

# 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*.

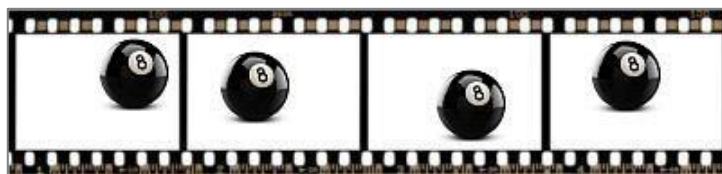


Fig. 1. See Fig. M and Fig. N in [test.pdf](#), pp. 10-13.

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

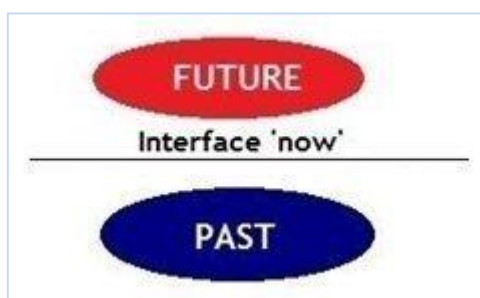


Fig. 2

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, empowered by the **Unmoved Mover** and depicted in [Slide 1](#) and [Slide 2](#).

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](#).

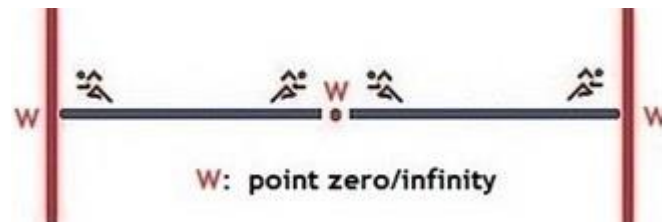


Fig. 3

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.

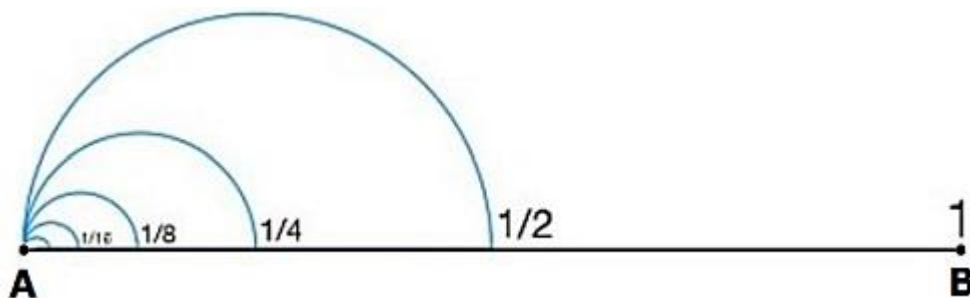


Fig. 4

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.

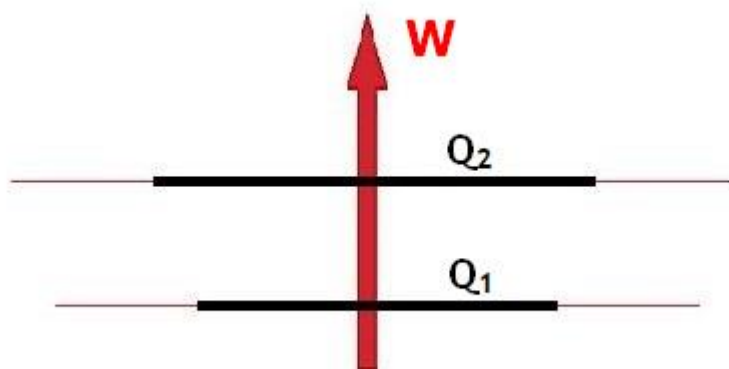


Fig. 6

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 offered the old idea of *two* types of distances in spacetime, which now I can explain as (i) [metric distance](#) (local mode of spacetime) and (ii) [pregeometric Platonic](#) “distance” (global mode). The latter is **zero**.

Let me briefly repeat what has been written so far. 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](#).

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) presented as the invisible **Platonic** hand in a 4D glove. We cannot in principle explain the origin of Time by examining the 'glove' alone. As Max Planck explained at his 1944 speech in Florence [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 into our [Weltbild](#) and talk about the *rate* of Time creating gravity (forget spacetime "curvature": read p. 10 in [gr\\_energy.pdf](#)), you will need new numbers called hyperimaginary numbers – see Fig. 7 and read my endnote at [this http URL](#).

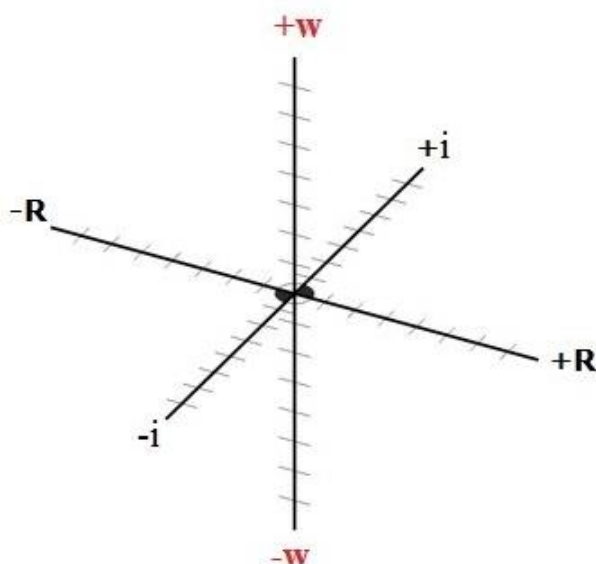


Fig. 7. Physically,  $|\mathbf{w}|^2 = 0$ .

The intrinsic Heraclitean Time has an **imaginary component** (p. 5 in [test.pdf](#)) left from the **nullified** hyperimaginary axis **W** in Fig. 7 above. This component has to be **squared** 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 4D events in the **time-symmetric** 4D world: you can’t derive the **Platonic** “hand” from its 4D “glove”. In order to observe the **flow** of 4D events called Heraclitean Time, the latter *must* be relational, but then the **non**-relational Aether (p. 3 and pp. 11-12 in [test.pdf](#)) will be exposed to observations with **light**, which will demolish the Theory of Relativity and the doctrine of **trialism**.

Thus, the intrinsic global Heraclitean Time – *Die lebendige Kraft* or Leibniz’s *vis viva* – is **completely nullified** in Fig. 1. 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**, could not have been written without the insights by *Geheimrat* **Max Planck** in his last speech *Das Wesen der Materie*. I dedicate my modest efforts to his 163rd birthday. May God bless his Soul.

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