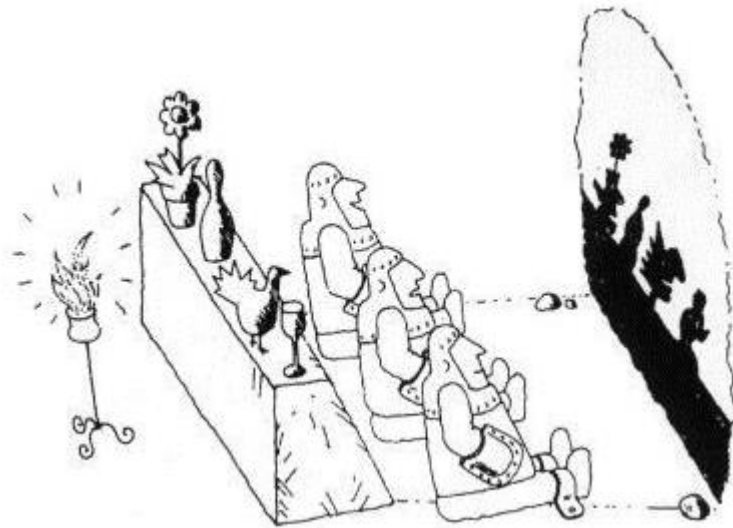


Gentlemen! The views of space and time which I want to present to you arose from the domain of experimental physics, and therein lies their strength. Their tendency is radical. From now onwards space by itself and time by itself, along with the entire physical world, will recede completely to become physicalized 4D shadows of their Platonic source.



About Space and Time

Video lecture, 21 September 2018, 10:00 GMT

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Commemorating 110 years of Hermann Minkowski's lecture [RAUM UND ZEIT](#), given at the 80th Meeting of the Natural Scientists in Cologne on 21 September 1908 and based on the crucial contributions to the theory of Special Relativity by [Hendrik Lorentz](#), [Albert Einstein](#) and [Henri Poincaré](#)², I offer my video lecture, entitled: 'About Space and Time'. It will be posted at my YouTube channel on Friday, 21 September 2018, at 10 AM GMT. Here is a brief introduction to the video lecture, which will be amended with the full text version by the end of September 2018. I hope that the video lecture, backed by its text version with references and notes, will be easier to understand and study.

Ensuing from [Plato's Cave](#) and the ideas by Heraclitus and Aristotle, I present the Platonic theory of spacetime: the atom of geometry (dubbed "point") is treated as complex object endowed with topology, kinematics, and dynamics. It is suggested that what we call 'spacetime' is not some inert geometric object, but a holistic bootstrapping phenomenon, which holds the entire physical world together, as the latter evolves along the so-called Arrow of Space. Hence 'space' and 'time' are interpreted as *emergent* phenomena pertaining solely to the 'wall' in Plato's cave, whereas their nonphysical Platonic source, dubbed 'potential reality' or *Res potentia*, does **not** live anywhere on Plato's 'wall' (called 'local mode of spacetime', pp. 8-9 in [FRAUD.pdf](#)) and remains *perfectly* hidden by the

¹ Email: dchakalov@gmail.com. Download the full version of [about_spacetime.pdf](#) on 30.09.2018 from [this http URL](#).

² H. Poincaré, Sur la dynamique de l'électron, *Comptes Rendus Acad. Sci Paris*, 140, [1504-1508](#) (5 Juin 1905).

“speed” of light. What physicists nowadays call ‘spacetime’ is treated as *local mode* of spacetime relevant only to the *physicalized* explications of the Universe cast on the [light cone](#) – nothing but 4D “shadows” of *Res potentia*, as Plato suggested many centuries ago. Thus, a new quantum-gravitational spacetime, equipped with local and global modes, is proposed for quantum gravity and cosmology: every *physicalized* system is endowed with both 4D local mode of spacetime determined by the local properties of matter and fields, and global mode of spacetime determined by the properties the entire Universe as ONE. It’s a bundle.

