



Dimi Chakalov &lt;dchakalov@gmail.com&gt;

## What could possibly FIX time-direction?

Dimi Chakalov &lt;dchakalov@gmail.com&gt;

Wed, Feb 16, 2022 at 9:56 PM

To: Alex &lt;guts@omsu.ru&gt;

Cc: Hans &lt;hansr@kth.se&gt;, Michael Heller &lt;info@copernicuscenter.edu.pl&gt;, michal@eckstein.pl, iriking@wp.pl, t.miller@mini.pw.edu.pl, skot@aegean.gr, nicolas.franco@math.unamur.be, janusz.garecki@usz.edu.pl, piotr.chrusciel@univie.ac.at

P.S. Suppose, for the sake of argument, that, given initial data, there might be some unique maximal globally hyperbolic development (MGHD). Can MGHD be related to the puzzle below?

Best - D.

On Wed, Feb 16, 2022 at 9:36 PM Dimi Chakalov <dchakalov@gmail.com> wrote: >

> Hi Alex,

>

> May I ask for your opinion on the following issue.

>

> In arXiv:2202.07302v1, Michal Eckstein and Michael Heller wrote (p. > 7): "The set of timelike vectors has two components: the 'future' and > the 'past'. It is standard to assume [Wald, 1984] that the space-time > is time-oriented (and not only time-orientable), which means that a > choice of time-direction is fixed (smoothly) for all vectors > throughout the tangent bundle TM."

>

> What phenomenon could possibly FIX time-direction, globally and > smoothly over all vectors throughout the tangent bundle TM? If this > phenomenon was made of any physical stuff, it must be governed by > another physical phenomenon -- 'turtles all the way down'. Can > synthetic diff geometry shed some light on this puzzle?

>

> I will appreciate the opinion of your colleagues as well. Please see > <http://www.god-does-not-play-dice.net/Heraclitus.pdf>

>

> All the best,

>

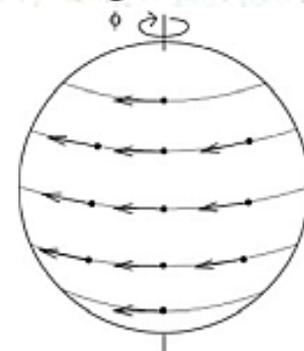
> Dimi

> --

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A Lorentzian manifold will be "time-orientable" (Wikipedia) iff all timelike and null vectors have an equal global **difference** between their future- and past-directed components, like some global vector field on a circle that points clockwise to the **future**, and has the same length at each point.



[https://en.wikipedia.org/wiki/Causal\\_structure#Time-orientability](https://en.wikipedia.org/wiki/Causal_structure#Time-orientability)

### Time-orientability

At each point in  $M$  the timelike tangent vectors in the point's **tangent space** can be divided into two classes. To do this we first define an equivalence relation on pairs of timelike tangent vectors.

If  $X$  and  $Y$  are two timelike tangent vectors at a point we say that  $X$  and  $Y$  are equivalent (written  $X \sim Y$ ) if  $g(X, Y) < 0$ .

There are then two equivalence classes which between them contain all timelike tangent vectors at the point. We can (**arbitrarily**) call one of these equivalence classes **future-directed** and call the other **past-directed**. Physically this designation of the two classes of future- and past-directed timelike vectors corresponds to a choice of an **arrow of time** at the point. The future- and past-directed designations can be extended to null vectors at a point by continuity.

A Lorentzian manifold is **time-orientable**<sup>[1]</sup> if a continuous designation of future-directed and past-directed for non-spacelike vectors can be made over the entire manifold.



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## Energy from geometry (a.k.a. "gravitational energy")

Dimi Chakalov &lt;dchakalov@gmail.com&gt;

Fri, Feb 18, 2022 at 10:57 AM

To: Lili He <lhe31@jhu.edu>, Jonathan Luk <jluk@stanford.edu>, Demetrios Christodoulou <demetri.christodoulou@math.ethz.ch>, Junyan Zhang <zhangjy9610@vip.qq.com>, Hans Lindblad <lindblad@math.jhu.edu>, Igor Rodnianski <irod@princeton.edu>, Christopher Kauffman <christopherjkauffman@gmail.com>, Daniel Ginsberg <dan.ginsberg@gmail.com>, Vaibhav Kalvakota <vaibhavkalvakota@gmail.com>, Sergiu Klainerman <seri@math.princeton.edu>

Dear colleagues,

The mathematical task of deriving energy from geometry is beyond my limited knowledge in math. Perhaps you will be interested to see

[http://www.god-does-not-play-dice.net/p\\_9.jpg](http://www.god-does-not-play-dice.net/p_9.jpg)

<http://www.god-does-not-play-dice.net/Heraclitus.pdf>

Detailed explanation at my website below.

Kind regards,

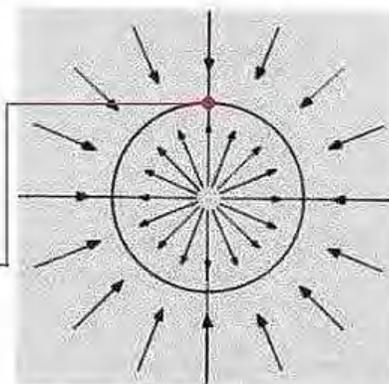
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## Parity (physics)

[https://en.wikipedia.org/wiki/Parity\\_\(physics\)](https://en.wikipedia.org/wiki/Parity_(physics))

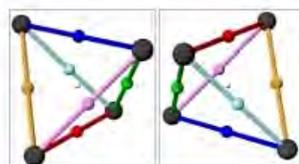
In quantum mechanics, a **parity transformation** (also called **parity inversion**) is the flip in the sign of *one* spatial coordinate. In three dimensions, it can also refer to the simultaneous flip in the sign of all three spatial coordinates (a point reflection):

$$P : \begin{pmatrix} x \\ y \\ z \end{pmatrix} \mapsto \begin{pmatrix} -x \\ -y \\ -z \end{pmatrix}.$$



Parity inversion (top left) is *not* sufficient to prove space-orientability. Consider a finite volume of 3D space pictured with a finite sphere (top right). The generic property of 3D space is that there is always a volume of 3D space trapped inside the finite sphere, which is always *smaller* than the volume of 3D space outside the sphere with cutoff at the "edge" of *the* maximal Cauchy surface (if any).

