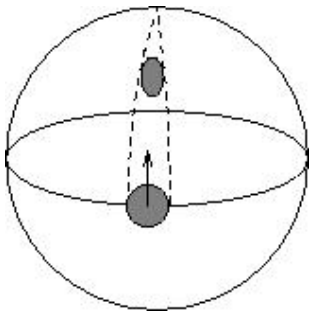
## Can geometry produce work?

GR textbooks begin with a "massive body" (Wikipedia) that *somehow*, and for some unknown reason, would create particular influence in *non-flat* 4D spacetime (watch the clip below), and then "the Christoffel symbols play the role of the gravitational force field and the metric tensor plays the role of the gravitational potential", etc.

Can non-tensorial Christoffel symbols produce **work**? What kind of "influence" is that? It doesn't look like electromagnetism. All we know for sure is that gravity can alter the *rate* of time, as demonstrated in GPS navigation and time dilation. But the *rate* of time (W.G. Unruh) cannot produce **work** either. If it could, it will be *physical* entity.

Let's read the experts in GR. Quote from John Baez and Emory Bunn, *The Meaning of Einstein's Equation*, January 4, 2006, Sec. Spatial Curvature:

"On a positively curved surface such as a sphere, initially parallel lines converge towards one another. The same thing happens in the three-dimensional space of the Einstein static universe (cf. Einstein 1918 and Hubble – D.C.). In fact, the geometry of space in this model is that of a 3-sphere. This picture illustrates what happens:



"One dimension is suppressed in this picture, so the two-dimensional spherical surface shown represents the three-dimensional universe. The small shaded circle on the surface represents our tiny sphere of test particles (say, an apple – D.C.), which starts at the equator and moves north. The sides of the sphere approach each other along the dashed geodesics, so the sphere ***shrinks*** (emphasis mine – D.C.) in the transverse direction, although its diameter in the direction of motion does not change."

This last sentence may sound comprehensible only to my dog. I can certainly see that "the sphere shrinks" in the drawing above, but the 'shrinking' *itself* cannot produce **work**. Apples are *physical* objects, not some fictitious "vacuum" devoid of matter. Let me offer an explanation of the question posed in the title.

Consider two kitchen scales, A and B, on a table at rest, and two apples on them, with different weight, say, an apple with 200g on scale A, and another apple with 400g on scale B. How would you relate their "trajectories" in 4D spacetime to the non-tensorial Christoffel symbols, so that the former will produce different **weight**?

Obviously, an apple with weight 400g will resist acceleration *harder* than 200g apple. Obviously, *something* is doing **work** by pressing the scales A and B on the table.

**What is it?**

If you can answer this question in the framework of GR, you may discover the coupling of geometry to matter sought by Felix Klein, David Hilbert, and Hermann Weyl, among many others. Also, you might (eventually) *vindicate* the claim by Kip Thorne and his LIGO collaborators about their "discovery" of so-called GW150914 (p. **13** in Zenon). You might also qualify for Nobel Prize for your astounding discovery of renormalizable perturbative quantum gravity based on "gravitons" with mass $m_g \leq 7.7\times10^{-23}$ eV/$c^2$: see the ground-breaking experiment proposed by Kip Thorne at p. **24** in BCCP. Good luck.

If you cannot answer the question, read Über Die Gravitationsfeldrelativitätstheorie. In an nutshell, gravity can produce enormous work (for example, Earth tides), but we need first to explain why we observe only one "charge" with positive energy density. This is totally unexplained puzzle, and theoretical physicists talk only about 'positive mass conjecture' (references are available upon request). The idea suggested in GTR is very simple: recall QM operators (*ibid.*, p. **7**). They are *not* geometric points. They take some stuff, denoted **P**, at the input and convert it into *another* stuff **Q** at the output. The latter becomes *physical* stuff (**Q**), which is 'geometric point' that can be located at the apex of the light cone. But **P** (from **Plato**) is *not* on the light cone. We observe only **Q**-stuff, with positive energy density only. So, QM operators act **P** → **Q**.

For comparison, consider another operator from particular pattern (Gesetzmäßigkeit): if I gently stroke Linda's head (**L**), she will wave her tail (**Q**): **L** → **Q**. In this case, I can track the entire sequence of events in **L** → **Q** with light. Not so in QM: **P** is *physically* unobservable (pp. **6**-**7** in BCCP), as we know since 1935, thanks to Erwin Schrödinger.

The *origin* of gravity is also **P** → **Q**, because again we observe only **Q**-stuff, once at a time, as recorded with a physical clock: read **A4** on p. **4** in GTR. Namely, the **Platonic** origin of quantum gravity (**P**) does *not* live on the light cone. We can see with light only its waving ***tail*** (**Q**). People claim that the trajectory of the *physicalized* tail implies some non-flat 4D spacetime (watch the clip below). But we cannot see our Linda (**P**). She has *already* disappeared at the very instant of observation, just like Macavity. See Escher's 'drawing hands' and my note on the spacetime interval here.

To sum up, the *origin* of gravity (**P**), called also 'John', does *not* act on any physical stuff. What actually acts on the physical world is the *physicalized* 'John's jacket' (**Q**). And since in **P** → **Q** the former is *physically* absent, the latter (**Q**) becomes *self-acting*, like your brain. Hence the *origin* of classical gravity (**P**) is *not* physical field, but **Q** is. Yet **Q** only ***facilitates*** the Platonic origin of gravity (**P**), like a **hand** in 4D glove (**Q**).

Moreover, GTR offers the path to quantum gravity from the outset: read my endnote here and pp. **2**-**4** in Gravitational Energy, and notice the Heraclitean ***flow* of events** (recall the puzzle above) depicted with the vector **W** in the drawing at p. **8** therein.

Needless to say, Einstein was fully aware of the problems in his General Relativity (see p. **13** in Gravitational Energy):

> The right side is a formal condensation of all things whose comprehension in the sense of a field-theory is still problematic. Not for a moment, of course, did I doubt that this formulation was merely a makeshift in order to give the general principle of relativity a preliminary closed expression. For it was essentially not anything more than a theory of the gravitational field, which was somewhat artificially isolated from a total field (Gesamtfeld) of as yet unknown structure.

My theory is also incomplete, firstly because "the total field (Gesamtfeld) of as yet unknown structure", suggested by Plato many centuries ago (p. **9** in BCCP), lacks mathematical presentation: we need new Mathematics. Read **NB** at p. **6** below.