First, some history. On 2 June 2008, commemorating the one-hundredth anniversary of Hermann Minkowski’s lecture ‘Space and Time’ on 21 September 1908, I invited many theoretical physicists and mathematicians to attend my talk in Munich on 21 September 2008: read my invitation at [this http URL](#). Now I offer a video lecture, which will be available on 21 September 2018 (read above). Feel free to subscribe by email with subject “About Space and Time, 21 September 2018”. You will receive password to watch the lecture (app. 20 min) and will be able to download it until 10 AM GMT on 30 September 2018. The main idea was explained at my [first talk](#) on 21 September 2008³: every *finite* (bounded) spacetime region has both *local* properties (local mode of spacetime) and *global* properties (global mode of spacetime); the latter are determined by the properties the entire [Universe as ONE](#), most notably by the **self-acting** faculty of Aristotle’s [Unmoved Mover](#). Thus, we arrive at the proposal by [Heraclitus](#) ‘you cannot look twice at the same river’, and suggest that the irreversible *flow* of 4D events ‘here and now’, constituting the local mode of spacetime, cannot be observed in principle due to the “speed” of light. We only have *physicalized* remnants from the **self-action** of the Universe as ONE (global mode of spacetime), which some (otherwise [smart](#)) people consider “[dark](#)”. Simple, isn’t it? Yet ten years after my conceptual solution of “[dark](#)” gravity, it has not been even mentioned!

To give you a glimpse to the forthcoming video lecture, check out (i) [Slide 7](#) and [A2](#) in [Slide 19](#) in [Quantum Spacetime](#), (ii) my comments on the alleged temporal and spatial orientability of spacetime at [this http URL](#), and (iii) pp. [21-26](#) in [Hyperimaginary Numbers](#). Instead of mimicking Nature by postulating the global mode of spacetime ‘by hand’, we should get professional and uncover the proper mathematical formalism and tools.

Notice that the local 4D “shadows” on Plato’s wall (local mode of spacetime) [above](#) are patches from the inflating balloon in [Fig. 4](#) in [Gravity-Matter Duality](#), p. [5](#). If you follow all the links here and study the references, I believe you will easily grasp the Platonic theory of spacetime. The only thing you may not know about it is its *practical* application: spacetime engineering (p. [9](#) in [Gravity-Matter Duality](#)). I will be happy to explain it to all who have subscribed by 10 AM GMT on 21 September 2018 (read above). Yes, we can tweak our common global mode of spacetime ([Fig. 10](#) in [CEN.pdf](#), p. [11](#)). No, it is not “[magic](#)”: Any sufficiently advanced technology is indistinguishable from magic ([Arthur C. Clarke](#)).

Now, to understand ‘space’ and ‘time’, let me stress that their *origin* poses an outstanding challenge. Consider, for example, Sergio Ulhoa *et al.*⁴ (I will talk on the Hubble Law later):

The modern observational cosmology inaugurated at the Mount Wilson Observatory gave a great impetus to understanding the Universe [1]. The Standard Cosmological Model, alongside the Cosmological Principle and field equations of GR, describes all knowledge about large structures with good approximation. The Hubble Law shows how fast galaxies

³ You may wonder, why am I doing these efforts to promote again the Platonic theory of spacetime? Because spacetime engineering is the future. If [people](#) again ignore my work, as they did [ten years ago](#) — so be it. [Matthew 7:6](#).

⁴ Sergio Ulhoa *et al.*, [arXiv:1802.08087v1 \[gr-qc\]](#), 21 February 2018.

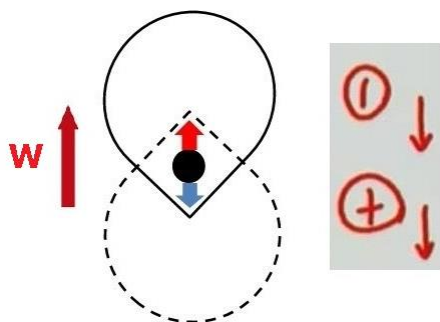
move away from each other at a relatively small distances. Thus it could be used to test new cosmological theories. The Cosmological Principle states that the Universe is isotropic (above 100 Mpc) and homogeneous (there is no center) in addition its dynamics is given by the Einstein field equations, $R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = 8\pi T_{\mu\nu}$. In such a way it is possible to trace a complete time evolution of the Universe. If the time is set backwards we see that everything started in a warm and dense state with domination of the radiation energy. The metric that admits the Cosmological Principle and the dynamics given by the GR is that of Friedman-Lemaître-Robertson-Walker (FLRW) [2-6]:

$$ds^2 = -dt^2 + a^2(t) \left[\frac{dr^2}{1 - \kappa r^2} + r^2 d\Omega^2 \right], \quad d\Omega^2 \equiv d\theta + \sin^2 \theta d\phi^2 \quad (1)$$

where κ assumes values of -1 (negative or closed spatial curvature), 0 (null or flat spatial curvature) or $+1$ (positive or open spatial curvature).

