# Relative Scale Spacetime

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## Abstract

Ensuing from the proposals of Plato, Heraclitus and Aristotle,
a new theory of spacetime has been suggested. The scope is
to reveal the origin of gravity and replace the absolute size of
**spatial volumes at different length scales by 'relative scale
spacetime'.**
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> *The next question was - what makes planets go around the sun?*
> *At the time of Kepler some people answered this problem by saying that*
> *there were angels behind them beating their wings and pushing the planets*
> *around an orbit. As you will see, the answer is not very far from the truth.*
> *The only difference is that the angels sit in a different direction and their*
> *wings push inward.*
>
> Richard Feynman, *The Character Of Physical Law*, 1967

The current interpretation of gravity[1] is related to spacetime "curvature" (Fig. 1).



Fig. 1

See the little **red** arrow? We only have a *name* for it: gravity. We cannot suggest an *explanation* of gravity, only a description, as one could describe 'heat' with hot weather which makes you thirsty and you want to jump in the pool. This is *describing* 'heat' with something hot, like describing gravity (the little **red** arrow) with something caused by gravity. It would be like describing heat with some brand new particles, which are very small and terribly hot, say, heatino and its SUSY partner heatinino. An *explanation* of 'heat' requires *reducing* it to 'something else', such as kinetic energy, and then demonstrating how kinetic energy produces what we *described* as 'heat'. But we don't have such *explanation*, and might as well use "angels" instead of "curvature" to *describe* gravity, as Richard Feynman remarked. Why?

Because "curvature" is not an *explanation*, and cannot be linked to any other phenomenon, just like you cannot fit heatino and heatinino in the Standard Model.

For if we cannot define the *entire* spacetime as 'closed system', up to its endpoints at null-and-spacelike infinity (which requires to explain *both* the localization of the energy density[2] of the gravitational "field" at a topological point *and* at the "boundary" of that "field" at null-and-spacelike infinity), we cannot claim that one can boil water with gravitational energy (the so-called Bondi news[3]) nor explain the positivity of mass and *prove* (not assume) the existence of maximal spacelike hypersurface[4]: with gravity, what happens here-and-now depends on the *entire* spacetime[5]. If you have an electric heater at some location in your living room and wish to understand how it works, you don't need to know 'the entire living room' up to its final endpoints *and* the gradient of heat at every point, because you will be dealing with a local source of physical (not *physicalized*) energy and its local effects, and can easily make your living room a 'closed system' by ignoring 'the rest of the universe'.

The conformal speculations of R. Penrose[6] are wrong[38] (explanation at this http URL), so statements such as "since no light rays can enter an asymptotically flat spacetime through I+, no boundary data are needed to evolve the interior spacetime"[7] are wishful thinking. If you replace "no light rays can enter an asymptotically flat spacetime" with 'no light rays can *leave* an asymptotically flat spacetime', you'll run into another mathematical poetry, resembling "event horizon". Regardless of how you would "confine" infinity, it cannot be proved for massive particles in FLRW spacetime.

We cannot *explain* the little **red** arrow by *reducing* it to 'something else', like we explain temperature by reducing it to kinetic energy. We cannot use any physical gravitational field that would be similar to magnetic field. Only the geometry of the *entire* spacetime, but in GR it cannot be defined as 'closed system'[4]. As M. Visser explained (emphasis mine – D.C.), "The essence of the problem lies in the fact that the Einstein equations of general relativity are **local** equations, relating *some* aspects of the spacetime curvature at a point to the presence of stress-energy at that point. What general relativity does not do is to provide any natural way of imposing **global** constraints on the spacetime – certainly the Einstein equations provide no such nonlocal constraint."[8] Moreover, GR cannot determine the topology of spacetime in the first place, and since the topology depends on matter-energy density, while the academic scholars claim that 95 per cent of the stuff of the world were "dark"[9], their efforts to understand gravity resemble the old joke:

> How do we know that Father Christmas has a beard?
> We know it, because show falls when he shakes it.

What if the *physical* universe changes at the fundamental level of 'spacetime', such that every topological point here-and-now is the **end product** of the negotiation**s** -- one-at-a-time -- between mass and "curved" spacetime? If 'mass tells spacetime how to curve, and curved spacetime tells mass how to move'[2], we need an *atemporal* medium (dubbed 'global mode of spacetime', Fig. 14.2) to **connect** every local topological point 'here-and-now' with 'the entire universe as ONE', like a school of fish[38] (explanation at this http URL). Stated differently, to explain the little **red** arrow in Fig. 1, we need to reveal what Einstein dubbed "a total field of as yet unknown structure"[10]:

> The right hand side is a formal condensation of all things whose comprehension in the sense of a field theory is still problematic. Not for a moment did I doubt that this formulation was merely a makeshift in order to give the general principle of relativity a preliminary closed-form expression. For it was essentially no more than a theory of the gravitational field, which was isolated somewhat artificially from a total field of as yet unknown structure.

Let me suggest a hypothesis about the origin of gravity, ensuing from the *dynamic* causality

(dubbed biocausality[37]) along the so-called Arrow of Space. The ultimate task is to understand how the *physical* universe evolves during its cosmological evolution, ensuing from the idea that the entire Universe is designed like a human brain: there must be *something* pertaining to the entire Universe (called 'potential reality', residing in the so-called Zen gaps), which remains **invariant**, thanks to which the *physical* universe can change *in time*, as measured with a clock. Consider, for example, a concept such as 'corner': it can be *physicalized* with many languages and hence has different neural correlates in the brains of different people, their brains change as well, etc., yet the concept of 'corner *per se*' remains *invariant* (cf. Plato, Fig. 3). The human self also keeps its **identity**, despite its perpetually changing brain composed of 100 billion neurons and 500 trillion synapses, ever since its prenatal Stage 1, Zygote. In the case of human brain and body, such invariant "matrix" for evolution **cannot** be reduced to the physical, and perpetually changing, constituents of the Zygote.

In the case of the Universe, such **invariant** "matrix" resembles a blank colorless canvas (Fig. 2), which cannot exist without the colorful painting on it, yet the colorless canvas *per se* is something *ontologically* different. Ditto to the *physical* and perpetually changing universe: the *physical* content of the universe does change, like changing colors (cf. REIM) cast on a blank colorless canvas, yet the *ontologically* different "colorless canvas" (Fig. 2) must keep an *invariant* 'line element' (Wiki) with which the *physical* content of the universe is defined 'in spacetime'. This *invariant* 'line element' is considered 'potential reality' (Fig. 3) residing in *physically* unobservable Zen gaps – "a total field of as yet unknown structure", Einstein[10].

**NB**: But what if the "colorless canvas" *itself* can be shrunk and inflated relative to its *macroscopic* "size", denoted with **Alice** in Fig. 2 below? After all, in the three cases depicted below, the "colorless canvas" could be traced to the *physical* or "colorized" spacetime (not shown) **only** as infinitesimal changes **dt**, but (**i**) it is impossible to detect the transition between any **dt** and its *next* **dt** online (along axis **w** in Figs 13 and 14), as it "happens" in time-like direction, and (**ii**) the "sizes" of **dt** are *indistinguishable*, as all different-in-size colorless canvases contain the same *undecidable* "number" of spacetime points[11]. If **dt** had Archimedean topology and could be presented with an integer, say, **dt** = $10^{-44}$ s (Planck time), we could use an *absolute* 'one second' and determine the duration of each colorless canvas, as read with a physical clock. Thanks to Cantor[11], we know that it is impossible *in principle* to attach any *numerical* value to **dt**, as it *emerges* from *potential* "colorless canvases" with *undecidable* "size" due to the absence of *any* metric there.

But what is **dt**, really? It is "an intrinsic time interval associated to any timelike displacement", as "fundamental systems all march to the beat of *the same* drummer"[12]. But the *rate* (denoted with **R**, see the explanation below) of "beating" elementary **dt**-s by *the same* "drummer", in order to *assemble* 'one second time of light', is **not** a number. If the *rate* **R** was an integer, as in the operational definition of international second (see below), we will have to assume, in line with Archimedean topology, that such "drummer" is some mysterious *physical* system capable of *assembling* 'one second time of light' from elementary *cycles* **dt** -- without any **gaps** between the successive *cycles* **dt**. But this is absurd, plain and simple[13]. To solve this fundamental puzzle, we will assume that **R** is **fixed** (see frames-per-second analogy and its disambiguation on p. 13) and allow **T** to be *flexible*, as depicted with three "colorless canvases" in the drawing below. Obviously, neither **T** nor **R** or **dt** can be presented with *any* number.

Again, **dt** is *the only* 'drum beat' we can observe from the three colorless canvases below, so we cannot determine whether it *emerges* from "large" or "small" colorless canvases **T**, as they do **not** possess *metric*.

Although the three colorless canvases are shown as 'different in duration' (Fig. 2), what we *cannot* see is the **one single** "colorless" point **w** (cf. Fig. 14.2), which is the *source* of potential or "colorless canvases", being both "that which has no part" (Euclid) and 'that which has no end nor part' (see the explanation at Eq. **1** below).
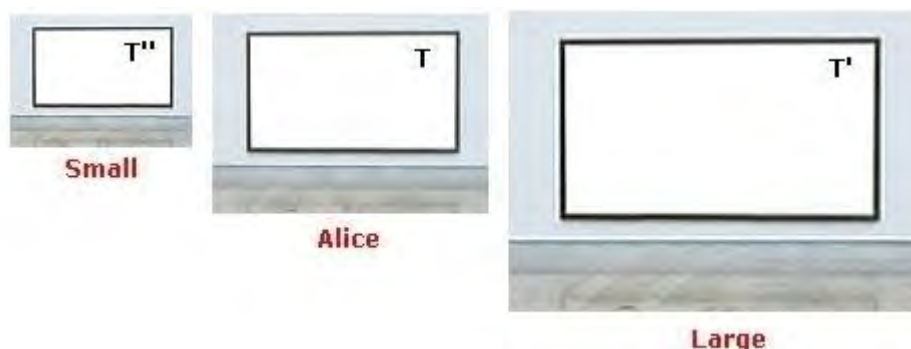
Fig. 2

The "colorless canvas" is both "that which has no part" (Euclid) and 'that which has no end nor part' (cf. Eq. **1** below). It is a mind-like *potential reality* (cf. Fig. 3), known as "that which moves without being moved" (Aristotle), dubbed God's thoughts by Einstein. It is 'the grin of the Cheshire cat without the cat', and its *physical* presence is "zero" (**w²** = **0**, Fig. 14.1). It has no metric: the *idea* of a tree cannot be "smaller" than the *idea* of a mountain (the "largest" colorless canvas).

Hence Nature can obtain smaller or larger *physical* (colorful) stuff (just "details", Einstein) with smaller or larger size, pertaining to the so-called *local* (physical) mode of spacetime (see below). We postulate that the sole *variable* of the *potential*, "colorless canvas" of spacetime is an *atemporal* unphysical "time" (denoted with **T**) of the *physical* time read by a clock (explanation below). In brief, **T** is 'potential reality' residing in *physically* unobservable (due to the speed of light) Zen gaps (Fig. 14.2): "a total field of as yet unknown structure," Einstein[10].

In every theory of spacetime, the first off task is to define the rods and clocks. Our theory of Relative Scale (RS) spacetime is based on the proposal of Plato in his work *The Republic* and the Universals, which we denote as 'potential reality' and interpret as unphysical (yet *physicalizable*) 'elements of reality' shown as two *explications* of the Universe, matter and psyche, originating from **one** common source (Wolfgang Pauli[14]). Physicists are very reluctant to acknowledge that 'potential reality' is the cause of Genidentität (Kurt Lewin) and run into insoluble problems. For example, John Wheeler[15] stressed that "an electron *here* has the same mass as an electron *there* is also a triviality or a miracle. (…) No acceptable explanation for the miraculous identity of particles of the same type has ever been put forward. That identity must be regarded, not as a triviality, but as a central mystery of physics." In psychology and Mathematics, we freely operate with 'potential reality'. It is UNspeakable, like an unphysical "colorless" element of reality, which can be explicated in many (open set) *physicalized* objects. For example, mathematicians introduce Platonic solids, yet we know that their physical explications (Fig. 3) come *always* in some concrete form, like 'this football is a sphere'. It is like using adjectives: if we say 'blue', we must always specify *what* physical object is blue.

