Quantum of Spacetime: Zenon Connection

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Abstract

The origin of Time and Continuum is addressed with the so-called Zenon Connection (ZC), 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, in one sentence: 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 R*es potentia* or **Platonic** reality. Which means that Fig. **1** below, depicting matter being "connected" to matter *exclusively* (Sic!) *by* matter, is actually **false**. If the origin of Time were *physical* phenomenon (Fig. **G**, p. **7** in test.pdf), like the mainspring in your old clock, something will have to introduce energy to run the movie reel (Fig. **1**), but then it will need yet another *physical* phenomenon to empower itself, *ad infinitum*.
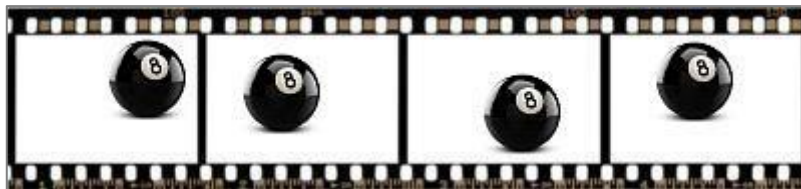

Fig. **1**

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

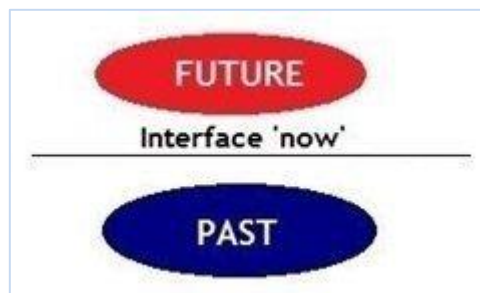Fig. **2**

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.
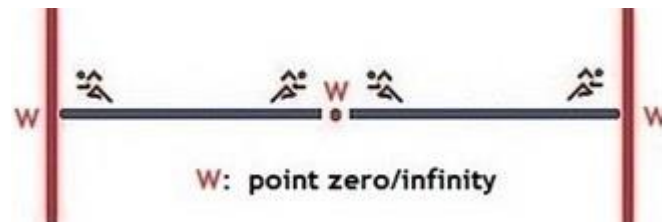

W: point zero/infinity

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 problem with motion: the limit of the sequence in Fig. **4** below is "obviously" zero, but the expression **0 x ∞** makes no sense, because it cannot recover the initial *finite* size (AB) of physical objects.
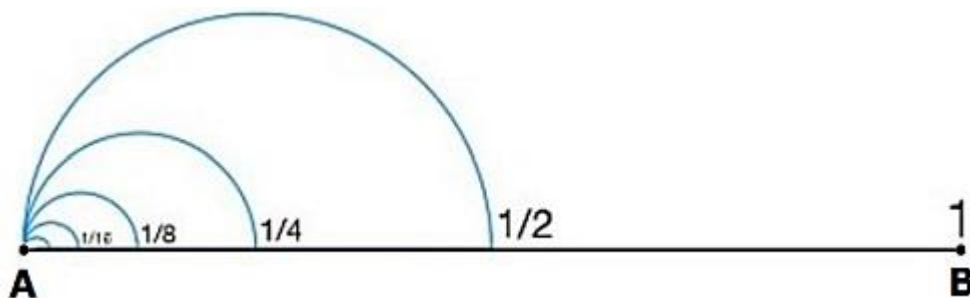

Fig. **4**

Some mathematicians would argue that the ultimate limit at point **A** in Fig. **4** does *not* belong to the sequence, yet the 'running guys' in Fig. **3** above can try to approach it 'as closely as desired', but I consider such statements sheer mathematical poetry. If we use actual/completed infinity, the limit at point **A** is *perhaps* included in the sequence.

Recall the story about '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.

[two pint beer]

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 Plank'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**). Despite the fact that the quantum of Time and Plank's quantum of action have *finite* size, the entire physical world examined as *physicalized* **4D** partition of the Universe enjoys **perfect** Continuum.