Here's the problem: once we introduce *metric* of spacetime, as Hermann Minkowski did at his famous talk on 21 September 1908, we face the *origin* of spacetime, which must have existed "before" the instant of creating spacetime endowed with metric. This metric paradox prompted Yakov Zel'dovich to suggest that "long time ago, there was a brief period of time during which there was still no time at all." (Private communication; translation mine - D.C.) Needless to say, he was joking. Point is, the metric paradox remained unsolved until the author of these lines found its unique, and highly non-trivial, solution dubbed Finite Infinity (FI)⁵. Do you remember the ancient Dragon [chasing its tail](#)? You need two *dual* states of the Dragon: one in which it has already caught its tail, and another one in which it is only approaching its tail, but can never actually catch it. The first state of the Dragon is called actual or completed infinity, while the second one is known as potential infinity. Blend the two states and you will obtain FI, plus the so-called *dual age* of the Universe (p. 4 in [Hyperimaginary Numbers](#)). But let's go back to the basics.

Let me again suggest, following my previous talk on 21 September 2008, two *modes* of the Universe viz. its spacetime: local mode (determined by actual or completed infinity) and global mode (determined by potential infinity). It's a bundle: see Fig. 3 in [Gravity-Matter Duality](#). We can explain the local mode only by referring to properties of the global mode, and *vice versa*. I will elaborate later on the hypothetical *polarization* of primordial mathematical points (read my comments at [this http URL](#)); for now let me stress that the two *modes* of spacetime exist due to the Heraclitean *flow* of 4D events 'you cannot look twice at the same river'. Prior to the *polarization* of primordial points, the proto-Universe could have existed only as 'non-being' or simply [John 1:1] which, *after* the Beginning, is located "inside" each and every [fleeting 4D shadow](#) 'here and now' ([Luke 17:21](#)).



The **self-action** of the Universe. Check out Fig. 5 in [Gravity-Matter Duality](#), Refs 9 and 10 in [Hyperimaginary Numbers](#), and Sec. 3 in [Panta Rei: The Evolution Equation](#).

⁵ D. Chakalov, [viXra:1410.0194vD](#), 2015-11-08, p. 7; [viXra:1705.0219v8](#), 2017-06-21, p. 6.

Here I won't be able, due to the lack of time, to explain the Heraclitean *flow* of events hidden by the "speed" of light (A2 in Slide 19 in [Quantum Spacetime](#)). Let me briefly mention that the infinitesimal step "forward" along the *flow* of events (dubbed 'Arrow of Space', to be explained later) is *complemented* by infinitesimal step of "rotation". It's a bundle, again. See the drawing [above](#) and study the references. As I mentioned [previously](#), we have *physicalized* remnants from the **self-action** (depicted [above](#)) of the Universe as ONE (global mode of spacetime), which some (otherwise [smart](#)) people call it "dark".

But what is *local* mode of spacetime? It pertains to the *physicalized* 4D world of "shadows" (see [above](#)). It is always "squared" ([Wikipedia](#)) and is placed exclusively in the *irreversible* past of every instant 'here and now' (Sec. 4 in [Gravity-Matter Duality](#)) from the [light cone](#). The *global* mode of spacetime, on the other hand, does not live anywhere on the light cone (pp. 8-9 in [FRAUD.pdf](#)). It inhabits the *potential* future (*Res potentia*) of the same instant 'here and now'. The latter is supposedly endowed with kinematics, dynamics and topology: the transition from potential future to irreversible past (recall the Dragon [chasing its tail](#), p. 3 in [Penrose-Norris Diagram](#)) is neither along an open (straight) causal line nor along a closed causal circle, but is "along" topological *superposition* of the two (Fig. 1 in [CEN.pdf](#)).

Regarding Quantum Theory, the reason for introducing *global* mode of spacetime was explained in [Quantum Spacetime](#). In one sentence: the generic 'quantum state' of every quantum system is an **intact** *Res potentia*, which is neither "particle" nor "wave", does not "[collapse](#)" nor "[decohere](#)", and is not "[uncertain](#)" but *flexible*: God casts the die, not the dice ([Albert Einstein](#)). As to General Relativity (GR), we need the *global* mode of spacetime to understand the origin of inertia ([Ignazio Ciufolini and John Wheeler](#)) and *physicalization* of gravity in (the *local* mode of) spacetime. In current GR textbooks, it just doesn't work ([MTW p. 467](#)) – check out the analogy with gravitational pizza in [Gravity-Matter Duality](#).

In short, I suggest quantum-gravitational spacetime endowed with local and global modes, which could allow us to model the entire Universe as [human brain](#). Now let me more specific on the two modes of spacetime and their origin [[John 1:1](#)].

