calibrate” the **ideal** rods and clocks ([MTW p. 397](#)) pre-built in spacetime?

As the authors acknowledged: “We assume that *every* clock in the latticework, whatever its construction, has been calibrated in meters of light-travel time.”

Calibrated? Based on *what*? And by *what*?

Fig. F

If you prefer unquestionable and widely known [GR texts](#), here’s a dead simple task:



Try to explain the **crap** by [Kip Thorne](#) and his [LIGO collaborators](#).

Have you seen [pink unicorns](#) dancing with [red herrings](#)? This is the so-called [GW150914](#): read pp. 1-6 in [facts.pdf](#). These are the **bold facts**. You can’t argue with **facts**. Nobody can. Period.

Fig. G

I will patiently wait for the feedback by any [academic scholar](#). Once received, I will proceed to the explanation of Fig. D and Fig. E above and to the *dynamics* of spacetime topology (Fig. E) – the “[gimbal](#)” creating gravitational rotation & inertia. It’s a [bundle](#).

Again, the *only* way to [modify gravity](#) is by tweaking the underlying *atemporal* **Platonic** world ([p. 5](#)) “**before**” it enters the physical spacetime, as explained in [September 2011](#). This is why I suggested [4+0 D spacetime](#) ([p. 1](#)). Could you please prove me wrong ([p. 9](#))?

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23 April 2021, 10:30 GMT