Think of "bare" spacetime as blank colorless canvas (Fig. 2), such that (**i**) there is no canvas without its physicalized, colorful painting, and (**ii**) there is no physicalized, colorful painting without its canvas. The second requirement explains the so-called sufficient conditions for spacetime, which are introduced as **global** constraints on the spacetime (cf. M. Visser[8] above). Further, in *relative scale* spacetime we postulate 'potential reality' as fundamental reality, which is explicated, for example, as an *invariant* region of spacetime, such as 300,000km viz. 1s time of light. So we suggest, after Plato, that a *spacetime* region, corresponding to 1s time of light, shows *physicalized* explications of its unphysical "colorless" Platonic source dubbed here 'potential reality', and stress that such *physicalized* 'line element' (denoted with **L** below)

is **not** identical to its unphysical, yet-to-be *physicalized* 'potential reality'. Due to requirement (**ii**), it is impossible to *derive* the properties of the "canvas" (introduced 'by hand' with mathematical axioms[1]) from its physicalized, colorful "painting", e.g., *derive* the time-orientability of the "canvas" from manifolds that are Hausdorff, second countable and C$^\infty$ by using only and exclusively only their material (physicalized) content[38]; scroll down to the end of the text at this http URL for specific (and widely known) examples.

**NB**: Thus, in our theory of *relative scale* (RS) spacetime we use an *unobservable* 'time of light' (denoted with **T** below) as colorless canvas or simply 'potential reality' (the flight time of not-yet-absorbed photon is **not** physical), and propose its alterations as *the* origin of gravity: changes of **T** are changes of the *potential reality* of the *physical* 'one second time of light', denoted with **D**. The latter is physical ("colorized"), while **T** is its underlying atemporal "colorless canvas". Scroll down to read the FPS analogy and its disambiguation (p. 13).

The current formulation of GR is still 'work in progress', as we haven't revealed Einstein's "total field of as yet unknown structure"[10]. Surely the gravitational energy density is always *physicalized* at every topological point here-and-now, yet it is not tensorial quantity[2]. Why? Because the localization of positive gravitational energy is quantum-gravitational phenomenon **based on 'potential reality'**: we encounter *physicalized* explications (Fig. 3), which the orthodox theory of gravity (e.g., Wald[1]) cannot explain. Another example of 'potential reality' is the quantum vacuum -- check out ATM (cash machine) analogy at the end of this http URL and the "dark puzzle"[38] explained at this http URL. At this moment, we can offer equations only in symbolic form, because the Mathematics is still uncovered (Fig. 14).

**Let's get started.** We suppose that the differentiable structure of spacetime manifold is related to the ultimate puzzle of spacetime: how *finite* objects, presented symbolically with number **1** in the right-hand side of the equation below, *emerge* from purely geometrical points ('the grin of the Cheshire cat *without* the cat', as observed by Alice) with non-Archimedean topology?

$$\mathbf{0} \cdot \boldsymbol{\infty} = \mathbf{1} \quad \text{(Eq. 1)}.$$

This equation is under investigation (Fig. 14). As of today, Eq. 1 does not make sense[38]. It only shows the puzzle of the invariant 'one meter' and 'one second' of **finite** (Sic!) size and duration, obtained by multiplying "that which has no part" (Euclid) with 'that which has no end nor part' **by** "that which moves without being moved" (Aristotle). Suppose we place an invariant 'one second' in the right-hand side. All we can say is that 'one second' is **finite**. Which means that, on the one hand, it can be *physicalized* by "colorful" stuff and offer *metric* for its *physicalized* "colorful" stuff, thanks to which we can use Archimedean topology for the *physicalized* "colorful" stuff (cf. Case II below). On the other hand, the same invariant 'one second' can be *physicalized* by "colorful" stuff  **iff**  it has the non-**Archimedean** "blank colorless canvas" as *potential reality* (Fig. 2) in which there is no metric, so the three canvases depicted in the drawing above are *indistinguishable* (Case I) as well.

We can interpret the right-hand side of Eq. 1 as the product of *assembling* infinitely many (**actual** infinity) topological points with **0**-dimensionality to obtain a 'completed totality' (known as 'set') of topological points with infinite (**actual** infinity) cardinality and *elementary* ("that which has no part", Euclid) duration **dt**. Thanks to Cantor[11], we know that such 'completed totality' (known as 'set') of temporal points (**dt**) *cannot* be defined with Archimedean topology[38] viz. by using any *denumerable* value of **n**, for example, 'n frames per second' (FPS) or "9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom" (international second). No *physical* phenomenon can do the job of assembling denumerable *cycles*  **n**  to obtain 'one second' of *finite* duration, with the utmost precision of an *invariant* 'one second'. No way[13]. Not even with Gedankenexperiment, by setting **n** = $10^{44}$ to *assemble* an *invariant* 'one second' from the so-called Planck time. Thus, we have to acknowledge that the phenomenon of *assembling* the topological dimensions of the physical universe does **not** have physical nature, simply

because it *cannot* have physical nature, as we know since the time of Plato (Fig. 3). This creative phenomenon is dubbed here 'Aristotelian Connection' (**AC**), and we postulate that **it** (not "He") has self-acting nature (Fig. 2) resembling the human brain, leaving aside all untraceable theological implications, such as Universal Mind[38].

**NB**: In our theory of relative scale (RS) spacetime, we shall assume that **AC** is related to the invariant "speed" of light **c**, with which an invariant spacetime region 299,792,458m ($3.10^5$m) is being assembled by **AC** as the *physical* '1s time of light' (denoted with **D** below) -- once-at-a-time along the Arrow of Space (Figs 11-14). In this sense, one may **say that** 'light *assembles* physical **time viz. spacetime'**.

Thanks to the *finite* value of "speed" of light **c**, we can define 'spacelike separation' and introduce a metaphysical axiom called 'causality', which we use to define 'cause and effect' (recall that in GR acceleration is not an 'effect', since "it is not a generally relativistic vector", as explained in Wiki). So we *know* that with Archimedean topology we cannot *understand* the two sides of Eq. **1**, as we *cannot* set **n = ∞** and **dt = 0**. Also, **c** does not possess Archimedean topology either; for example, in theory of relativity 0.8c + 0.7c = **c**. If we use Archimedean topology and set **dt** = $10^{-44}$s (Planck time) and the number of temporal frames **n** = $10^{44}$, we would recover 'one second of light time', but will introduce an **absolute** length scale of *bare* spacetime *per se*, which is *very* bad idea (see below).

Let's go back to Eq. 1, which shows the *emergence* of finite elements of reality from their mind-like source. Sir Arthur Eddington described the latter as "the aggregation of relations and relata which form the building material for the physical world"[17]. It is "ferociously difficult" (Isham and Butterfield[16]) to understand the *emerging* of Archimedean spacetime as "shadows" (Plato, Fig. 3) from '**something else**' endowed *ab initio* with non-Archimedean topology (dubbed here 'potential reality', outlined with **red** below).
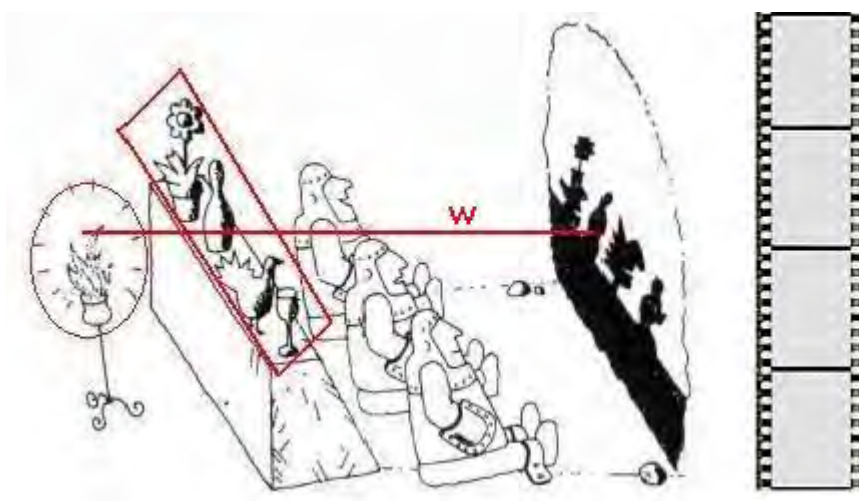


Fig. 3

The *names* of the shadows are "explained" in physics textbooks.
Creating changes in the *potential* reality (outlined with **red**) is
considered 'spacetime engineering', performed by the "chained"
observers during the so-called "Zen gaps" (Fig. 14.2 below).

Plato's light emitted from the source along the **w** axis has *two* spacetime presentations, dubbed (i) global and (ii) local *modes* of spacetime. In case (i), Plato's light along the **w** axis (Fig. 13) reaches **only** the dark strips ("Zen gaps") separating 4 successive movie frames. Notice that

the **w** axis is *atemporal* ("outside the train")[38] and occupies the so-called global *mode* of spacetime. In case (ii), Plato's light and the **w** axis (**w**$^2$ = **0**, Fig. 14.1) are being **nullified** – **once at a time** – to obtain the infinitesimal *physical* lifetime **dt** (Fig. 11) of every movie frame filled with "colorized" shadows. We have 4 movie frames, each with duration **dt**, filled with *physicalized* shadows (Fig. 3). This is the so-called local (physical) *mode* of spacetime. It is a *perfect* continuum of events, because the *physical* "duration" of "Zen gaps" (the **dark** strips between frames) is "zero" (Fig. 14.1). Hence at every instant **dt** (Fig. 11) from the *local* mode of spacetime, the **w** axis is being **re**-nullified and its *physical* presence becomes *again* "zero", in order to obtain the **next** "Zen gap" separating the successive (in 1-D time) and neighboring ("sideways" at 2-D Cauchy surface) topological points constituting *physicalized* shadows cast on the movie screen (Fig. 3). The screen itself is "colorless canvas" (Fig. 2) during the *atemporal* global mode of spacetime (Fig. 4), denoted as case (i). The screen becomes "colorized" only *once-at-a-time*, only during the infinitesimal *physical* lifetime **dt** (Fig. 11) of each and every 2+1-D movie frame. The *emerging* continuum of topological points of the "shadows" is **perfect** (case (ii) above), because the separation **]**between**[** the points is along the **re**-nullified **w** axis (Fig. 14.1). Ditto to 4D[1], only the Cauchy surface cannot be "curved". It is **re**-created as instantaneous "**slices**" of the entire Universe – **one slice at a time** – from which the *physicalized* universe (just "details", Einstein) is *assembled* along the **w** axis (Fig. 13), like a scanned pumpkin. The entire Universe ("pumpkin") remains at *absolute* rest, like Plato's light.

We can try to understand 'that which has no part' only with the new zero-valent logic YAIN[38], by interpreting **dt** with two *complementary* properties: *both* zero (Eq. **1**) *and* finite. Of course, **dt** may be something we cannot comprehend in principle, like an Eskimo who would interpret 'nose' and 'arm' as two complementary presentations of 'trunk'. Ditto to the reciprocal case of 'infinitely large': it may be *both* infinite (Eq. **1**) *and* finite, or maybe something *entirely* dif**f**erent, like 'trunk'[38].

The conclusion from this metaphysical exercise is that we can use Archimedean topology **only** to the extent to which the spacetime of *physicalized* potential reality (called *local mode* of spacetime) *has indeed* Archimedean topology (cf. Case II in Addendum **1**), knowing very well that the primordial spacetime of *potential* reality has non-Archimedean topology (Fig. 2). Which is why we *cannot* introduce an **absolute** lengths scale viz. determine "absolute" distances pertaining to "large" and "small" regions of spacetime and eliminate requirement (**ii**) for sufficient conditions for spacetime[38].

What we do know, however, is that gravity *cannot* be presented as "curvature", so that we could use tensor calculus to handle the so-**c**alled curvature and tangent vectors "intrinsically"[18]. Gravity might look like "curvature" (Fig. 1), but isn't. Why? Because Minkowski spacetime is not like an elastic body or rubber band. To quote from Hyun Seok Yang[19], "the flat spacetime in general relativity behaves like an elastic body with tension although the flat spacetime itself is the geometry of special relativity. (...) That is, the (flat) spacetime behaves like a metrical elasticity which **opposes** the curving of space. But this picture rather exhibits a puzzling nature of flat spacetime because the flat spacetime should be a completely empty space without any kind of energy as we remarked above. How is it possible for an empty space of *nothing* to behave like **an elastic body with tension ?**" The latter is believed to be some "dark" smooth dynamic *tension*[9], which people consider "dark" because it cannot be traced back to its omnipresent source[38] (explanation at this http URL). It would be like you throw a stone up in the air and expect to see it coming down, but the stone suddenly begins to *accelerate* upwards and disappears i**n** the sky. What would be the source of such "anti-gravity"? **Wrong** question. Gravity has two *presentations* by centripetal and centrifugal gradients (Figs 7.1-7.2).