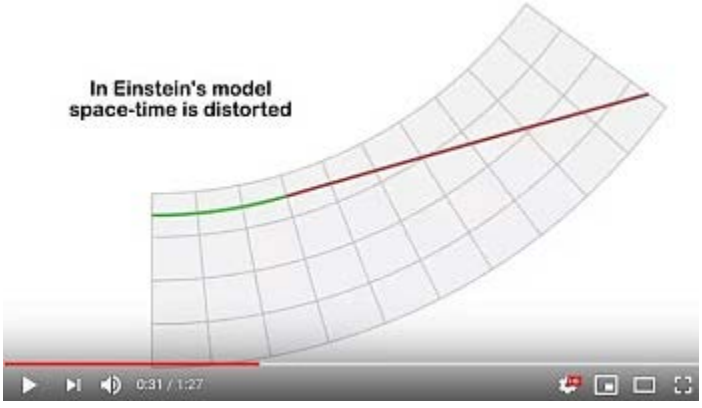
Feel free to download the latest version of this paper from this http URL.

D. Chakalov
20 March 2020
Last update: 2 April 2020, 11:52 GMT

## Addendum 1

### General Relativity: Einstein vs. Newton

https://www.youtube.com/watch?v=DdC0QN6f3G4




"In Einstein's model space-time is distorted." Fine. But there is no ***explicit*** time parameter $\tau$ in GR: read Carlo Rovelli, Bill Unruh, and Charles Torre. Why? Because the Heraclitean *flow* of Time, shown with the **radius** of the 'inflating balloon' (Hubble), is missing in Einstein's equations. The misleading drawing by John Baez and Emory Bunn above shows "Einstein static universe" from 1918 **without** the crucial *unphysical* inflating **radius**.

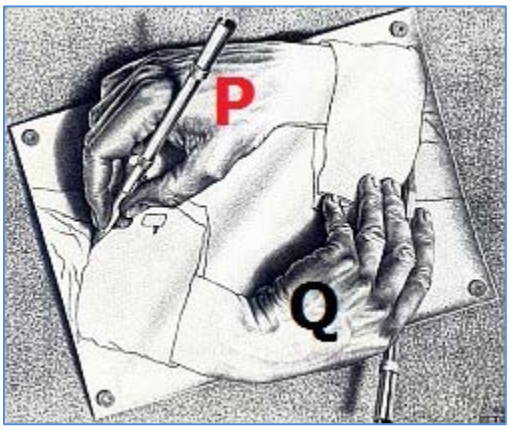
We read that "space acts on matter, telling it how to move. In turn, matter reacts back on space, telling it how to curve." (J.A. Wheeler, p. **1** in Gravitational Energy.)

Fine. But which goes **first**? Space acting on matter (telling it how to move) or matter acting on space (telling it how to "curve")? See again Escher's 'drawing hands' and my note on the spacetime interval $\Delta\, \mathbf{s}^2$ (R.M. Wald, Ch. 11, p. 286) here. Simple, isn't it?

In GTR, the statement by J.A. Wheeler above is amended as follows:

> Space**time** acts on matter, telling it how to move-and-rotate. At the same instant, matter acts back on space**time**, telling it how to ***alter*** the *rate* of Time in the invariant spacetime interval $\Delta$ **s**$^2$.

Namely, the local *deflation* of $\Delta$ **s**$^2$ creates attractive gravity, like going from Bob (**B**) to Alice (**A**), and the local *inflation* of $\Delta$ **s**$^2$ creates repulsive gravity, like going from Bob (**B**) to Carol (**C**): p. **12** in GTR and p. **2** above. See the 'general rule' (**1 + 0 = 1**) in p. **2** in Gravitational Energy and the 'atom of geometry' at p. **7** therein, shown below.




The Platonic hand (**P**) in 4D glove (**Q**).
Examples from QM in The Physics of Life.

The arrow of Time *cannot* be modeled with *temporal orientability* of spacetime: see the enormous smashing **errors** by Robert Geroch and Gary T. Horowitz in 1979 here. The *orientability* of **3D** space by "a choice of spatial parity" ("left-handed and right-handed triads", *ibid*.) is also **false**. The fact that in 3D space we can invert 2D *left* rubble glove into its mirror image of 2D *right* rubber glove (parity inversion) does ***not*** represent the fundamental *asymmetry* in spacetime topology: time reversal symmetry (**t** $\Leftrightarrow$ **-t**) and left glove $\Leftrightarrow$ right glove symmetry (parity inversion) do *not* model the fundamental *asymmetry* along the **3D** "axis" of Small and Large. That is, if you have a large 3D ball in front of you, you cannot "invert" it ***inside-out***, so that you will wind up *inside* the ball. Do you know how mathematicians would catch a lion in Sahara? Check out p. **19** in Hyperimaginary Numbers and Mark Armstrong at p. **26** in BCCP. The non-trivial topology of spacetime is a big can of worms, which has been quietly swept under the carpet by the established mathematicians and theoretical physicists.

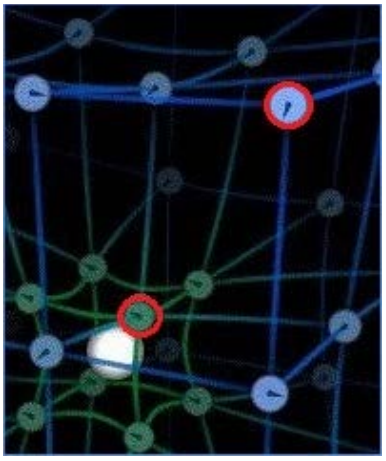
Further information on the flow of Time is available to qualified individuals: read the last paragraph of p. **15** in Über Die Gravitationsfeldrelativitätstheorie.

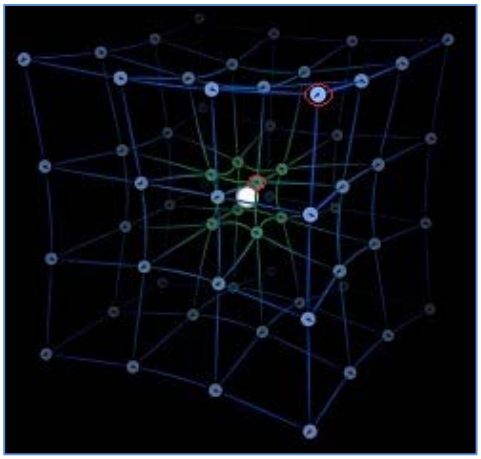
Feel free to download the latest version of this paper from this http URL.

D. Chakalov
24 March 2020
Last update: 7 April 2020, 12:55 GMT

## Addendum 2

This is what we know about gravity: read William G. Unruh and compare the local *rates* of time read by the two (highlighted) clocks in the animation (time.gif) below.





Read the principle of GTR at p. **4** above. There is no ***explicit*** time parameter **τ** in GR: read Carlo Rovelli and Charles Torre, as well as Adam Helfer, Mihaela Iftime, and my comments at p. **4** in The Atemporal Platonic World. The latter is always **nullified** in the ***squared*** spacetime interval $\Delta \mathbf{s}^2$ (R.M. Wald, Ch. 11, p. 286): click here. If it were possible to "discover" a *local* expression for gravitational field energy density (*ibid*.), the gravitational field will be local tensorial observable (L. Szabados and MTW p. 467) and gravity will become a *classical* force field. Therefore, GR cannot be a *bonafide* classical theory. But it cannot be quantum theory either. We need quantum gravity. We need Mathematics.

