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 Poincaré², 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 Aristotelé, 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.
“speed” of light. What physicists nowadays call ‘spacetime’ is treated as local mode of spacetime relevant only to the physicalized explication 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 2008: 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. (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

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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.

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 Friedmann-Lemaître-Robertson-Walker (FLRW) \([2-6]\):

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

where \( k \) 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).

![Diagram of the self-action of the Universe](image)

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.

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\(^{5}\) D. Chakalov, viXra:1410.0194v0D, 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), 錢 (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 UNSpeakable: 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)