To understand how 'an empty space of *nothing*' acquires *physicalized* (Sic!) energy in the right-hand side of Einstein's equation, see the ATM analogy at the end of the text at this http URL and pp. 4-5 at this http URL. We need quantum gravity, because GR is **not** classical local theory. Matter is *self-coupled* **by** its own gravity, which leads to self-action of matter. This is the crux of the dynamics of gravity "along light cones". To understand why we **cannot**

represent the dynamics of gravity with its final end results -- the time read by a clock -- watch the animation at this http URL from John Walker (Fig. 4).



Fig. 4
The "intermediate" time of "free" photons is **not** physical. Only the end results are physical, as instants **dt** (Fig. 11) of "clapping hands"[20].

Gravity is a bootstrapping phenomenon producing a holistic "school of fish" in which every "fish" follows its own *quasi-local* (Sic!) geodesic. Metaphorically, the school of fish tells every fish where to go in its next instant 'now' by exerting *physicalized* (see **NB** below) energy-momentum into its **next** state, while *at the same instant* (Sic!) every fish determines the **next** global state of the entire school (=spacetime) of fish. This non-linear bi-directional negotiation (resembling Escher's drawing hands below) is the crux of gravity. It requires 'necessary and sufficient conditions for spacetime'[38] (D. Chakalov, 21.09.2008). Due to the "speed" of light, we can observe in the local mode of spacetime only the **end result** -- one-at-a-time[20] -- from such bi-directional negotiation in the *global* mode of spacetime, between every *quasi-local* fish and the entire school of fish as ONE.

**NB**: Hence at *every* instant of "clapping hands"[20] here-and-now, the bi-directional negotiation has been *already* (Sic!) completed "within" photon's *zeroth* world line, which the photon has *already* completed by traveling "zeroth" unit space **ds** per "zeroth" unit time **dt** (cf. Eq. **1** and the **w** axis in Fig. 13). As Kevin Brown[20] stressed, "light exists only as completed interactions on null intervals."
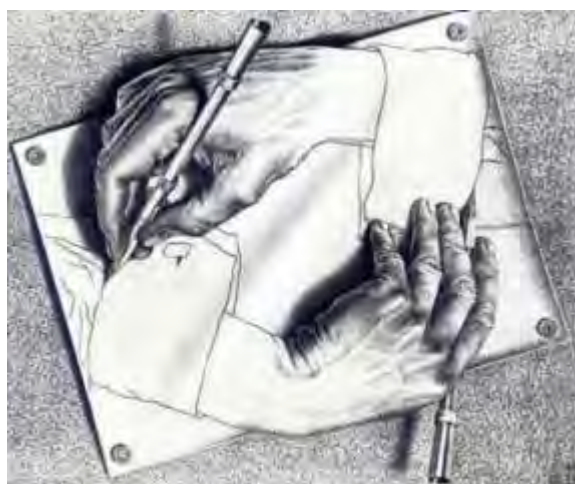


**Which goes first?**
**Matter or geometry?**

Fig. 5

The dynamics of gravity "along light cones" is unknown. Notice that in GR 'mass tells spacetime how to curve, and curved spacetime tells mass how to move' (Wheeler[2]), but the *upper hand* can modify the lower hand  iff  it was already determined in its past light cone by the lower hand, but the *lower hand* can modify the upper hand  iff  it was already determined in its past light cone by the upper hand: Catch 22 logical contradiction. The *non-linear* dynamics of matter-spacetime negotiation requires 'potential reality' in the *global mode* of spacetime to facilitate such *atemporal* negotiation -- one-at-a-time (cf. the **w** axis in Fig. 14.1).

Unlike magnetism, gravity is intertwined with rotation: see centripetal and centrifugal gravitational gradients **below.** The "push and pull" gradients of gravity are of *topological* origin, and spacetime is produced by *physicalized* potential reality. Its localized "flashes" (Fig. 3) are *physicalized* energy (and momentum) which either *gives* to, or *takes away* 'tangible energy'[21] from matter and fields placed in the right-hand side of Einstein's field equation. Such *physicalized* intangible energy[21] is indistinguishable from the tangible energy, as they merge and show up in the **past** light cone, i.e., in the right-hand side of Einstein's field equation[1].

Metaphorically, we observe different physical "gloves" (e.g., proton mass and dressed particles) which *facilitate* their common "dark hand", but never the "dark hand" itself (Fig. 3). Such *physicalized* energy is *always* smuggled into the **past** and leads to generic energy non-conservation. As shown by T. Padmanabhan, "the geodesic equation is capable of encoding the effect of external gravitational field on a material particle and - in general - will not lead to any conservation law"[22].

**NB**: If the *source* of gravity were some *classical* field (e.g., resembling electromagnetism), its "flashes" will be *localizable* energy density[2], which will inevitably comply with Newton's third law, and the inertial mass of an accelerating particle will be a simple "back-reaction to its own gravitational field"[23]. Bad idea, because the duration of such back-reaction won't be an *infinitesimal* **dt** (Fig. 11) but *finite* time interval, and we could detect some *physical* force by which the *entire* spacetime "out there" affects matter and fields *locally* at a spacetime point "here": "Mass *there* governs spacetime geometry *here*"[5].

No, gravity is not classical field, because the **localization** of gravitational energy density is quantum-gravitational phenomenon[38] (cf. pp. 4-5 at this http URL), which cannot be presented with tensors; the latter can refer to classical objects only. Matter is *self-coupled* by its **gravity** and the gravitational "field" is produced by its *potential reality*. The gravitational waves are produced from bootstrapping the whole spacetime *en bloc*, and of course have no topological "boundaries"[38] -- check out the no-boundary proposal at this http URL.

GR cannot be classical local theory, because particles follow geodesics under perpetual energy non-conservation. As Kevin Brown[24] explained, "the field equations of general relativity *imply* (emphasis mine - D.C.) this conservation, as can be seen by the vanishing of the covariant divergence of the Einstein tensor

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R$$

"The field equations simply equate this to the energy-momentum tensor $T_{mn}$, so the covariant divergence of the latter must also vanish, hence energy-momentum is locally conserved, hence particles follow geodesics.

"But the local conservation of mass-energy didn't arise automatically, it was specifically designed into the field equations by the inclusion of the "trace" term (the term with coefficient 1/2) in the Einstein tensor. In fact, one of the early attempts of Einstein and Grossmann to formulate generally relativistic field equations led to the result $R_{mn} = T_{mn}$, but not surprisingly this is unsatisfactory, precisely because the covariant divergence does **not** vanish. After a great deal of searching (and with the crucial help from Levi-Civita - D.C.), Einstein finally realized that the natural conservation laws – and hence the law of inertia – is recovered if we include the *trace term*. David Hilbert arrived at this same conclusion almost simultaneously (in November 1915), although his route was much more direct, since he proceeded from a Lagrangian, which automatically leads to conservation laws."

Only we cannot have conservation laws in GR to make particles "follow geodesics": we cannot ignore the contributions from maximal spacelike hypersurface[4] and "assume" that the energy-momentum tensor of the system, stretched *exactly* to null-and-spacelike infinity, is *entirely* confined in a *closed* region in spacetime. We will need well-defined **boundary** of the integration domain (similar to 'the entire school of fish', see above) to make conservation laws[25].

But in the current formulation of GR we cannot make such "boundary" *exactly* at null-and-spacelike infinity, because the latter cannot be defined mathematically[4]. Moreover, you will have to install there a special "mirror" for gravitational waves[3]. So the only available option is to explore a model of bootstrapped gravity in which the source of energy nonconservation[22] comes from a **dual** surface placed at null-and-spacelike infinity, pertaining to the *global* mode of spacetime of *potential* reality. Why **dual** surface? Because it is installed ]between[ every neighboring points of the spacetime continuum **as well**, like the unphysical Zen gaps[38].

Hence the spacetime manifold is "quantized" by physically invisible (due to the speed of light) gaps of Zen (Fig. 11) with zeroth duration[20], and once we unravel its Mathematics (Fig. 14), we *might* recover Einstein's "total field of as yet unknown structure" (see above).

In general, my interpretation of Einstein's Equivalence Principle includes both (**i**) energy conservation and (**ii**) energy nonconservation. Case (**i**) corresponds to a newly **re**-created achronal "slice" of the Universe, used to *assemble* the local mode of spacetime: see option **Nein** here. Case (**ii**) corresponds to the *binding* and *rendering* (Addendum **1**) of such "slices" by the Arrow of Space, which *assembles* the topological dimensions (Sic!) of the *local* mode of spacetime from 'som*ething else' (Isham and Butterfield[16]). Sure enough, if we examine such *assembled* chain of spacetime slices 'here-and-now' (*local* mode of spacetime), energy cannot and **must not** be conserved, and we encounter the law of energy nonconservation as well[22]. With my interpretation of Einstein's Equivalence Principle, we can 'have our cake and eat it'.

Notice that the issue of conservation vs. non-conservation of energy can be formulated only and exclusively only in classical physics[25], in which we have 'objective reality *out there*' (e.g., the state of the Sun when nobody is looking at it[38]; see Heisenberg). To use the ATM (cash machine) analogy mentioned previously, if I withdraw *more* money than the amount in my bank account, I will have additional money on "credit", which will be like "negative of money" (Dirac). In Quantum Theory, however, we don't have 'objective reality *out there*'. Recall Erwin Schrödinger[26]:

> In general, a variable *has* no definite value before I measure it;
> then measuring it does *not* mean ascertaining the value that it *has*.

So if we consider a physical system grounded on the vacuum, we cannot even *formulate* the question whether energy has or has not been "conserved". All speculations about negative energy in GR[27] and negative energy densities for gravity[28] and quantum field theory[29] are based on the **wrong** presumption that GR refers to a classical theory. But the issue of energy

"conservation" viz. "non-conservation" makes no sense. To use again the ATM analogy at the end of the text at this http URL, if I withdraw less money from the total amount stored in my bank account, or more money and run into "negative of money", the "remaining" amount of money in the *entire* bank will **not** change at all. Why? Because the absolute or total amount of money (viz. the *total* energy density of the vacuum) is *undecidable* -- any *denumerable* amount of money viz. *any* energy *difference*[30] is irrelevant.

This is the nature of the vacuum and its non-Archimedean topology. The case of "credit" or "negative of money" corresponds to emission of gravitational "radiation" in which the *potential* or "negative" energy is **not** bounded[27] and is manifested, for example, as gamma-ray bursts. Thus, "negative energy" comes in virtual negative-positive mass pairs. There is no "conservation" of mass-energy in the Creation of the Universe (cf. Eq. **4**). And since the human brain is grounded on the vacuum[30], we should be able to transfer energy from the vacuum into macroscopic systems, and there will be no need to burn coal nor build nuclear power plants. This was the idea of my proposal sent to U.S. Department of Energy in March 1994.

Going back to Einstein's "glücklichste Gedanke meines Lebens" depicted with a hypothetical 'isolated system' in Fig. 6 ("closed room"), notice that at every instant 'now' from the duration of such "fee fall" we have the case (**i**) above -- one-at-a-time, as **re**-created achronal "slice" of the Universe, which cannot possess *anything* that would be pulling the "closed room" in any direction from the *assembled* local mode of spacetime. Why? Because acceleration is **not** "a generally relativistic vector" (Wiki), and gravity does **not** obey Newton's third law. The case (**ii**) produces *omnidirectional* displacement of the whole 'closed room' ("shoal of fish") in the *assembled* local mode of spacetime, whic**h** we call 'time as read with a clock' (see Addendum **1**). Due to the speed of light, we cannot detect the global referential "dark room", which Hermann Weyl dubbed 'the eternal repose of Father Æther'.
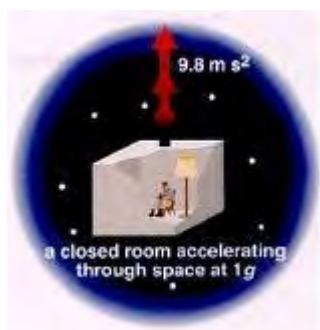


Fig. 6

But how Mother Nature makes gravitational mo**tion? Let's examine the rotation of the Moon** around Earth.
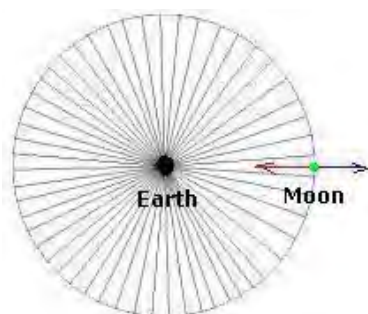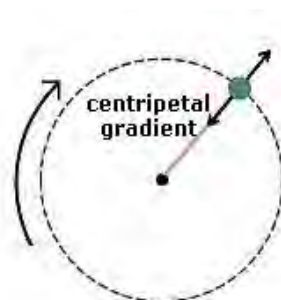


Fig. 7.1                         Fig. 7.2
Centripetal and centrifugal gravitational gradients

See the little **red** arrow in Fig. 7.1? We call it gravitational *centripetal* gradient, which produces 'gravity as attraction', including "dark matter". The geodesic motion of the Moon is the result of *dynamic equilibrium* between gravitational *centripetal* gradient and the opposite *centrifugal* gradient **due to rotation**. The case of 'gravity as repulsion' is produced by gravitational *centrifugal* gradient, which is in **dynamic equilibrium** with 'gravity as attraction'.