More in Über Die Gravitationsfeldrelativitätstheorie and Gravitational Energy. There are *two* classical limits in quantum gravity, depending on the "direction" taken from the macroscopic world (denoted **B**) along the **3D** "axis", toward the Small or the Large (p. **12** in GTR): (**i**) from Alice (**A**) to Bob (**B**), and (**ii**) from Carol (**C**) to Bob (**B**). At the first classical limit (**i**), the nonlocal effects from the quantum world are FAPP zero; for example, in the effect discovered by Charles Wilson. At the second classical limit (**ii**), the nonlocal effects from large-scale gravity are also FAPP zero. That is, the *physicalized* effects facilitated (Sic!) by the "glove" (**Q**), as explained with **P** → **Q** at p. **2** above, do not lead to any "anomalous" **Q**; for example, in Earth tides. There is no violation of energy conservation by "dark energy" or by "mystery matter" at (**ii**): the phenomenon of **self-action**, exhibited also in the human brain, is FAPP zero, too. With very few exceptions, people can use at (**ii**) only Newtonian gravity (e.g., NASA), and everything is sweet, because nobody dares to talk about gravitational rotation.

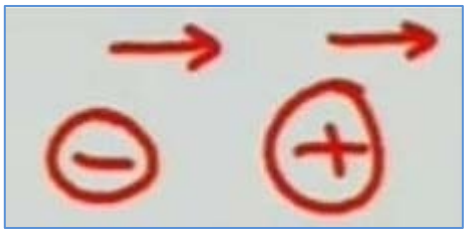
Those interested in quantum gravity would eventually acknowledge that it would be "ferociously difficult" to understand the *emerging* of spacetime from 'something else' (C.J. Isham and J. Butterfield), although Plato suggested it many centuries ago (p. **2**).

The latest feedback to my *pre-geometric* **Platonic** theory of spacetime, initiated in July 1997, came eight years ago from Prof. Dr. Maurice de Gosson at the University of Vienna: "Buzz off, idiot!" (Mon, 21 May 2012 18:47:46 +0200). That's it. Nothing else.

Regarding the topology of spacetime discussed at p. **4** above: the **4**+**0** D spacetime, made exclusively by ***physicalized*** 4D 'jackets' **Q** (p. **2** above), has simply connected topology of ***perfect*** continuum, as it consists of one asymptotically flat ($\Omega_0$=1) 'piece' that does not have any "holes" denoted **P** above. The intrinsic *dynamics* of spacetime topology is highly non-trivial, as it also requires hyperimaginary numbers. This is how we live in **4**+**0** D spacetime ($|\mathbf{w}|^2 = \mathbf{0}$): read carefully pp. **3**-**4** in Gravitational Energy.

**NB**: In my model of causality (dubbed *biocausality*, January 1990; p. **16**-**17** in Zenon), the *atemporal* **Platonic** world, denoted **P** above, is *exactly* **re-nullified**: read here. Thus, we can observe *only* matter (**Q**) acting on *itself* (**Q**): the universal **self-action**.

The new **re**-interpretation of the so-called negative mass (H. Bondi 1957) is *the* only possible path toward the explanation of universal **self-action**. Nature does not put "positive and negative mass side-by-side", as Robert Nemiroff claimed at YouTube.



Read Robert L. Forward at p. **13** in Hyperimaginary Numbers and the explanation in p. **3** therein. It is not like Baron Münchhausen. Newton's 3rd law is not valid here. The end result is *uncancelled* forces and self-acceleration by universal **self-action** of the *physicalized* world **Q**: see **P** → **Q** at p. **2** above.

To understand how the universal **self-action** is implemented by your brain, try the experiment at p. **5** in Gravitational Energy. Also, watch Flavian Glont arranging $10^{30}$ permutations of the Rubik Cube blindfolded: at the end of the video clip posted here, he finished with arranging the cube and then "looked" at it for nearly **2**s. But he was still blindfolded, so what was he "looking" at? Watch Kyudo Master Ishikawa-san here. This is Spacetime Engineering 101: read p. **6** in Gravitational Energy and p. **16** in GTR.

We need advanced, large-scale effects of spacetime engineering. The best example is Anomalous Aerial Vehicle (p. **16** in BCCP), but first we need to know *much more* about gravity and gravitational rotation (Richard Feynman). Suppose, just for the sake of the argument, that one day some guy decides to fly over River Thames in London. Surely many tourists there will be fascinated (tourists love free entertainment), but what is the chance for the established mathematicians and theoretical physicists to become interested in spacetime topology, the origin of gravity, general topology, set theory, and number theory viz. hyperimaginary numbers (pp. **22**-**23** in BCCP)? When pigs fly.

Again, further information on the flow of Time is available to qualified individuals: read the last paragraph in p. **15** in Über Die Gravitationsfeldrelativitätstheorie. Read also the story about the 'large yellow button' at p. **15** in Hyperimaginary Numbers.

Read my questions to Sir Hermann Bondi here and download the latest version of this paper from this http URL.

D. Chakalov
27 March 2020
Last update: 4 April 2020, 23:55 GMT

## Addendum 3

I asked a friend of mine (p. **5** in Über Die Gravitationsfeldrelativitätstheorie) to read this online paper and to tell me if he could understand my interpretation of gravity. He replied today with text message "Sorry, cant read it". Obviously, it is my fault. Let me try harder. Quote from *The Adventure of Silver Blaze*, by Arthur Conan Doyle:

Gregory: Is there any other point to which you would wish to draw my attention?
Holmes: To the curious incident of the dog in the night-time.
Gregory: The dog did *nothing* in the night-time.
Holmes: That was the curious incident.

The 'curious incident' here is the *origin* of gravity, denoted **P** at p. **2** above. It can *never* show up in the physical world, just like Eliot's "mystery cat" called Macavity.

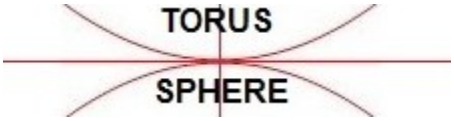
We see (with light) only the *end result* **Q** from **P** → **Q** . The latter only ***facilitates*** the *origin* of gravity (**P**) to act like a **hand** (**P**) in **4D** glove (**Q**): see Escher's drawing hands in p. **4** above. Surely I can see (with light) my dog Linda (**L**) waving her tail (**Q**), **L** → **Q** (read p. **2**), so how come we *cannot* trace with light **P** → **Q** ? Because the *origin* of gravity, pictured with the **Platonic** (**P**) above, is *atemporal*: read closely p. **31** in Platonic Theory of Spacetime and notice the two *atemporal* "waves", dubbed offer wave and confirmation wave, at p. **7** in Gravitational Energy. With a physical clock, the duration of the *atemporal* "waves" is ***zero***: **P** itself *never* "barks". Only the *end result* **Q** from **P** → **Q** . Notice that **Q** is universal, from apples (p. **1**) to galaxies.