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 thought experiment. Take an apple and cut it with 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, claimed Democritus, 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 have to *stop* there. Why? Because the 'atom' is *not* an 'apple' anymore. It is a *different* form of reality, as Plato suggested many centuries ago. I only add the condition under which the **Platonic** reality in the atom of geometry (Fig. **2**) is hidden *by* the "speed" of light. Simple, isn't it?

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.
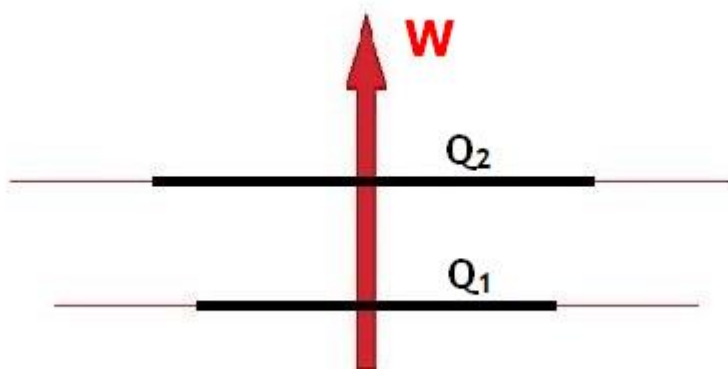

Fig. **6**

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 **up↑** along the "ladder" in Fig. **6** above. Not along the movie reel in Fig. **1**. This is why I suggested two *modes* of spacetime: local (physical) mode pertaining to 'change **in** space' (coordinate time read with a clock) and global (**Platonic**) mode pertaining to 'change **of** space' (p. **27** in GR_textbook.pdf). And this is the so-called *quantum of spacetime* made by the Zenon Connection (Sec. **4**).

Next, I will offer my solution to the problem of physical time read with a clock (p. **2**).

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 a "nondynamical time parameter" (W. Unruh & R. Wald).

Welcome aboard! The Heraclitean Time is always and *inevitably* **nullified** (R. Wald). In order to incorporate the Heraclitean Time into our Weltbild, you will need new numbers called hyperimaginary numbers: see Fig. **7** below and read my endnote at this http URL.

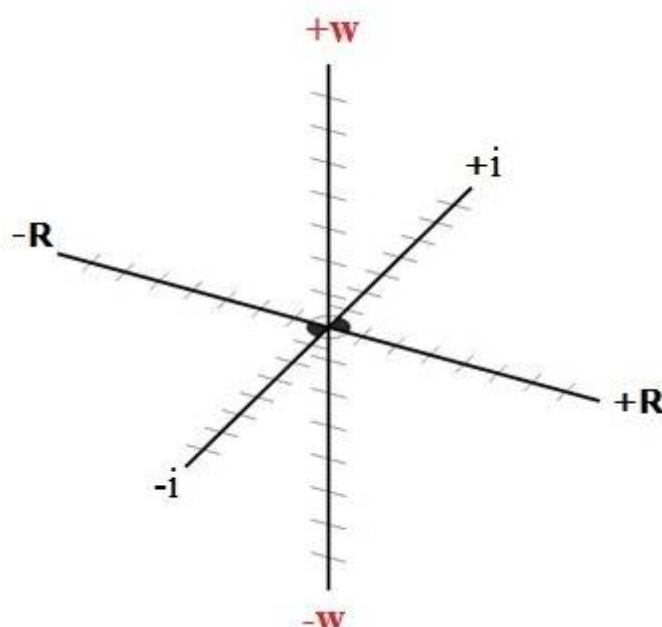Fig. **7**

The intrinsic Heraclitean Time is **imaginary** (p. **5** in test.pdf). It has to be *squared* to enter the physical **4D** world (local mode of spacetime), and so we see (with light) only the physical (local) time with *negative* sign in the *squared* invariant spacetime interval (Wikipedia). Hence the intrinsic Heraclitean Time is *completely* **nullified** in Fig. **6**. Read closely my note from September 2011 at this http URL. You will only need Mathematics. Interested? Read p. **13** in test.pdf.

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 dare to dedicate my modest efforts to his 163rd birthday. God bless his Soul.

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