**NB**: This hypothesis is based on the interpretation of 'rotation' (as well as spin) as global *topological* property of spacetime. The phenomenon of 'rotation' is present at all length scales, from elementary particles to the so-**called "axis of evil"** in the cosmic microwave background. The origin of 'rotation' is the **dual** topology[38] of the elementary temporal and spatial displacement, **dt** and **ds**, along the Arrow of Space (Addendum **1**). Firstly, the joint displacement **dt** & **ds** does not have referential system, like the two river banks at *absolute* rest with respect to the flowing water in the river of Heraclitus. And secondly, this *dynamic* causality (dubbed biocausality[37]) includes **two** transitions with *complementary* topology: *both* along an infinite line (1-D Euclidean space) *and* along a *completed* (Sic!) circle. The *remnant* from the latter is observed as 'rotation', as it introduces angular momentum to the temporal and spatial displacement **dt** and **ds**. The "true" topology of spacetime cannot be comprehended by humans, because it is like a "trunk" to an Eskimo (see above). And if we combine this **dual** topology of spacetime (see again the no-boundary proposal[38] at this http URL), observed as 'rotation & elementary tick of time', with relative scale theory of spacetime, we obtain relative scale theory of *gravity* based on flat alteration of the spacetime metric (Addendum **1**). No "curvature" is needed. No "dark matter" or "dark energy" either.

It is crucially important to understand that the joint phenomenon gravity & rotation does **not** have *material* source located in the **past** light cone, but is a global topological phenomenon[38]. It is "blank canvas" (Fig. 2), like 'the grin of the Cheshire cat *without* the cat', as observer by Alice. We certainly observe rotation and, unlike the case of quantum spin, can imagine an axis of rotation, but the gravitational rotation does **not** have any *physical* engine which could be placed at some axis in space. No physical field is "pushing" planets, stars, galaxies, and the whole visible universe (cosmic equator) to *rotate*. This phenomenon may be "counter intuitive", but is a fact of Nature.

Quantum gravity shows that something *physical* can be **added** to the physical world (e.g., proton mass and dressed particles), and the *source* of this additional *physical* stuff comes from 'the universe as ONE BRAIN' (*potential* reality) and cannot *entirely* (Sic!) be traced back to any physical stuff in the **past** light cone[37]. If you nevertheless try to think of such effects as produced *exclusively* by some physical stuff in the **past**, you'll have to pronounce the *source* of such effect "dark" (source here). For example, "positive pressure does not promote the expansion [of the universe]; therefore, one must have a high negative pressure!", says Yakov Zeldovich, but "negative pressure" is a misnomer. Briefly, gravity & rotation cause *physical* effects on matter, but the source of such *physical* effects cannot be derived *exclusively* from matter in the **past** -- the source resides in the *potential* future **as well** -- which is why quantum-**gravitational matter looks** "alive", like self-acting brain.

In the case of 'gravity as attraction' shown with geodesic motion of the Moon, the very rotation and gravitational *centripetal* gradient are produced by "shrinking" (see Addendum **1**) the spacetime metric, caused by the inertial mass of Earth. In the case of 'gravity as repulsion', the *whole universe* (cf. 'school of fish' above) *acts on itself* by "inflating" (Addendum **1**) the distances between spacetime points, and the "inflating" increases proportionally to the distance between all points of a "large" (see **B$_L$** in Addendum **1**) spatial domain -- a *larger* domain will be endowed with *greater* gravitational *centrifugal* gradient (Hubble's law). Hence some people gathered the idea of "dark energy" (source here). Again, the difference between the two presentations of gravity is that *attractive* gravity is local phenomenon related to distribution of inertial mass in **B$_L$** (see Addendum **1**), while *repulsive* gravity is global phenomenon of 'the

entire universe'. Their *dynamic equilibrium*[38] is essential for the formation of galaxies and the precise fine-tuning of the topology of the universe.

To understand RS gravity **and the "inflating" and "shrinking" of spacetime metric, consider an** *invariant* (also *indistinguishable*) flow of time 'one second (**D**) per second (**D**)' as produced by the "speed" of *time* (**R**) with which **light** *assembles* 'one second' (**D**) by integrating the **successive elementary "durations" of time dt** to obtain the unphysical "time" **T** (Fig. 2) of light "during" photon's flight (cf. John Walker, Fig. 4): even a miniscule *decrease* of the "duration" **T** will cause huge "shrinking" of the invariant 'one meter' and 'one second' with which the **separation** between two spacetime events is defined, hence will cause gravitational *centripetal* gradient viz. 'gravity as attraction'. The opposite *increase* of the "duration" of **T** will produce "inflating" of the invariant 'one meter' and 'one second' with which the **separation** between two spacetime events is defined, hence will cause gravitational *centrifugal* gradient viz. 'gravity as repulsion', known as Hubble's law. Yet at **all** length scales the invariant 'one meter' and 'one second' will remain *indistinguishable* (not identical, see Addendum **1**), because in Relative Scale (RS) spacetime the "size" of all spacetime domains is defined with *variable* (Sic!) 'one meter' and 'one second' (Fig. 2), while all clocks run with an *indistinguishable* flow of time 'one second per second', at **all** relative-length scales.

The initial idea is borrowed from the distance equation, speed (**R**) multiplied by time (**T**) equals distance (**D**), but here **D** means the *temporal* "distance" of 'one second *time of light*', which is used to express (not define) the *flow* of time as 'time runs as one second **D** per second **D**'. As is known from the distance equation for light, 360,000km *separation* between two spacetime points/events corresponds to 'one second time of light' (**D**), hence different "durations" of the unphysical *atemporal* **T** will cause different values of the *physical* 'one second time of light' **D**, which in turn will render different-in-size *spacetime* regions **L** (see Addendum **1**).

Notice that the two unobservable variables have different nature: the "duration" of *unobservable* time **T** (Fig. 2) is *flexible,* while the unobservable speed (rate) of time (**R**) is **fixed**. These two variables are physically unobservable, because one cannot detect an *emitted* photon "during" its flight (watch John Walker, Fig. 4), *before* it is absorbed[20] (see the 'clapping hands' at **dt** in Fig. 11).

To avoid misunderstandings of the *flexible* "duration" **T** "during" the Zen gaps, read again the explanation at **NB** above, and keep in mind that **dt** itself is not flexible, because **dt** obtains numerical value as a 'limit'. What *is* flexible is the *duration* **T** of assembling *atemporal* unphysical and unobservable **dt**-s of *not-yet-absorbed* photon, spanned over physically unobservable *atemporal* **T** of *not-yet-absorbed* photon "during" its flight. We suggest *flexible atemporal* "durations" **T** (Fig. 2) of assembling 'one second' *before* the photon is absorbed, which leads to different -- yet indistinguishable -- durations of *physical* 'one second' of *already*-assembled time (**D**) at the instant of 'clapping hands' at **dt**. Shortly, the *flexible* **T** is *the time* of **D**, while the unobservable "dynamics" of **T**, denoted with **R** (from **r**ate), remains **fixed**.

Perhaps the best way to explain **T** and **R** is with analogy from recording one-second video with two different *rates* (**R**) called 'frames per second' (FPS), say, 30 FPS (**A**) and 90 FPS (**B$_L$**, cf. Addendum **1** below). In the cases of 1s video recorded with 30 FPS, we denote 1 frame duration with **T**, which defines its duration **T** = 1/30s and rate **R** = 30 FPS. However, in the second case of 90 FPS we denote 1 frame with **T'**, stressing that in RS spacetime the *flexible* duration **T'** is **3x** *increased* relative to **T**, as if it were spanned over 3 frames from the first video. Hence with the *increased* duration **T'**, the second 1s video will be *assembled* with the same fixed rate of 30 (albeit undetectably larger) FPS and will be *indistinguishable* from the first one. Likewise if we consider a third one-second video recorded with 10 FPS (cf. **B$_S$** below), and set its duration of 1 frame **T''** (Fig. 2) to be **3x** smaller *relative* to **T** in the first video -- the third 1s video will be *assembled* with the same fixed rate of 30 (albeit undetectably smaller) FPS and will be *indistinguishable* from the first one.

We shall refer to the variable **T** as 'gravity differential', after Wilbur B. Smith (Fig. 17). Notice that the "value" of **T** (Fig. 2) cannot be determined with observation or experiment. **T** valid for case **A** is *indistinguishable* from (not identical to) **T'** valid for case **B$_L$** (Addendum **1**). Ditto to **T''**. There is no absolute scale with which we could detect any *change* of the "duration" **T**. There **is no absolute frame nor rate of 'absolute frames per absolute second' (FPS) in Nature.** Otherwise the ether will be *physically* detectable.

Hence the crux of relative scale (RS) spacetime: 'one meter' and 'one second' are made by the Aristotelian Connection **AC** (cf. Eq. **1** above) to be indistinguishable (not identical) *between* **all** length scales, **T = T' = T''** (Case I). Yet different length scales are different *for themselves*, as different "values" of **T** lead to *assembling* different durations **D** viz. different-in-size *spacetime* regions (Case II, see Addendum **1** below). In symbolic form, the equation of the first case (Case I) is **RT = 1** (e.g., 30x1/30 = 90x1/90 = 10x1/10). The equation of the second case (Case II) is **RT = D ,** and different "values" of **T** lead to different durations of **D** viz. different-in-size *spacetime* regions **L**. In all three cases, **T** (Alice, see below), **T'** (Large), and **T''** (Small), **dt** can and will obtain point-**like numerical values as 'limit'[38]**, yet **dt** will pertain to different-in-size regions of spacetime **L**, which are *assembled* with "blank colorless canvas" **T** (Fig. 2).

Surely one cannot measure proper values of **T** and **R, as we cannot detect some "river banks"** of Heraclitus river at *absolute* rest to measure the *flow* of time as 'one second per second'. We cannot measure the minimal timelike displacement **dt** either, because it is an instantaneous *frozen* "shadow" (Fig. 3) of the *underlying* light-in-motion: *Panta rei conditio sine qua non est.*

Similar phenomenon is known since 1911 (Fig. 8), thanks to Charles Wilson: see *the* most widely known public secret in theoretical physics, and keep in mind that the same *underlying* light-in-motion is an unobservable *atemporal* quantum reality (global mode of spacetime, Fig. 14.2) from which different values of **dt,** obtained with macroscopic clock at 'water droplets' (Fig. 8), are observed upon quantum measurements. Yet the *intact* quantum reality 'out there' is **not** directly observable: see Plato (Fig. 3) and Erwin Schrödinger[26] above.
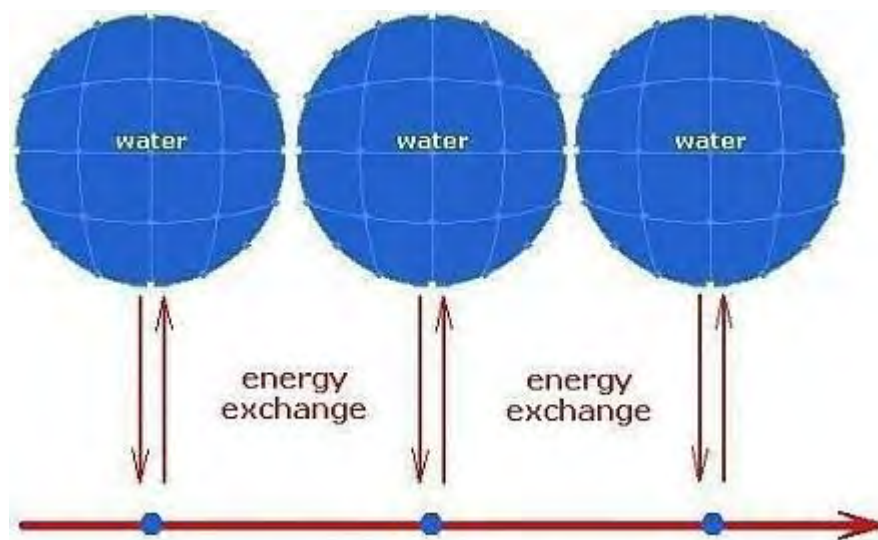


Fig. 8
How can you explain the emergence of visible track of water droplets in Wilson chamber, made by **energy exchange** with a single quantum particle?
How can you explain the invisible **red** quantum arrow?