Thus, any time you look at me, the *atemporal* "waves" have *already* (Sic!) produced the **4D** glove **Q** in **P** → **Q** . This is the meaning of 'at the same instant' in GTR above.

But what is 'atemporal'? Follow the experiment mentioned at p. **6** above. Capiche?

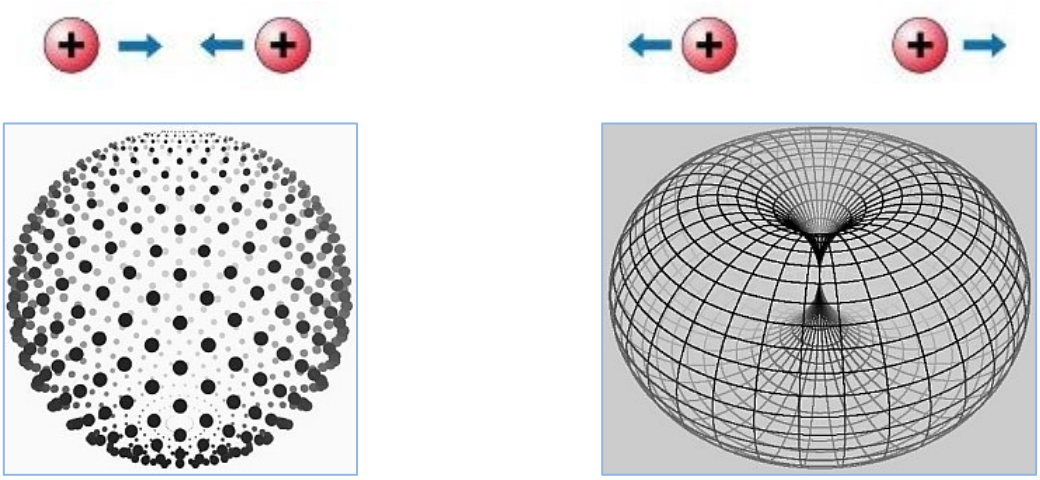
Note to GR experts: read Hermann Bondi and my two questions here. Let me know what you could not understand, it will be entirely my fault. See the references here.

Note to mathematicians: if you are interested in spacetime topology, the origin of gravity, general topology, set theory, and number theory (pp. **22**-**27** in BCCP), feel free to contact me by email. The task is to develop the phase space of the **Platonic** world (read **A4** on p. **4** in GTR) and reveal the so-called hyperimaginary numbers and two forms of gravity (see below) in asymptotically flat ($|\mathbf{w}|^2 = \mathbf{0}$) **4**+**0** **D** spacetime.




The *atemporal* sphere ⇔ torus transitions (pp. **20**-**22** in BCCP).

Look at the **circle** in the sphere ⇔ torus drawing here, and picture the point at the top as 12:00 from your analog watch. Then *inflate* the circle until the length of its **radius** (p. **21** in BCCP) reaches actual/completed infinity, shown with the horizontal line in the drawing above. At this 'point zero', the **radius** will be *exactly* zero as well: it will be **fused** with all points from the former circle. You keep inflating, but now you are inflating a torus, and you'll pass through the same 'point zero' back to the circle. **NB**: You will also *rotate* the **3D** sphere ⇔ torus, in infinite-dimensional Hilbert space.



Read p. **11** in Spacetime Engineering and pp. **11**-**12** in GTR.

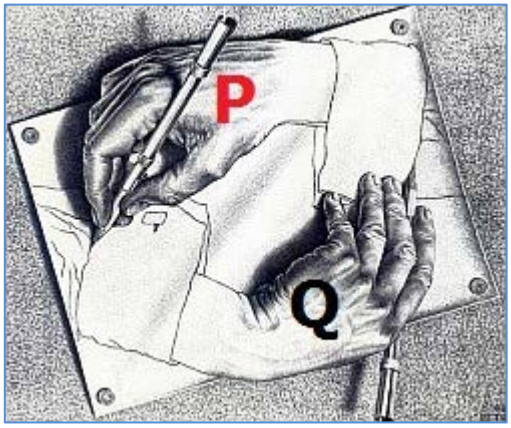
As stated above, the task is to develop the *phase space* of the **Platonic** world, in which one could "see" all points in the physical world *simultaneously* and from all directions in **4**+**0** **D** spacetime, including the *inner* structure of solid objects and things obscured from three-dimensional viewpoint; for example, all six sides of an opaque box (Wikipedia) and, at the same instant, *everything* that is inside the box, from "inside out". Hence you will be able "see" the *atemporal* **Platonic** image (also called **matrix**) of the opaque box and work with '**It**' (pp. **5**-**7** in Gravitational Energy).

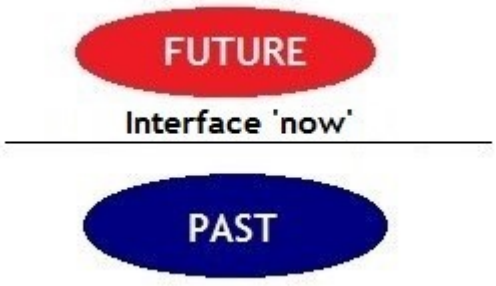
As always, I am ready to explain the task (p. **22** in BCCP) in details. The full-blown quantum gravity (cf. p. **5** and my endnote here) can describe only the **self-acting** Brain of the Universe, similar to the human brain: the ultimate **4D** '**glove**'. The ultimate Platonic **'hand'** (denoted **P** in p. **4** above) can manifest itself only by pure mathematics, as quantum gravity enters physical theology (John 1:1; Luke 17:21). If it were possible to *reduce* physical theology to physics and mathematics, people could propose a theorem of the existence of God *without* UNdecidable statements. Then God (1 John 4:8) could be either proved or disproved. Thank God, this is impossible.

Let me stress, however, that the idea of God is inherently incomprehensible with human cognition based on binary logic and the current formulation of set theory. The same restriction applies to the incomprehensible idea of 'the Universe as ONE' viz. 'universal set' discovered in 1899 by Ernst Zermelo. This was the reason to formulate the so-called Maximal Set Theory (MST), in which I introduced the Axiom of Existence (details upon request). Check out the doctrine of *tralism* at p. **25** in BCCP and pp. **5**-**6** in Über die Substanz von Raum und Zeit. In one sentence: Nature is smarter, as **It** (not "He") contains *absolutely* everything fused into **ONE** incomprehensible entity. The bi-polar structure of both physical world (*Res extensa*) and noetic world (*Res cogitans*) is inevitable, as demonstrated by both the theory of relativity and the human cognition: we can formulate an ordinary set, denoted **A**, iff we can relate **A** to **non-A**. Otherwise the notion of 'set' will be incomprehensible to us. But again, Nature is smarter. The latter statement cannot be proved nor disproved, in line with the Axiom of Existence.