We assume that 'spacetime' is represented by geometry, but what is 'geometry' made of? What is the *atom* of geometry? We know 'matter' from classical physics, say, tables and chairs or physical fields (e.g., [electromagnetic field](#)). Given the indisputable practical success of Quantum Mechanics (QM), we are sufficiently confident that what we call 'matter' is ultimately rooted on [energy](#), at least to the extent to which mass and energy are "[equivalent](#)" (there is a big can of worms in this issue, which I am not going to open right now). However, we cannot reproduce 'matter' solely from 'energy', because an *absolutely essential* ingredient of the physical world is missing in today's QM textbooks: the **matrix**. Let me quote from the seminal speech by Max Planck *Das Wesen der Materie* (The Nature of Matter) at Florence in 1944:

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.

But the **matrix** is not 'mind' (bewußten intelligenten Geist): the **matrix** is not *Res cogitans*, but the Platonic *Res potentia* or 'potential reality'. Surely one cannot "attach" mind and consciousness to quantum particles and the [vacuum](#); check out a simple explanation on p. 3 in [Hyperimaginary Numbers](#).

But if the **matrix** is not physical stuff (*Res extensa*), how is the physical world related to it? Via its spacetime: the **matrix** operates exclusively in the global mode of spacetime, and the creative effects of the **matrix** (Slides 9, 10, and 12 in [Quantum Spacetime](#)) are being *physicalized* (Sic!) in the local mode of spacetime (Table 1 in [The Spacetime](#), p. 14).

To help you understand the **matrix**, replace it with ‘money’ and imagine a 4D physical universe made only by physical money: you can never see ‘money *per se*’ (global mode of spacetime), but only particular *physical* manifestation of ‘money’ (local mode). You cannot ask profound questions like ‘what are money made of?’, just as you cannot ask ‘what is matter made of?’. Everything in the physical universe, including gold, silver, and crypto currencies, are *physical* manifestations of ‘money’. If you prefer, you may replace the English label ‘money’ with different labels from another languages, say, *argent* (French), *Geld* (German), *pengar* (Swedish), 钱 (Mandarin), etc., yet you can never alter the *meaning* of ‘money’, nor observe its Platonic **matrix** ‘money *per se*’ kept in the global mode of spacetime. Why not? Because you can see only various *physicalized* 4D “shadows” from the **matrix** (see [above](#)) – you cannot “turn around” and look straight at their common **matrix**, as Plato explained many centuries ago. I wish to ameliorate Plato’s proposal by suggesting that the Platonic **matrix** is both ‘one’ and ‘many’ (non-denumerable *Res potentia*), which cannot have any metric, just as there is no *physical* difference between the *idea* (matrix) of a tree and the *idea* (matrix) of a mountain. Also, if the *qualia* from electromagnetic radiation with wavelength 620-750 nm is what we call (in English) ‘red’, keep in mind that there is no *qualia* from the Platonic **matrix**, because the latter is inherently **UNS**peakable: check out a simple experiment with your brain on p. 2 in [Hyperimaginary Numbers](#). Thus, in cognitive psychology the **matrix** corresponds to ‘cognitive vacuum’, whereas in physics *the same matrix* corresponds to quantum vacuum⁶. If we learn how access the **matrix**, perhaps we all will be able to practice spacetime engineering. Again, it is not “**magic**” nor is “**dark**”, as some (otherwise **smart**) people chose to call it. It is neither physical stuff (*Res extensa*) nor mental stuff (*Res cogitans*). It is ‘potential reality’ (*Res potentia*), “just in the middle between possibility and reality” (Werner Heisenberg⁷).

Can we find *Res potentia* in Mathematics? Yes we can. It has been quietly residing in the atom of geometry, dubbed “point” – “that which has no part” (**Euclid**). Let me try to explain, and also show the topological property of spacetime, called Finite Infinity (**FI**).

Look at $R_\infty = \emptyset$ in Fig. 7, p. 9 in [Hyperimaginary Numbers](#), and notice that ‘the Ghosts of departed Quantities’ (**George Berkeley**) has **absolutely** (Sic!) disappeared *exactly* at the limit. Namely, *Res potentia* does not belong to the “points” from the **real number line**, but keeps there only its *physicalized* footprints (p. 8 in [FRAUD.pdf](#)). Thus, we can include **absolutely** all points from the spacetime manifold with **FI** (read [above](#)), by both actual infinity *and* potential infinity: check out p. 6 in [Penrose-Norris Diagram](#).

8 March 2018, 22:42 GMT

(TBC)

⁶ Peter W. Milonni, *The Quantum Vacuum*, Academic Press, 1993, [Ch. 2.6](#).

⁷ Werner Heisenberg (winter 1955-1956), *Physics and Philosophy*, Prometheus Books, 1999, p. 43 and pp. 155-156.