Wait for the mathematical theory of MST. In the context of set theory[38], the **dual** potential

reality, denoted with **φ** in June 2007, is explicated as *physicalized* members (shadows on Plato's cave, Fig. 3) of its set, yet **φ** is residing 'outside' its set *as well*: God is purely *mathematical* object, residing *both* inside of the universe *and* outside of it, as 'the Universe as ONE'[38]. There will be no "angels" (Richard Feynman) nor mythical CDM & DDE there. Only self-action along null surface (biocausality[37]), performed by the Universe as ONE (Luke 17:21).

In my (certainly biased) opinion, relative scale spacetime is *the* only possible road to quantum gravity. Only with relative scale spacetime we may have mutual fusion and interpenetration of the Large and the Small (cf. Fig. 10), such that a galaxy and a proton will be entangled and perfectly correlated due to their indistinguishable (not identical) relative-scale "size" (Case I), and we can describe their quantum-gravitational interactions. There is no way to introduce gravity at quantum level (forget about "gravitons") nor suggest some quantum behavior of large scale objects. At the beginning of the quantum-gravitational world (Alice, cf. Fig. 10 below), the *entanglement of space*, denoted with $E_{space}$ , is effectively zero,

$$E_{space} \in (0, \infty) \quad (\text{Eq. } \mathbf{2}).$$

Notice that $E_{space}$ takes values in an open interval. Alice lives in a world with Archimedean topology, in which the value of $E_{space}$ is tending asymptotically toward zero, while the quantum-gravitational world dubbed 'Brain of the Universe'[38] starts from Alice and is extended up to values of $E_{space}$ **tending asymptotically toward infinity. Hence at every instant 'here**-and-**now'** (Fig. 11), the entire universe, at *all* relative-length scales, obtains unique correlated *physicalized* state -- one-at-a-time -- endowed with Archimedean topology (Case II). All events are bootstrapped (G. Chew) **by their common potential state or 'Bridge' (resembling a self**-correlated school of fish), while God as *mathematical* object is located **exactly** at actual (completed) infinity, at absolute rest. In notations: Luke 17:21 $\in [0, \infty]$[38].

Once we develop the mathematical theory of relative scale spacetime with hyperimaginary numbers (Addendum **1**), **it** will be **presented with 'pure mathematics', because no** *comprehensible* object can be attributed to God. **It** cannot be reached with *any* Gedankenexperiment either, as our rational thinking cannot grasp God in principle. Only by Mathematics, yet **it** can never be underst**ood with human cognition: see 'the eye of the Universe'[38]** at this http URL**. Otherwise we could pinpoint God's "hand" and it** can become *comprehensible*, after which theology will be reduced to science. Thank God, this is impossible.

As of today, however, the contemporary academic scholars stubbornly refuse to even mention the theory of relative scale spacetime. Yes, it is based on The Gospel. No, you cannot deny the existence of God, because at the most primitive level of science and mathematics **it (not "He")** is *there*, as *mathematical* object. Religion in not relevant here. Only Mathematics.

## Acknowledgments

> An important scientific innovation rarely makes its way by gradually
> winning over and converting its opponents: it rarely happens that
> Saul becomes Paul. What does happen is that its opponents gradually
> die out and that the growing generation is familiarized with the idea
> from the beginning: another instance of the fact that the future lies
> with youth.

D. Chakalov
November 19, 2014

**Addendum 1**

According to Relative Scale theory of spacetime (hereafter RS spacetime), the length scale in Nature, shown in the Gedankenexperiment Powers of Ten (Fig. 9), is not absolute but *relational*. The *assembling* of spacetime *by* the Aristotelian Connection (**AC**) along the Arrow of Space (cf. Figs 11-14 below) produces **finite** regions of spacetime, which are interpreted with two *complementary* cases. In Case I, two regions, denoted with **A** and **B$_L$**, are **in fact** *indistinguishable* in "size". In Case II, the second region **B$_L$** is **in fact** *larger* in "size". Cases I and II are also applicable to the opposite case of Small, denoted below with **B$_S$**; just replace 'larger' with 'smaller' to obtain Case II and **T''** (Fig. 2). I hope the explanation is obvious and will be omitted for brevity. No experiment or observation can determine whether Case I or Case II is wrong or correct, because the two **factual** cases are also *complementary.*



Fig. 9

According the **girl shown above (let's call her Alice, denoted with A**), she is in the middle ("visible dot") between the Small and the Large (see the drawing below). Correct. But if make **another Gedankenexperiment by instructing her partner (let's call him Bob, denoted with B**) to move along the two opposite directions of the **axis** (watch Powers of Ten above), toward the Small and the Large, Alice (dotted line in the drawing below) will conclude that Bob is getting **"small" viz. "large".**

Correct, according to Alice. But **not** according to Bob, because he will be *always* assembled or rather *rendered* by the Arrow of Space (Figs 11 – 14) as an invariant spacetime region possessing *the same* size (Case I) of Alice (dotted line in Fig. 10). Hence the two *rendered* (see explanation below) *spacetime* regions, belonging to Alice and Bob, are in fact different (Case II), yet are in fact *indistinguishable* (Case I) as well.
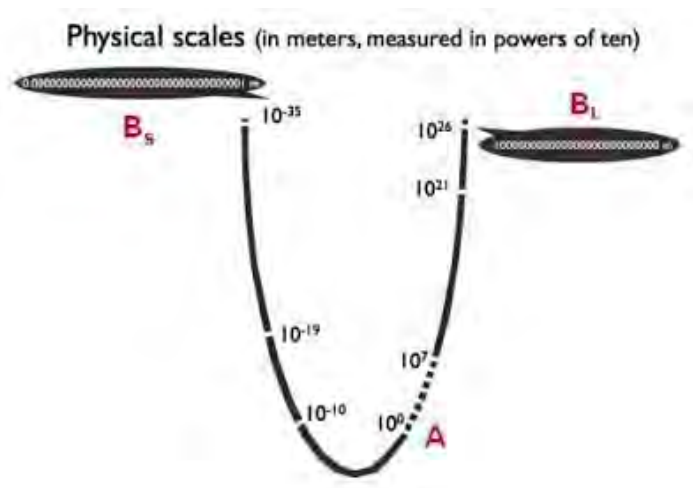
Fig. 10

How could this happen? By altering the physically unobservable and *flexible* variable **T** (see above) which determines the *physical* '1s time of light' (**D**) in all *finite* spacetime regions. How? At the level (Sic!) of the *potential reality* of spacetime, denoted above with **T** (Fig. 2).

In Fig. 10 above, Alice is denoted with **A**, 'Bob in the Large' with **B_L** (**T'**), and 'Bob in the Small' with **B_S** (**T''**). The **axis** connecting the Small, Alice, and the Large is an *achronal "slice" of the Universe* **AB** = **dt**, shown in Fig. 11 below. The alteration of the *physical* '1s time of light' (**D**) produces different (Case II) *rendered* regions of spacetime, which are "stacked" on the spacetime axis in Powers of Ten (Fig. 9), yet these *rendered* regions of spacetime are *indistinguishable* (not identical) as well (Case I).

To understand how the spacetime metric is **altered** ("curved" spacetime is *very* misleading metaphor) in RS spacetime, keep in mind that the meter *itself* -- the invariant length -- is "shrinking" toward the Small and "stretching" toward the Large, depicted in the drawings below. Hence the *alteration of spacetime metric* at the level of *atemporal* (Fig. 3) potential reality (**T**) is "directly related to the energy and momentum of whatever matter and radiation are present" (Wiki). But there's no "curvature" in RS gravity, because the *physicalized* presentations of 'potential reality', which produce the local (physical) mode of spacetime (shadows in Plato's cave, Fig. 3), are embedded in the *atemporal* global mode of spacetime "outside the train"[38] (September 2011), and cannot be "curved" there.

Here I will be *very* brief, and will be happy to elaborate upon request. Suppose this is an invariant 'one meter', according to Alice:



Below is also an invariant 'one meter', somewhere along the road toward the Small:



Relative to Alice, it *is* indeed "smaller" (Case II), but according to 'Bob in the Small' **B_S**, it is *indistinguishable* from the first invariant length denoted as 'one meter' (Case I).

And this is also an invariant 'one meter', somewhere along the road toward the Large:



Relative to Alice, it *is* indeed "larger" (Case II), but according to 'Bob in the Large' **B$_L$**, it is *indistinguishable* from the first invariant length denoted as 'one meter' (Case I).

**NB**: The *alteration* of the **invariant** 'one meter' is made in the *atemporal potential* reality (Fig. 3) denoted with **T** above.

Who has 'the right meter'? **Nobody**. See the analogy with *recording* and *rendering* one-second movie with different frames per second (FPS) on p. 13. Besides, the Small and the Large are *separable* only at point **A**. Once Bob moves toward the "small" (relative to Alice), he will be moving toward the "large" (relative to Alice) as well, because the "small" and the "large" *interpenetrate* and produce *entanglement* of spacetime (Eq. **2**). So the size of a proton and the size of a galaxy have "the same" indistinguishable length (Case I). Yet relative to Alice at point **A**, the two have indeed different and opposite sizes (Case II), being **in fact** Small and Large *as well*.

Of course, Alice is right. So is Bob (**B$_S$** & **B$_L$**), because there is no absolute 'one meter' nor 'one second' -- at **all** length scales they are being *rendered* by the Arrow of Space (see Figs 11 - 13) from 'one and the same' *continuum* of **non**-Archimedean topological points (cf. Eq. **1** above). Why 'one and the same', instead of some "number"? Because of Cantor's discovery[11].

Suppose Alice, who stays always at the length scale of tables and chairs, examines a spherical region of *her* spacetime, assembled with her value **T** (Fig. 2) to obtain diameter of app. 300,000km, which corresponds to app. 1s time or light (**D**) to trespass it. Let's denote this spatial size with **L** and its characteristic light-time (1s) with **D**; their ratio is the "speed" of light, **L/D = c** [km/s]. Suppose also that Bob's spacetime in the Large (**B$_L$**) is enlarged by coefficient **K**, that is, **B$_L$** has been *rendered* with **T' = KT**. With respect to Alice, 'Bob in the Large' (**B$_L$**) is **K**-times larger *compared to her* (Case II). But in RS spacetime, Bob's **T' = KT** of *rendering* his physical 1s (**D'**) viz. spacetime region (**B$_L$**) will be **K**-times larger to *her* **T** (Case II) -- not to *his* **T'** (Case I). Relative to Alice, Bob's *physical* 'one second' (**D'**) will be **K**-times *inflated*, rendering **K**-times larger (**L' = KL**) spacetime region (**B$_L$**). Relative to whom? Only to Alice. Relative to Bob, his **B$_L$** will *in fact* be exactly as "large" as Alice's **A**. Relative to him, **T' = T**, hence **D' = D** viz. **L' = L**: see FPS analogy and its disambiguation (p. 13).

**NB**: If Alice is observing **B$_L$** rendered with *his* **T' = KT**, she will consume **K**-times *more* time (e.g., playing Bob's 1s video rendered with 90 FPS with Alice's 30 FPS will consume 3s from *her* time), thus Alice (not Bob) will observe (with Hubble Space Telescope) **B$_L$** in "slow motion", just as she (and three other people) would observe a bouncing droplet in slow motion. The relative-scale "slower motion" of light will produce the effect called redshifted light, as if light were coming to Alice from **3c** larger (relative to **A**) spacetime region, **B$_L$** = **3cA**. Ditto to the opposite case, **B$_S$**: relative to Alice's clock, at roughly $10^{-35}$s "after" the Beginning the "size" of the universe would look like "1 cm" and a causally connected region would be $10^{-24}$ cm across (the horizon problem), so Alice (and those three people) will assume that all this mess has caused by some mysterious faster-than-light "inflation", while in fact every "small" region of spacetime is just as "large" as is the macroscopic one; see the **dual age** cosmology and Eq. **3** below.