In Platonic theory of spacetime, the "intuitively clear" statement that the distance from a point *to itself* is "zero" (Wikipedia) is amended with the new notion of 'zero' in **4**+**0 D** spacetime: the Universe as **ONE** at **sub-photon** level "inside" null intervals (**x** = **±ct**). Read about physical theology on p. **12** in GTR and on p. **2** ('**It**') in Plato.

How do we ***split*** the geometric point that "has no part" (Euclid)? See again (p. **4**) the general rule (**1 + 0 = 1**) at p. **2** in Gravitational Energy and the new *atom of geometry* (p. **7** therein) reproduced below.



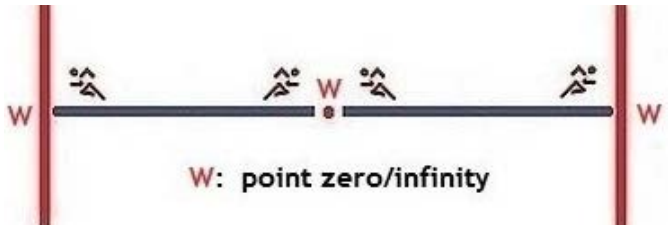

**P** (potential future) → **Q** (past)

We need Mathematics: read p. **8** above.

Note to theologians: God is by no means "downgraded" in physical theology. Instead, we postulate that Nature has two ***dual*** and ontologically different explications, which are *equally legitimate* "copies" of Nature, similar to wave-particle duality. See again the doctrine of *trialism* at p. **25** in BCCP. It doesn't matter if people commemorate Jesus' Birthday, or choose the *complementary* "copy" called 'the Universe as ONE'. They both are correct. It is up to your free-will decision, which is a gift from God as Love (1 John 4:8). Only you will decide which "copy" suits you best. I choose both. In my opinion, both theism that anti-theism are *horrible* brainwashing religions. Period.

Let me go back to (**i**) the interpretation of gravity (p. **7**), which depends on (**ii**) the new notion of 'zero' applicable to the Platonic Universe as **ONE** at **sub-photon** level (p. **9**) called '**It**' (p. **2** in Plato). The origin of inertia (John Wheeler) and gravitational rotation (Richard Feynman) is still unknown, so the proposed interpretation of gravity (**i**) cannot be tested – it will look like sheer "entertainment" (p. **6**). The second issue (**ii**) cannot be verified either, as we still do not know the topology of spacetime in the first place: read p. **4** above. At this moment, I can only offer the explanation of '**It**' (**ii**) with the "boundaries" of spacetime.

**NB**: If the reader can offer *any* other theory of fixing spacetime "boundaries", then my theory will be **wrong**, and I will immediately delete this paper and my website. Bottom line is that these "boundaries" ***must not*** belong to the physical **4**+**0** **D** world. The Platonic Universe as **ONE**, called '**It**', **wraps** the entire *physicalized* world, being both "inside" the spacetime point with **zero** dimensions (p. **9**) and infinitely far away, "outside" the entire *physicalized* world at null and spacelike infinity denoted **W** :




The Universe is like an unbroken ring with no circumference, for the circumference **W** is nowhere and the center **W** ('**It**') is everywhere.

Look at the **dark** "boundaries" of spacetime below, discussed at p. **5** in Zenon.

The dark "pizza" shows the idea of 'inflating universe' pictured as the *surface* of the inflating balloon, after Arthur Eddington. We cannot see the **nullified** *atemporal* **radius** of the inflating balloon and its **center** at 'time zero' (John 1:1). Physically, we live in "inflating" **4**+**0** **D** universe. You may try to suggest *physical* "boundaries" of spacetime, but they **must** (Sic!) be accessible from ***within*** spacetime and will inevitably belong to the **4D** physical world; for example, some GW mirrors placed *exactly* at the **dark** boundary of the "pizza". Can't have you cake and eat it. You need new spacetime "boundaries" fixed by '**It**'.

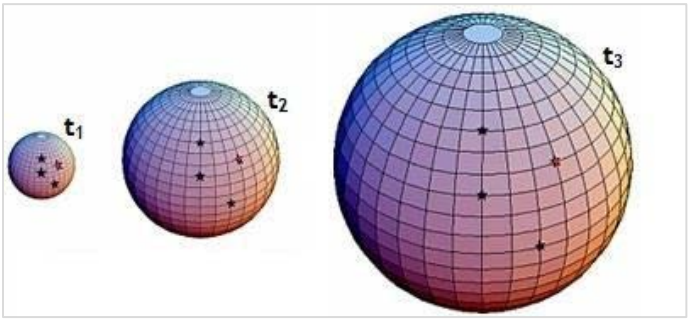
Needless to say, the *atemporal* Platonic '**It**' could be accessible with the human brain.

Feel free to download the latest version of this paper from this http URL.

D. Chakalov
6 April 2020
Last update: Easter 2020, 20:56 GMT

## Addendum 4

This is the balloon analogy by Arthur Eddington from 1933: every **4D** point/event on balloon's surface (p. **9**) belongs also to the nilpotent (Sic!) **radius** denoted **W** (p. **10**).




Consider the time-like sequence (world line) from the Beginning: $T_0$, …, $t_1$,$t_2$,$t_3$, … . Notice the drawing at p. **6** in GTR:


The Beginning at $T_0$ will **disappear**.

Back on 8 May 1998, Ned Wright explained: "the balloon analogy is a 2-dimensional model, and the center of the balloon and the space around are not (Sic! – D.C.) part of the 2-dimensional universe. In our 3-dimensional universe, these points could only be reached by traveling in a 4th spatial dimension (not the time dimension of 4-D spacetime), but there is no evidence that this dimension exists."

Sounds fine, but why "**4th spatial** dimension"? In my opinion, we face ***pre-geometric*** infinite-dimensional Euclidean space $\mathbf{R}^{\infty}$. Let me try to explain.

Fig. **A** below shows one of the six sides of an opaque box: read p. **8** above. To "see" all six sides instantaneously, you will need a new god Janus capable of seeing objects *simultaneously* along the three spatial axes, **x**/**-x**, **y**/**-y**, **z**/**-z**, and also along **t**/**-t**. We can look at one of the six sides, once at a time; for example, along axis **z** (not shown in Fig. **A**) orthogonal to **x**/**y** plane. Fig. **B** is borrowed from Mark A. Armstrong (*Basic Topology*, Springer, 1997, Fig. 5.7, p. 104): read p. **19** in Hyperimaginary Numbers. Can you count all ***infinitely many*** arrows in Fig. **B**, including those "inside out"? $\mathbf{R}^{\infty}$!