Again, if Alice and Bob had a common background Newtonian spacetime to act as some fixed grid endowed with *absolute* metric, they could *prove* which spacetime region is larger by introducing Archimedean topology[38] as fundamental fact of Nature, hence obliterate the theory of relativity by introducing a *physical* ether.

Let's talk about the *flow* of time as *rate* of **assembling** "frames" **dt** (Fig. 3). In Fig. 11 below, **dt** = **AB** (see Fig. **4** at this http URL).
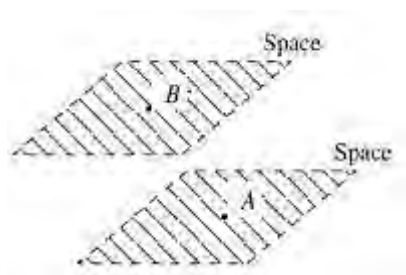


Fig. 11
Fiber-bundle structure where each moment in physical time, **dt**,
pertains to its own **re**-created 4-D "slice" of the Universe (Fig. 3):
spacetime is erased and redefined "within" every instant **AB** = **dt**
(gaps of Zen) corresponding to photon's **zeroth** world line along
axis **w** in Fig. 13.

Notice that the propagation of light, which *assembles* its relative-scale 'one second' to obtain the topological dimensions of the local (physical) mode of spacetime, cannot have reference frame: "due to Lorentz invariance, an electromagnetic wave cannot be at rest with respect to any inertial observer; therefore, we do not need to specify a reference system for the propagation of light, i.e. its movement is completely independent of the motion of inertial observers and it can thus be considered as *absolute*"[31].

Why *absolute* reference frame? Because the *rendering* of spacetime is **atemporal**, as it "happens" on null surfaces (Fig. 12). With respect to my clock, the unphysical *time of light* **T** is an *atemporal* global mode of time -- the same *atemporal* global mode of time pertaining to the human **brain**. It is *physicalized* only as 'clapping hands' with "duration" **AB = dt**. Yet the invariant time interval is assembled from **infinitely many** (*actual* infinity, not 9,192,631,770) **dt** to produce the local (physical) *mode* of spacetime endowed with Archimedean topology (cf. Eq. **1**) -- *once-at-a-time* along the Arrow of Space (cf. Figs 11 - 14). This *atemporal* process on null surfaces (Fig. 12) is called *rendering* of spacetime.
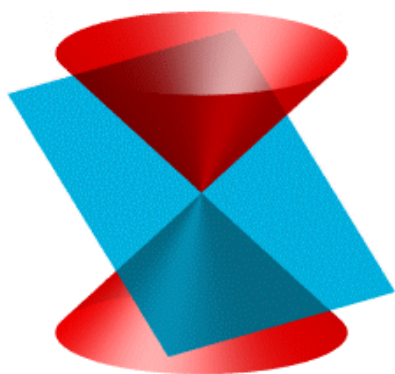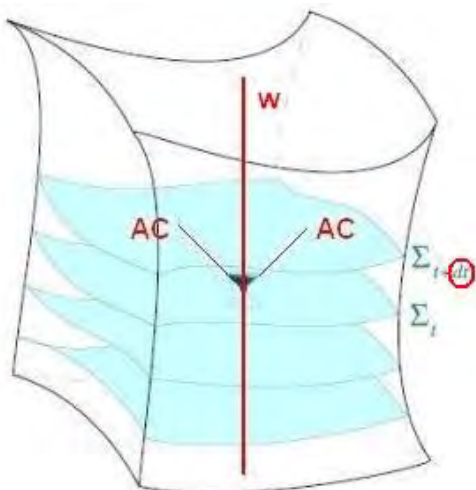
Fig. 12
The *atemporal* rendering of spacetime along the **w** axis (Fig. 13),
performed with the self-action of Aristotelian Connection (**AC**), is
being **nullified** -- once-at-a-time -- to **seal off** the Zen gaps of
the *perfect* continuum called local (physical) mode of spacetime.

In RS spacetime, changes of the values of **T** will produce at **all length scales** *indistinguishable* temporal **d**istances **D** of 'one second', and *indistinguishable* flow of time as 'one second per second' (Case I), yet different values of **T** will *render* different values of 'light-time 1s' **D**, yielding Large (**$B_L$**) and Small (**$B_S$**) regions of *spacetime* (Case II). Namely, **K**-times *inflated* **T** will correspond to **K**-times increased **D** (see Case II below) viz. **K**-times inflated *spacetime* region **L** with *indistinguishable* "speed" of light **c**,  **L/D = c** [km/s]. Here's a brief summary:

Case I: **RT = 1**  (Eq. **1.1**), so if we multiply **T** by **K**, **R** will be multiplied by **$K^{-1}$**, and all *relative-length* spacetime regions, **A** and **$B_S$** & **$B_L$**, will be *indistinguishable* (not identical). Alice (**A**) remains in the middle (Fig. 10) between **$B_S$** and **$B_L$**, with "30 FPS": see FPS analogy and its disambiguation on p. 13 above.

Case II: **RT** = **D**  (Eq. **1.2**), so if we multiply **T** by **K**, will obtain **K**-times larger 'light-time **1s**' (**D'**), which is *rendered* as **K**-times larger *spacetime* **$B_L$**, but *only* with respect to Alice. As explained in **NB** above, the light coming to Alice from a larger (to her) spacetime region **$B_L$** will be redshifted (no scattering of light is involved), yet no *absolute* "metric expansion of space**"**, valid for Alice *and* for 'Bob in the Large' **$B_L$**, will be needed (three people were lucky to get Nobel prize by employing alternative hypotheses **based on some** "dark" you-name-it).

Thus, the *atemporal* **T** obtains values **TK** with respect to Alice (dotted line in Fig. 10), yielding Large and Small *physical* 'one second' **D** viz. Large and Small regions of *spacetime* **L**. In fact (Case I), there is only one 'Bob', **$B_S$** & **$B_L$**, thanks to which we have e*ntanglement of space* (Eq. **2**). Yet in fact **$B_S$** and **$B_L$** are different as well (Case II), as **$B_S$** is rendered with **K** ∈ (0, 1) and **$B_L$** is rendered with **K** ∈ (1, ∞). Alice (**A**) remains in the vicinity of **K** = 1, in which the e*ntanglement of space* is tending asymptotically toward zero (Eq. **2**).

Notice that **K** = **0** is indistinguishable from **K** = **∞**, as they match (Luke 17:21)[38].

Also, the entire spacetime, **A** & **$B_S$** & **$B_L$**, is rendered *from* **K** = 1 in two opposite "directions" toward **$B_S$** & **$B_L$**. The largest physical region of spacetime, *rendered* as **$B_L$**, will be an *asymptotic* region of **K** --> ∞ , which can **never** be completed exactly up to 'infinity' by massive particles (bradyons), because their *flow of time* will stop, like photon's proper time (Figs 12 and 15)

traveling on **zeroth** world line (Fig. 13). However, in RS spacetime we introduce a new axis, denoted with **w** (from *wunderbar*, after Theodor Kaluza), which is *orthogonal* to photon's **zeroth** world line, and is being (present continuous) **re**-**nullified** (cf. Fig. 3 and Eq. **4**) at every topological point here-and-now from the *local* (physical) mode of spacetime. This *atemporal* nullification -- one-at-a-time -- is made in the so-called *global* mode of spacetime[38] (September 2011), along the **w** axis (Fig. 13).
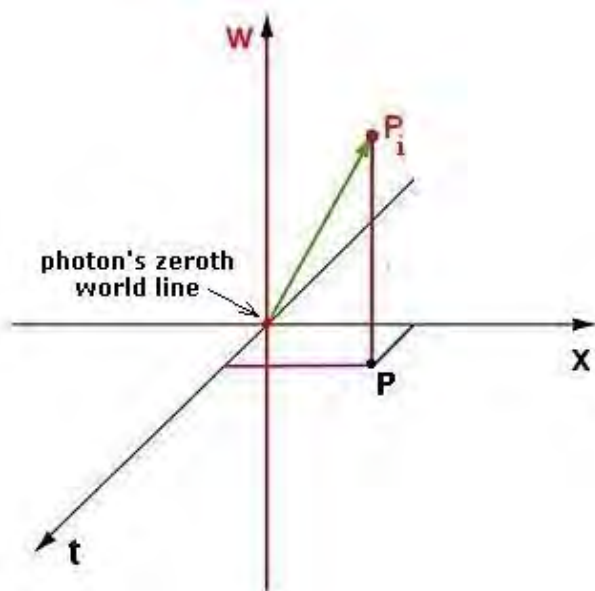


Fig. 13
The *physicalizable* "mass" at $P_i$ is *potential reality* (Macavity[28]), which is rendered as positive mass at **P** endowed with inertia.
Elevating **P** at $P_i$ is considered reversible process (REIM).
The **red** point from **w** axis shows *the* elementary transition
**AB** = **dt** in Fig. 11, which has zero "dimensions": photon's world line, which every *inanimate* clock reads as *already* completed[20].
The human brain and all quantum-gravitational objects read it as *atemporal* global mode of spacetime -- *potential* reality.

The first task toward the so-called Virtual Geodesic Path formulation of GR[38] is to get rid of tensors defined on a dead fixed manifold, and introduce 'potential reality' with new imaginary numbers (called *hyperimaginary* numbers viz. *hypercomplex* numbers) obtained "within" **w**, so that the squared moduli of the wave amplitudes of potential-reality waves in the vacuum will be *always* zero (**w² = 0**, Fig. 14.1), matching a flat line due to destructive interference. Notice that in the *global* mode of spacetime **w** is **not** zero, **w ≠ 0** (cf. case (i) in Fig. 3 and Fig. 14.2).
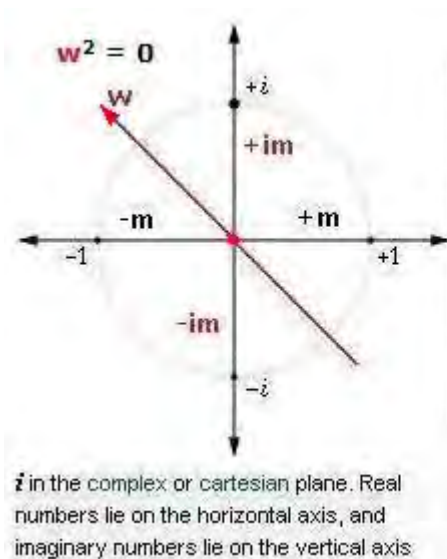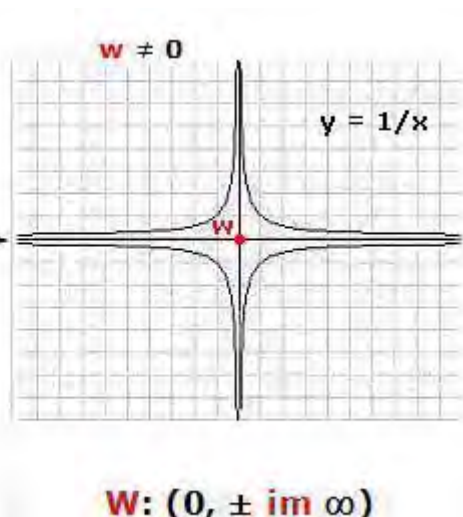
Fig. 14.1                    Fig. 14.2

We examine only purely imaginary numbers (Fig. 14.1), and interpret their center point **w** as *circular point at infinity* (Floor van Lamoen) endowed with *asymptotic* structure (Fig. 14.2), which supply open manifolds with **dual** boundary[38] at **w** -- the boundary **w** (i) does *not* belong and (ii) belongs to the topological space of *physicalized* "shadows" (cases (i) and (ii) in Fig. 3). Hence at every instant 'here-and-now' (Fig. 11), God is both (i) outside its universe (Fig. 14.2) and (ii) inside it (Fig. 14.1), as the Universe is "breathing" by (i) inhaling (Fig. 14.2) and (ii) exhaling (Fig. 14.1).