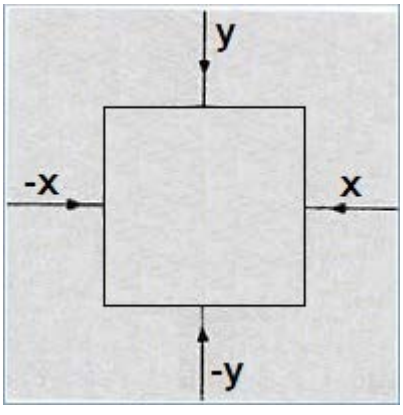



Fig. **A**

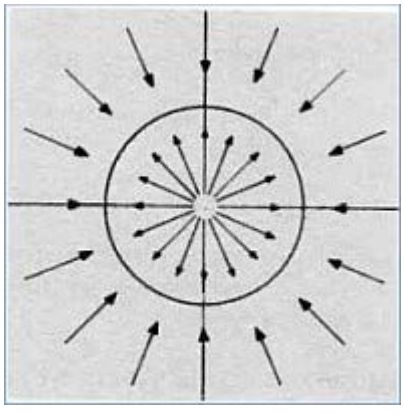


Fig. **B**

To understand Fig. **B** above, recall the old joke about how to catch a lion in Sahara: see the small **red** circle in Fig. **C** below.

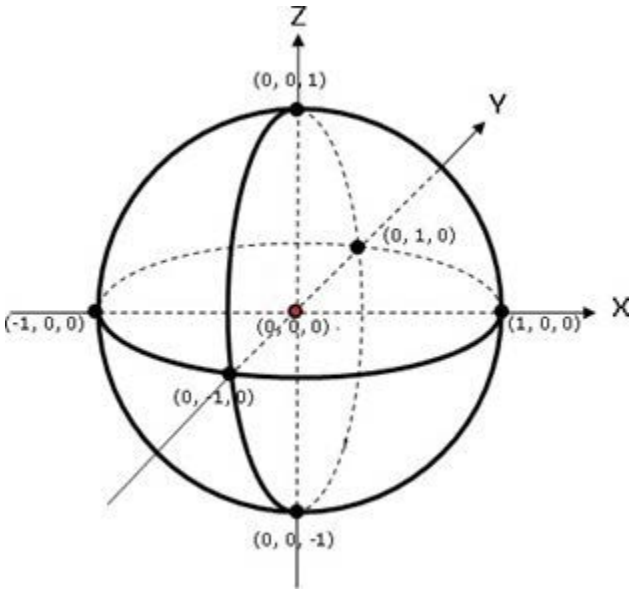



Fig. **C**

If you ask a mathematician, she would probably suggest that, given the existence of at least one lion there, she would drag a cage for lions in the middle of the desert, lock herself up, and then perform space inversion with respect to the cage surface (the circle in Fig. **B** above), such that all points outside it will be converted inside the cage, and *vice versa*. At the end of the day, she will find herself outside the cage, while the poor lion will be locked inside, and they both will undergo parity inversion.

Our task is far more complicated – read p. **8** above. The so-called point zero/infinity, depicted in the drawing at p. **10**, is the ***breaking point*** in sphere ⇔ torus transitions (p. **8**). I tried to explain it to my (adult) children, but they weren't interested at all. Only Linda showed genuine interest in the *phase space* of the **Platonic** world. Anyway.

Read again **NB** at p. **10** above. The *only* possible path toward understanding gravity and inertia (p. **1**) is by separating the *origin* of gravity (**P**) from the *effects* of gravity (**Q**): **P** → **Q** (p. **2**). And **P** is '**It**' (p. **10**). This is the *only* possible path toward quantum gravity as well (p. **2**). Not convinced? No problem, start from the *rate* of time (p. **5**). My solution is spelled out on p. **4** above. What is yours?

The latest version of this paper can be downloaded from this http URL.

D. Chakalov
Great Friday 2020, 22:37 GMT

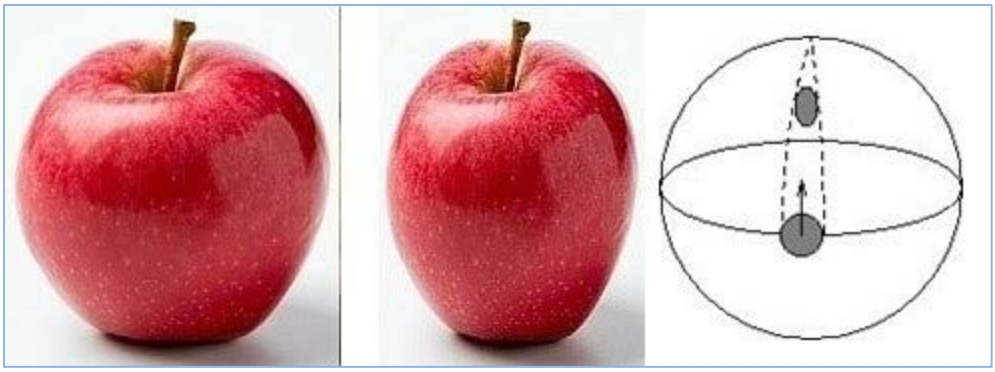
## For the Record

I am organizing two-day conference **GRAVITY 21** on 26-27 March 2021 in Munich (EU), to present my theory of gravity (reference below) and discuss it with many experts in mathematical general relativity and topology of spacetime (p. **4**). If the reader would like to present her/his theory of gravity, please contact me by email, available at my website, by Christmas 2020. The conference will cover three topics:

**1**. Continuum of geometric points. How do we define the notion 'zero' pertaining to an object that must *not* exist "between" geometric points in a *perfect* continuum? **It** cannot be an 'empty set', because **It** *cannot* be a 'set' in the first place. What is '**It**'? The *pre-geometric* continuum (**P**) is *infinitely divisible* by *physicalized* **4D** events (**Q**). The latter has positive mass and metric (*Res extensa*): **Q** is located on the light cone.

**2**. Structure of physical spacetime. Given the invariant speed of light and calibration of 4D spacetime in 'meters of light-travel time', how do we define the non-relational *flow* of time? With the exception of photons, all physical bodies (**Q**), standing still in their reference frames, will nevertheless "fly" in time, with different *rates* of time.

**3**. Physics of gravity. In General Relativity, we attribute gravity to geometry, like the *shape* of a mountain, but how can the 'shape' itself ***act back*** on the 'mountain'? Can Bondi's 'news tensor', which determines the "energy flux" of gravitational radiation, produce ***work*** on the apple? Or "gravitational waves" (GWs) and "gravitons"? Can the topological properties of spacetime (forget "curvature") produce inertia & rotation?



*Disce aut discede*.

Easter 2020, 13:00 GMT

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D. Chakalov, Can Geometry Produce Work? viXra:2003.0425, 2020-04-17.
https://vixra.org/abs/2003.0425

The Continuum of Geometric Points, by D. Chakalov. Presented on 26 March 2021 at **GRAVITY 21**, 26-27 March 2021, in Munich, EU.

**Abstract**. I suggest perfect *pre-geometric* Platonic continuum (**P**), which is *infinitely divisible* by *physicalized* points/events (**Q**) in the action **P** → **Q**. The former (**P**) is not observable with light, as suggested by Plato, whereas **Q** is located on the light cone.

## 1. Introduction

In number theory, we picture the idea of real numbers as "points on an infinitely long line called the number line" (Wikipedia):

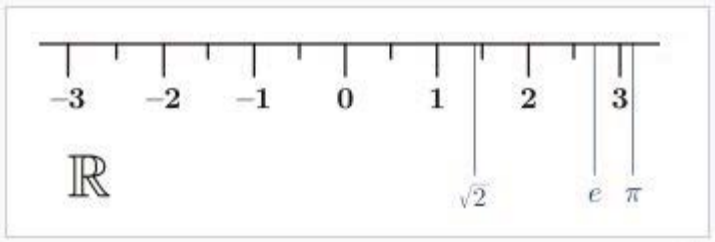


Fig. 1

Our cognition is relational: we can *think* of an individual point (**A**) iff we can relate it to something this point is not — **non-A**, pictured in **black** (Fig. 2). Fine, but what do we see in Fig. 3? **Absolutely all** (absolute infinity) *non-denumerable* white points from the finite segment of the number line (Fig. 2). This is the *perfect* continuum of the *pre-geometric* Platonic world called '**It**', also denoted **P** in the action **P** → **Q**.

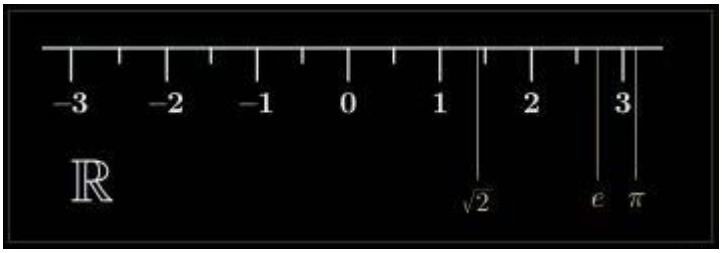


Fig. 2

Fig. 3

I will argue that (**i**) '**It**' (Fig. 3) is located "between" every *individual* (white) point in Fig. 2, and that (**ii**) '**It**' does ***not*** belong to the denumerably infinite set of individual (white) points in Fig. 2. Namely, the *uncountable* cardinality of the set '**It**' (Fig. 3) is greater than Aleph-null, and hence '**It**' can provide the unique **cutoff** on the physical world in Fig. 2: the Platonic entity '**It**' is one "point" stretched to absolute infinity. In the physical world endowed with metric (Fig. 2), '**It**' always "disappears", being set to "zero", like Eliot's cat Macavity living "inside" null intervals (**x** = **±ct**), presenting the dimensionless 'geometric point' in Fig. 2, which 'has no parts' (Euclid) anymore.

The individual (white) points in Fig. 2 work as blank templates or "colorless canvas" for the *physical* (Sic!) content undergoing '*change in time*', resembling the individual snapshots from a movie reel – without the **dark strips** separating the snapshots, there will be no 'change in time' and all **4D** snapshots from the movie reel will be fused into one QM "snapshot" of infinitely many *atemporal* superposed states. Notice that the "colorless canvas" of *bare* geometric points (Fig. 2) is like the invisible ***colorless*** nails shown in Fig. 4: we see only their *physical* "colors" that will '*change* in time'. Yet the invisible "colorless canvas" has its own topological structure demonstrated with the unique ***calibration*** of **4D** spacetime (Fig. 5). To quote E.F. Taylor and J.A. Wheeler in *Spacetime Physics* (1965, p. 18): "We assume that *every* clock in the latticework, whatever its construction, has been calibrated in meters of light-travel time."

Fig. 4

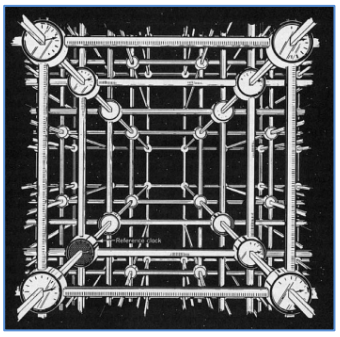

Fig. 5

**NB**: What phenomenon "calibrates" the **ideal** rods and clocks (MTW p. 397) pre-build in spacetime (Fig. 5)? As Arthur Conan Doyle remarked, when you have excluded the impossible, whatever remains, no matter how improbable, must be the truth. Here, the *pre-geometric* Platonic continuum '**It**' (Fig. **3**), offering the *only* possible solution to Thomson's lamp paradox, as shown in the operational (***ε*, *δ***) "definition" of limit.

## 2. The Platonic hand (P) in 4D glove (Q)

Let us examine an operator **P** → **Q**. Back in July 1997, I called the *pre-geometric* Platonic continuum (**P**) 'the undefinable matrix', and stressed that '**It**' is inherently incomprehensible. In QM parlance, the Platonic continuum (**P**) is only "projecting" its ***colorful*** localizable **4D** eigenstates **Q** – one **Q** at a time, placed only at the apex of the light cone. Hence the "projecting" operator **P** → **Q**. The *physicalized* partition of the Universe is just a **Q**-set. We cannot 'turn around' and look at the Platonic world (**P**), as Plato suggested many centuries ago. Why not? Because of the "speed" of light.

The Platonic world (**P**) does **not** produce any resistance to bodies (**Q**) "passing through it" (Wikipedia), just like *the* quantum state (dubbed John) and the quantum vacuum. There is no "space devoid of matter", for the same reason that there can be no 'time devoid of matter'. Light does not "propagate" in some luminiferous aether, but in the Platonic continuum (**P**) depicted in Fig. **3**. The "absolute" reference frame is "inside"

each and every **4D** point/event, camouflaged as '**zero** event'. The '**It**' is omnipresent. Strictly speaking, '**It**' has *indefinite* cardinality in **[**0,∞**]** and cannot be Cantorian set.

To wrap up, let me go back to Fig. **2** and explain the "structure" of (white) ***geometric*** points, for example, in the closed interval [0, 1] shown in Fig. 6 below.