Perhaps the two imaginary degrees of freedom "within" **w** facilitate the *atemporal* offer and confirmation waves of potential reality "outside the train" (September 2011)[38]. The *atemporal* offer and confirmation waves of potential reality should eliminate 'all but **one**' of the potential states of the Universe, yielding **one** *physicalized* (virtual) state at the *interface* **dt** in Fig. 11, while keeping the rest of non-physicalized *potential* states stored in the atemporal vacuum (Fig. 14.2), ready for negotiating the ***next*** interface 'now'. Hence the **red** point from **w** axis (Fig. 13) also denotes the *physicalized* presentation of **w** cast on its *real* basis (case (ii), Fig. 3) viz. the **re**-nullified ($w^2 = 0$, Fig. 14.1) structure of topological points (no-boundary proposal[38]).

In general, we propose that the physical world is made from "retarded" light-and-cognition (John 1:1) with equation of state

$$1.1 = 1 \quad (\text{Eq. } 3).$$

In relative scale spacetime we postulate *atemporal* conversions -- one-at-a-time -- between Eq. **3** and Eq. **1** above, yielding **dual** cosmological age[38] of the "retarded" physical world: once created by God (John 1:1), the physical universe is *already* (Sic!) eternal, as it can never *actually* reach its Beginning-and-End (Luke 17:21) at **w** ≠ **0** (Fig. 14.2).

Watch the video explanation below (Fig. 15), and keep in mind that nobody knows whether √0 is indeed "zero". It may refer to an *atemporal* light-like null surface, called here 'global mode of spacetime' (Fig. 14.2). The latter is governed by *actual* infinity as **ONE** entity, as it does *not* have physical metric (Fig. 2) viz. 'parts' (Euclid).
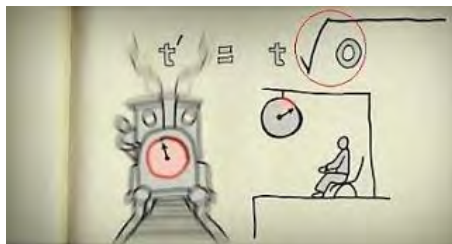
Fig. 15
0.47 - 0.52: "Relative to the platform, time on the train completely stops." Yet with *hyperimaginary* numbers **w**, **w** is not zero. Only $\mathbf{w^2} = \mathbf{0}$ (Fig. 14.1), hence (t' = t**w**) pertains to the null surface (global mode of spacetime) at which all tachyons will be "frozen" at *absolute* rest.

This is Relative Scale theory of spacetime. At the end of the day, we hope to offer new interpretation of Howard Georgi's scale-invariant theory and explain the three kind of masses (positive, negative, and imaginary) shown below, from Terletsky[32].
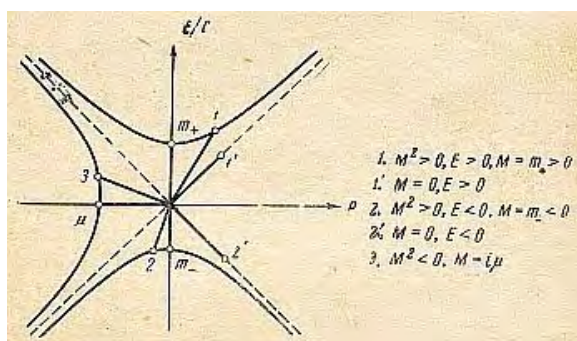


Fig. 16

Notice that the unphysical variables **T** and **R** are 'absolute structures' that do not conform to the principle of action and reaction[33]. If they were *physically* observable, we will have physical presence of 'Father Æther' and an absolute "reference fluid" (also called 'individuating field'), which can identify the points of space and the instants of time, like in the Newtonian spacetime (see above). Bad idea, because the spacetime will have Archimedean topology at *fundamental* level, and the *ether* (see above) will become *physical* observable at *absolute* rest, like the two river banks at *absolute* rest with respect to the flowing water in the river of Heraclitus.

Now let's move to RS *gravity* by introducing the alterations of spacetime metric in RS spacetime as *the* origin of gravity. To obtain **B_S**, set **K** <1 in the open interval (0, 1). To obtain **B_L**, set **K** >1 in the open interval (1, ∞). Keep in mind that in RS gravity the centripetal and centrifugal gravitational *gradients* (see above) are due to **K** <1 (attractive gravity) and **K** >1 (repulsive gravity). That is, gravity "shrinks" the **metric** of physical spacetime without any "dark matter" nor "supermassive black holes", and "expands" the **metric** to produce the repulsive presentation of gravity (Hubble's law): no need for any "dark energy" of (whatever).

Another application of RS gravity: if you fly with a jet plane (see below) with, say, 600 km/h in Alice's spacetime (dotted line in Fig. 10), you will pass 167m/s, but if you switch to the spacetime of 'Bob in the Large' and use **K** = 3, you will fly with **3x** speed, and with *enormous* acceleration. With respect to whom? Only to Alice, of course. You won't notice in your REIM drive any sudden acceleration (watch 0:49-0:51).

To fly like an Alien Visiting Craft (AVC), you may have to alter (p. 8 at this http URL) the gravity differential **dt** (cf. Fig. 11 and Wilbur B. Smith below) of your REIM drive by **K** >1. This will be *bona fide* spacetime engineering (Fig. 3).



Fig. 17
Wilbur B. Smith (3:00 - 3:10): "... to produce the gravity differential, the time field differentials which were necessary to operate the ship."

**Alice will see you "accelerating" from her, reaching** *enormous* speed (watch 0:49-0:51), and will think that you've been propelled by "dark energy" (explanation here). So imagine the following experiment. Alice and Bob are in Munich, and have synchronized their atomic clocks with highest possible precision at 09:00AM. Alice is walking her dog, while Bob jumps in his private jet plane and flies to Hamburg and back (2x600km) with average speed 600km/h with respect to Alice, so she expects to see him back at around 11:00AM. But at a safe altitude of 11km, Bob switches to **K** = 3 and makes his jet a REIM drive. Relative to his spacetime, his speed remains 600 km/h and can never exceed *his* relative-scale "speed" of light, but with **K** = 3 his speed with respect to Alice will be 1800 km/h, so he will get back to her in app. 40min instead of 2 hours.

Three questions come to mind. Will Bob see at **K** = 3 the space "moving" toward him, like in sci fiction movies? In the case of Alcubierre Warp Drive, Brendan McMonigal explained (private **communication**): "**Str**ictly speaking, the ship is stationary in space, rather it is the space that is **distorted around the ship. This is why it is different to, say, a plane flying through space.**" Secondly, when Bob and Alice rejoin in Munich, will their atomic clocks show difference in **reading their times? And thirdly, if there is a difference, whose clock will be "lagging" at 09:40AM? I bet on Bob's clock. Here's why.**

If Bob was flying the distance **L** =1200km (2x600km) like Alice (**K** = 1) but with 1800 km/h, we can calculate a miniscule value of his relativistic time dilation **with respect to Alice's clock at 09:40AM. If we denote the reading of Alice's clock (practically at rest) at 09:40AM with M, and the reading of Bob's clock (K = 1) with N, the time dilation will be M - N > 0. But since Bob is** flying with an *altered* gravity differential **T'** (**K** = 3), it will **3x** inflate (**M** - **N**), so if we denote the reading of his (also perfectly accurate) clock at **M** with **N'**, we claim that (**M** - **N'**) = **3x** (**M** - **N**), because his relativistic time dilation will be **3x** increased.

**I bet all air traffic controllers and "the good guys" monitoring Bob's jet with** spying satellites (*Süddeutsche Zeitung*, 6. Dezember 2013) will immediately detect the jet flying with *their* 1800 km/h (990 knots, 2:10 - 2:24). But what may happen if Bob uses **K** = 3000 and fly with 500 km/s *relative* to Alice? I suppose (**M − N'**) will be inflated by $3.10^3$, yet the relativistic time dilation will be still too small to detect with atomic clocks. Now, the diameter of Milky Way is

app. 120,000 light-years, which makes 378,684x10$^7$ light seconds, so an AVC would need to fly with **K** = 378,684x10$^7$ in order to pass through our galaxy (we stay with Alice) for 1s. If our guests were flying here on Earth like Bob with **K** = 3 or 1800 km/h relative to Alice, with the value of **K** above they will navigate through Alice's spacetime with 5.7x10$^7$**c** relative to Alice. Yet their speed in their *altered* spacetime will never surpass their relative-**scale "speed" of light,** because their (**M – N'**) can never be increased backwards to *eliminate* the initial 40min. Such "miracle" can be attributed only to some transcendental tachyon[34] which is *already* absolutely everywhere at 'time zero', 09:00AM.

Trouble is, the *engine* of AVCs is totally unknown, because it should use the centrifugal (to accelerate with **K** >1) and centripetal (to de-accelerate with **K** <1) gravitational gradients *without* 'rotation', and should be *de facto* unconstrained by inertia (REIM). Perhaps such engine can produce gamma-**ray photons ("**a bright flare**"; see the** *flash* at 0:54-0:56 here), but will it produce *unbounded* amount of positive energy by "runaway reaction"[34] ?

Perhaps the so-called *hyperimaginary* numbers (Fig. 14.2) can be explained with superposition of three kinds of masses (Fig. 16): (i) imaginary mass of tachyons (Addendum **2**), in which case their |$m_i$|$^2$ is *negative*[34], (ii) massless particles such as photons (E$^2$ - p$^2$ = **0**; Fig. 14.1), and (iii) particles with real positive/negative mass (cf. **"negative of money" above), in which** case their |**m**|$^2$ is *positive*, so case (i) **exactly cancels** case (iii), and we obtain a hypothetical *vacuum of light*, **w$^2$ = 0** . But how can we start and stop **K** ? With *polarization* of the light vacuum, **w$^2$ = 0** , producing *virtual* positive/negative pairs from (iii), which could eliminate (REIM) the inertia of (**+m**)? We need the engine of AVCs, can't fly *only* with our brains!

Of course, I could be wrong. Perhaps we can, but by using the Brain of the Universe. As Christopher Columbus on**ce noticed, if we didn't embark** directly west to seek new route to India, how could have we discovered America?

D. Chakalov
November 19, 2014


## Addendum 2


Three weeks ago, I wrote to my good old friend Erasmo Recami, informing him that after thirty years of studying tachyons (see also Gerald Feinberg), only now I can suggest something conclusive about their puzzling nature. First, check out the Quantum of Time (chronon), introduced by Erasmo Recami and Ruy Farias in 1997**, and keep in mind that, "unlike any** known particle, tachyons do **not** interact in any way and can never be detected or observed" (Wiki). To quote again from Wiki (emphasis mine), "**after** a tachyon has passed nearby, we would be able to see *two* images of it, *appearing* and depart**ing in opposite directions"; see the** drawing below (source here).
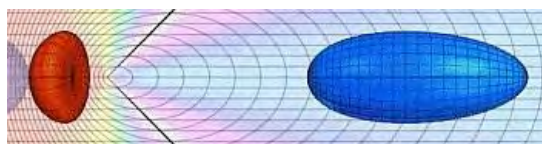


Fig. 18
According to Wiki (emphasis mine), "Because the object arrives **before the light**, the observer sees **nothing** *until* the sphere starts to pass the observer, *after* which the image-as-seen-by-the-observer splits into two -- one of

the arriving sphere (to the right) and one of the departing
sphere (to the left)."

To understand the meaning of "the observer sees **nothing** *until* (Sic! - D.C.) the sphere starts to pass the observer", notice that '**before the light**' is depicted with the asymptotic structure of **w** in Fig. 14.2, which is erected toward the *atemporal* potential reality at photon's **zeroth** world line (Figs 13 and 14.1), "over" **one** topological point 'here-and-now' from the spacetime continuum. We postulate two *atemporal* topological waves[38], propagating in the *atemporal* potential reality, to explain the *emergence* of the instant 'here-and-now', denoted with **dt** in Fig. 11. Obviously, one cannot "expand" the gravity differential **dt** (Fig. 17) to zoom on the "flashes" of *physicalized* world *during* their "proper" infinitesimal duration **dt** (Fig. 3). This is why the *atemporal* "duration" **T** (Fig. 2) is unphysical, or rather not-yet-physicalized.