As told by Aristotle *(Physics VI:9, 239b10),* Zeno of Elea (490-430 BC) has formulated the famous dichotomy paradox: that which is in locomotion must arrive at the half-way stage *before* it arrives at the goal. In Fig. 6, we imagine **B** going back to **A**, so that **B** can and will **stop** *only* at the ultimate limit **B≡A** (Sic!), which denotes *one single* dimensionless point (Euclid), and locomotion will be impossible. Moreover, the ultimate limit **B≡A** is UNdecidable, as demonstrated with Thomson's lamp paradox.

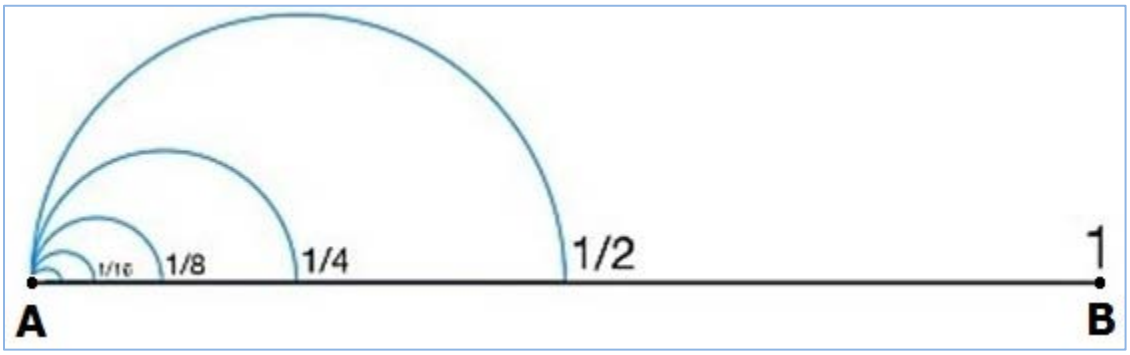


Fig. 6

[0, … , 1/16, 1/8, 1/4, 1/2, 1]

The only possible solution to Zeno's paradox is to endow *every single* point in [**AB**] with *pre-geometric* Platonic "structure" (Fig. **3**) and dynamics: the operator **P** → **Q**.

What can we make from this metaphysical exercise? Quantum gravity and cosmology, but only as conceptual theories. We need Mathematics.

Let me examine the paradoxes in the operational (***ε, δ***) "definition" of limit (Fig. 6), which produce insoluble problems in understanding the properties of spacetime ***exactly*** at the asymptotic "boundaries" (if any). In my opinion, the so-called 'local differential geometry' (Bob Geroch) is Russian poetry, to say the least. There can be nothing 'local' in the operational definition of 'infinitesimal' – you only have a recipe that, if **B** runs indefinitely toward **A** (Fig. 6), at the end of the day **B** *can* obtain some number, say, **C**. But is **CA** "explicitly nonzero" or **C≡A≡0** on the number line (Fig. **1**)?

The solution is very simple: every real number, depicted with (white) *geometric* point in Fig. **2**, is particular **Q** from the operator **P** → **Q**. The *physicalized* world is **Q**-set with **4+0 D** spacetime – **P** is ***squared*** and *exactly* nullified, just as *the* quantum state (dubbed John) mathematically disappears upon the wave function "collapse". Thus,

we see (with light) only a *temporal* sequence of *different-in-time* "jackets" from the **Q**-set, $\mathbf{Q_1, Q_2, Q_3}$, … , along the non-relational ***flow*** of time – all physical bodies (**Q**), standing still in their reference frames, will nevertheless "fly" in time. Therefore, the *only* possible solution to Zeno's paradox of motion-in-time is to endow the geometric point **A** (Fig. 6) with *different-in-time* **Q**-states placed at the beginning and the end of the *infinitesimal* (Sic!) time displacement: $\mathbf{Q_1 \rightarrow Q_2}$ denoted $\mathbf{\Delta t}$ . Hence at the ultimate limit **B≡A** (Fig. 6), B will ***not*** hit $\mathbf{A_1}$ but its ***next*** temporal "copy" $\mathbf{A_2}$, such that $(\mathbf{A_2} - \mathbf{A_1}) = \mathbf{\Delta t}$ . Again, **P** from the operator $\mathbf{P \rightarrow Q}$ is not observable with light.

We need the so-called hyperimaginary numbers to "insert" the Platonic *pre-geometric* continuum **P** "inside" the infinitesimal $\mathbf{\Delta t}$ .

### 3. Hyperimaginary Numbers: $|\mathbf{w}|^2 = 0$

The real numbers (Fig. **1**) may look simple: watch the explanation of 'instantaneous velocity' by Michel van Biezen at YouTube, particularly 2:50-3:08 from the timeline:

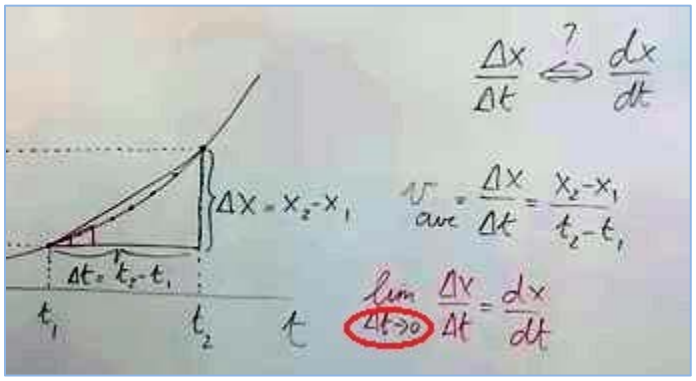


Fig. 7

Is (**i**) $\mathbf{\Delta t \equiv 0}$ *or* (**ii**) $\mathbf{\Delta t > 0}$ **?** Which is the correct answer, (**i**) *or* (**ii**)? Neither. As Murphy noticed, complex problems have simple, easy-to-understand wrong answers. Read the solution above. In the case in Fig. 7, we cannot show the *pre-geometric* continuum **P** "inside" the infinitesimal $\mathbf{\Delta t}$ . To show '**It**' (Fig. **3**), we need the **Platonic** quantum world (**P**) "just in the middle between possibility and reality" (Werner Heisenberg).

Look at the atomic "orbitals" of the electron in a hydrogen atom, at two different energy levels, from Wikipedia (Fig. 8). They are not 'trajectories' (Fig. 7).

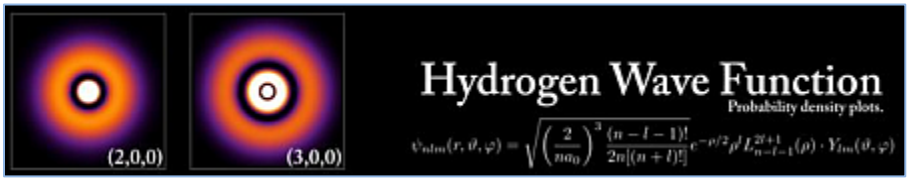


Fig. 8

(TBC)

Munich, Christmas 2020