The *light vacuum* $\mathbf{w^2}$ (see above) is by default *perfectly* neutral, as it does **not** interact "in any way and can never be detected or observed" (Wiki). Stated differently, the light vacuum is *the* omnipresent light-in-motion: *Panta rei conditio sine qua non est.*

The equation of state of the *light vacuum* $\mathbf{w^2}$ (resembling the Pythagorean theorem) requires the so-called hyperimaginary numbers (cf. Fig. 14 and the cancellation of case (i) with case (iii) above) with which we model 'the conservation of Nothing' (Eq. **4**) yielding two *atemporal* Higgs bosons $|\mathbf{m_i}|^2$ and their conjugated *atemporal* 'potential reality' in the vacuum, $|\mathbf{m}|^2$,

$$\mathbf{w^2} = |\mathbf{m_i}|^2 + |\mathbf{m}|^2 \quad (\text{Eq. } \mathbf{4}).$$

Due to the "speed" of light, we cannot see the *light vacuum* and its *atemporal* 'conservation of Nothing' (Eq. **4**) in real time, as 'happening' (Eq. **3**) within every instant 'here-and-now' (Luke 17:21), ever since The Beginning (John 1:1). Physically, we only have "**nothing**" (Fig. 18), because the *atemporal* 'conservation of Nothing' lives in the *global mode* of spacetime "within" point **w** in Fig. 14.2. We can detect an enormous asymmetry of matter vs antimatter only *post factum*, just "few parts in $10^9$ asymmetry" – not the *atemporal* Higgs boson nor its *atemporal* counterpart of positive/negative mass pairs $(+/-\mathbf{m})^2$. The right-hand side of Eq. **4** undergoes spontaneous symmetry breaking (Mexican hat) "before" we could see it physically, just like Macavity (Helfer[28]). To cut the long story short, I suggested (9 January 2003) that quarks will follow Fibonacci sequence[38]: pentaquark, octaquark, etc. *Qui vivra verra*.

Notice that **w** is not zero. Only $\mathbf{w^2} = \mathbf{0}$ (Fig. 14.1). The latter cannot provide a *measure* of the global intrinsic structure of spacetime by "determining what functions of global inertial coordinates **are independent of the choice of inertial frame**"[1], because at every instant 'here-and-now' from the spacetime continuum, **w** refers to 'the Universe as ONE', and at every instant of observation (cf. Macavity in Helfer[28]) **w** has *already* (Sic!) being squared and **re**-nullified due to the "speed" of light, once-at-a-time (Fig. 11). Thus, $\mathbf{w^2}$ cannot show up as non-zero global intrinsic variable in the *quadratic* form of coordinate differences used to define observer-independent spacetime interval (cf. Eq. 1.3.1 in Wald[1]). By the same *quadratic* token, **w** is nullified in the distance function defined with Euclidean metric, and is *totally transparent* in the topology of Euclidean space, induced by the metric. Yet **w** is not zero (Fig. 14.2), because it refers to 'potential reality' -- "a total field of as yet unknown structure", Einstein[10].

To understand 'potential reality' in quantum theory, recall the excerpt from Schrödinger[26] above and the ontological status of 'gravitational field *at a point*', as explained by Einstein[36]. In both cases we encounter *physicalized* explications dubbed "shadows" (Fig. 3), while their potential-reality source has no intrinsic color and is "colorless" (Fig. 2), in the sense that it contains all possible "colored shadows" in *potential* form. So if people try to present the *wegtransformierbar* gravitational field as 'objective physical reality of gravitational field *at a point*', they will be "looking for the right answer to the wrong question"[2]. The *source* of quantum-gravitational "shadows" lives along axis **w** in Figs 13-14, and its *physical* presentation

is *necessarily* "zero" (Fig. 14.1), just like Macavity[28]. Otherwise the metric could not be dynamical[2], but will be *dead fixed* at a point by fixed gravitational energy density at the same point, and gravity will become *physical force* obeying Newton's third law (cf. **NB** on p. 9).

Again, the *potential reality*, as suggested twenty-five centuries ago by Plato (Fig. 3), is neither 'mind' (*res cogitans*) nor 'matter' (*res extensa*). It produces *pre-established harmony* (Leibniz) by so-called biocausality[37], and occupies the *potential future* of all events. Which is why its coupling to matter produces "dark" effects[38] (cf. pp. 4-5 at this http URL), in the sense that such effects cannot be traced back *entirely* to their history in the *past* light cone. All efforts to reduce 'potential reality' to some physical stuff lead to *reductio ad absurdum*. It's a bit like this: you go in a china shop and see all porcelain vases arranged in the air, in perfectly stable configuration, and wonder what *physical* stuff could design and support such amazing configuration of fragile (baryonic) stuff. Then you assume that this phenomenon is due to an invisible dark (non-baryonic) elephant, but it is roughly four times larger than the shop. If you add another dark effect known as "dark energy"[9], you will obtain dark *dancing* elephant, which will be roughly twenty times larger than the china shop, yielding "the worst theoretical prediction in the history of physics!" (Wiki).

Anyway, I suppose by tweaking Eq. **4** we may obtain *retarded* light in the form of *always* positive[28] mass and energy, which can be physically observed only *post factum*, only in our *past* light cone (Fig. 3). But "before" we do that, we will see "**nothing**," as Wiki eloquently explained above. Then the tachyon *instantaneously* splits (not once but infinite times) into two particles with identical positive mass (+**m**) but opposite charge/magnetic polarity. The particle-antiparticle pair will literally *emerge* from within **one** single point here-and-now, at the *exact* same time and *exact* same place, causing annihilation (e.g., "a bright flare", see also the *flash* at 0:54-0:56 here). In electron-positron annihilation, two gamma rays will *emerge*, moving in *opposite* directions (no "black holes"), and one of the rays will accelerate you like an AVC (Fig. 18). Actually, one of the rays will be the AVC itself. Of course, "energy is given off" as well. Hence with just **one** tachyon one could reproduce the release of energy corresponding to **five** solar masses emitted in under 60 seconds in the form of X-rays and gamma rays.

Is this a new route to India?

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November 19, 2014

## References

1. Robert M. Wald, *General Relativity*, The University of Chicago Press, 1984, pp. 7-8, p. 12 ("we shall consider in this book only manifolds which are Hausdorff and paracompact"), and pp. 423-426; *Idem*, Teaching General Relativity, 14 November 2005, arXiv:gr-qc/0511073, p. 5: "First, one needs a mathematically precise notion of the "set of points" that constitute spacetime (or that constitute a surface in ordinary geometry)."

2. Charles W. Misner *et al*., *Gravitation*, Freeman, 1973, p. 5 and p. 467.

3. Hermann Bondi *et al*., Gravitational Waves in General Relativity. VII. Waves from Axi-Symmetric Isolated Systems, *Proc. R. Soc. Lond*. **A** 21, 269(1336) 21-52 (1962).

4. Richard Schoen and Shing Tung Yau, On the proof of the positive mass conjecture in general relativity, *Comm. Math. Phys*. 65(1) 45-76 (1979).

5. Ignazio Ciufolini and John Archibald Wheeler, *Gravitation and Inertia*, Princeton University Press, 1955, p. 270.

6. Roger Penrose, Conformal Treatment of Infinity. In: *Relativity, Groups and Topology*, Vol. 1, Ed. by B. DeWitt and C. DeWitt, Gordon and Breach, London, 1964, pp. 565-584.

7. Jeffrey Winicour, Boundary Conditions for the Gravitational Field, *Class. Quantum Grav*. 29 (2012) 113001; arXiv:1203.2154v2.

8. Matt Visser, The quantum physics of chronology protection. In: *The Future of Theoretical Physics and Cosmology: Celebrating Stephen Hawking's Contributions to Physics*, ed. by G. W. Gibbons *et al*., Cambridge University Press, 2009; arXiv:gr-qc/0204022v2.

9. Sean M. Carroll, Why is the Universe Accelerating? In: *Measuring and Modeling the Universe*, Volume 2, Carnegie Observatories Astrophysics Series, Cambridge University Press, 2004; arXiv:astro-ph/0310342v2.

10. Albert Einstein, *Philosopher-Scientist: The Library of Living Philosophers*, Volume VII, ed. by Paul Schilpp, Open Court, 1998, p. 75.

11. Kurt Gödel, What is Cantor's Continuum Problem? *The American Mathematical Monthly*, 54(9) 515-525 (1947).

12. Ted Jacobson, *A Spacetime Primer*, 2 September 2004, pp. 18-19, available at this http URL.

13. Asher Peres, Measurement of time by quantum clocks, *Am. J. Phys*. 48(7) 552-557 (1980).

14. Harald Atmanspracher and Hans Primas, The Hidden Side of Wolfgang Pauli, *Journal of Consciousness Studies* 3(2) 112-126 (1996); cf. Sec. VI, p. 122.

15. John A. Wheeler, Ref. [2], p. 1215.

16. Chris J. Isham and Jeremy Butterfield, On the Emergence of Time in Quantum Gravity. In: *The Arguments of Time*, ed. by J. Butterfield, Oxford University Press, 1999, pp. 111-168; arXiv:gr-qc/9901024; Karel V. Kuchar, The Problem of Time In Quantum Geometrodynamics. In: *The Arguments of Time*, ed. by J. Butterfield, Oxford University Press, 1999, p. 193.

17. Arthur Eddington, *The Nature of the Physical World: Gifford Lectures* (1927), Cambridge University Press, 2012.

18. John C. Baez and Emory F. Bunn, The Meaning of Einstein's Equation, *Am. J. Phys*. 73(7) 644-652 (2005); arXiv:gr-qc/0103044v5.

19. Hyun Seok Yang, Towards A Background Independent Quantum Gravity, *J. Phys*.: Conf. Ser. **343** 012132 (2012); arXiv:1111.0015v3.

20. Kevin Brown, *Reflections on Relativity*, MathPages, 2014, Sec. 9.9 Locality and Temporal Asymmetry, pp. 695-701.

21. Hermann Bondi, Conservation and Non-conservation in General Relativity, *Proc. R. Soc. Lond*. **A** 427(1873), 249-258 (1990).

22. T. Padmanabhan, *Gravitation: Foundations and Frontiers*, Cambridge University Press, 2010, pp. 211-213.

23. Wolfgang Rindler, *Relativity: Special, General, and Cosmological*, 2nd ed., Oxford University Press, 2006, p. 22.

24. Kevin Brown, *Physics in Space and Time*, MathPages, 2013, Sec. 4.14 General Relativity and the Principle of Inertia, pp. 348-352.

25. Walter Wyss, The energy-momentum tensor in classical field theory, *Concepts of Physics*, Vol. II (2005), pp. 295-310, p. 304.

26. Erwin Schrödinger, The Present Situation in Quantum Mechanics, *Proceedings of the American Philosophical Society*, **124**, 323-238 (1980), Sec. 8 Theory of Measurement, Part One.

27. Gary T. Horowitz, The positive energy theorem and its extensions, *Lecture Notes in Physics*, 202, 1-21 (1984).

28. Adam Helfer, Are Negative Energy Densities Detectable? 18 September 1997, arXiv:gr-qc/9709047v1.

29. L. H. Ford, Negative Energy Densities in Quantum Field Theory, *Int. J. Mod. Phys*. **A**25, 2355-2363 (2010); arXiv:0911.3597.

30. John Baez, What's the Energy Density of the Vacuum? 10 June 2011, Sec. 4, available at this http URL.

31. Herbert Lichtenegger and Bahram Mashhoon, Mach's Principle, 14 July 2004, arXiv:physics/0407078.

32. Yakov P. Terletskii, *Paradoxes in the Theory of Relativity*, Plenum, 1968, Ch. VI, § 25.

33. James L. Anderson, *Principles of Relativity Physics*, Academic Press, 1967, p. 73 and p. 339; Domenico Giulini, Some remarks on the notions of general covariance and background independence, *Lect. Notes Phys*. 721, 105-120 (2007); arXiv:gr-qc/0603087.

34. Scott Chase, Do tachyons exist? March 1993, available at this http URL.

35. Max Planck, *Philosophy of Physics*, Norton and Company, New York, 1936, p. 97.

36. A. Einstein, Dialog über Einwände gegen die Relativitätstheorie, *Naturwissenschaften*, **6**(48), 697-702 (29. November 1918), p. 700: "Man kann deshalb weder sagen, das Gravitationsfeld an einer Stelle sei etwas *Reales*, noch es sei etwas *bloß Fiktives*." (…) "dem Gravitationsfeld an einer Stelle entspricht also noch nichts physikalisch Reales, wohl aber diesem Gravitationsfelde in Verbindung mit anderen Daten." ("One can say that the gravitational field at a point is neither real nor merely fictitious." (…) "nothing 'physically real' corresponds to the gravitational field at a point, only to the gravitational field in conjunction with other data." Translated by A. Afriat and E. Caccese, arXiv:0804.3146.)

37. D. Chakalov, How To Bind Mind To Matter? Unpublished manuscript, 15 January 1990, abstract available at this http URL.

38. D. Chakalov, *Maximal Set Theory and Dual Topology of Spacetime*. Manuscript in preparation, expected in November 2015.