Can you perform "inside-out" space inversion at each **reflection point**, such that all the points *inside* the sphere will be substituted with all the points *outside* the sphere? Will you end up with a "mirror" 3D image inside the sphere?



## Explanatory Note

To understand my email from 16.02.2022 and the core issue of [global Time](#), recall that it is impossible *in principle* to formulate the gravitational dynamics “near the singularity” (H. Nicolai, [arXiv:2104.09626](#)). Let me offer a simple illustration of the *metric paradox*, from p. 8 in [Platonic Theory of Spacetime](#).

Once we introduce metric of spacetime, as Hermann Minkowski did at his famous talk on [21 September 1908](#), we face the origin of spacetime, which must have existed *before\** the instant of creating spacetime endowed with metric. This *metric paradox* prompted [Yakov Zeldovich](#) to say (private communication) that “long time ago, there was a brief period of time during which there was still no time at all.” He was, of course, joking.

I suggested the so-called vacuum cleaner paradox (VCP) along the deflation time toward the Beginning, from [Pink Panther](#): he used a super powerful vacuum cleaner to suck in the entire world, including himself, after which the vacuum cleaner sucked itself and disappeared into the blob of gray stuff below (known as “inflation”, [Slide 12](#) in [Quantum Spacetime](#)), with duration from  $10^{-32}$  s to  $10^{-36}$  s *toward* the Beginning [[John 1:1](#)]. Notice the doctrine of *trialism* (two *complementary* paths, from physics and from theology, leading to the same “trunk”). We use the path from theology, which is easier to explain.



It should be agonizingly clear that the Universe ([S. Hawking & G.F.R. Ellis](#)) does not and cannot have *any* description “near the singularity”, e.g., some sort of “[quantum soup](#)” or a hypothetical  $\mu$ -vacuum ([Erast Gliner](#)). If it had, the “vacuum cleaner” will suck it as well, and then suck itself and totally disappear into the blob of gray stuff above, which cannot be described even [mathematically](#). The solution is [physical theology](#), in which God [[John 1:1](#)] is eternally residing both “inside” each and every consecutive 4D instant ‘here and now’ and “outside” the *physicalized* partition (dubbed “[jacket](#)”) of the Universe (**P**), ever since the Beginning. Read [Quantum of Spacetime: Zenon Connection](#) (25.04.2021, 26 pp.) and my one-page memo on [spacetime engineering](#) at [this http URL](#).

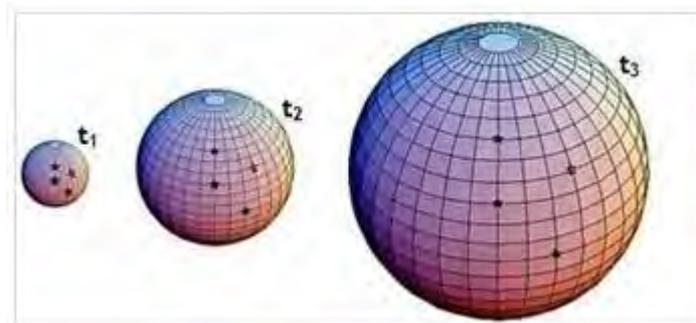
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\*The phenomenon called *causality* requires temporal (before → after) ordering of events. For example, when you look at the Sun, you see the state it had 500 sec earlier.



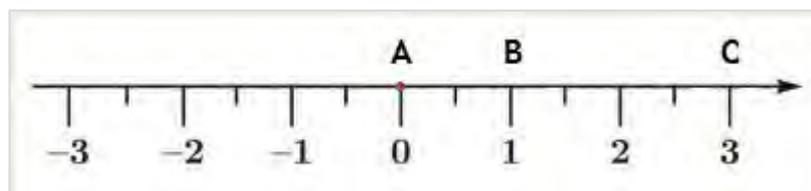
Denote your instant of observation with  $t_2$ : you see the past state of the Sun at  $t_1$  on your timeline at  $t_2$ , namely,  $t_2 - t_1 = 500$  sec. Also, at your instant  $t_2$  the Sun has had a new state, which you will see at your timeline at  $t_3$ , such that  $t_3 - t_2 = t_2 - t_1 = 500$  sec. **NB:** The Sun *always* exists as ‘physical reality out there’, regardless if we see it or not.

Thus, we can define three consecutive instants along the *cosmological time*:  $t_3 > t_2 > t_1$ .



But the relativistic causality does *not* hold for Quantum Theory: read Erwin Schrödinger from 1935 at [this http URL](#). Moreover, if we use the current notion of causality to trace back the *origin* of spacetime, we will hit the *metric paradox* viz. VCP mentioned [above](#).

People are prone to ignore the metaphysical issue of ‘time zero’. If we denote the latter with **A** and place it at the beginning of the positive numbers on the *real line* below, we can say that  $(AC) - (AB) = (BC)$ , hence the ‘time zero’ at **A** will somehow “disappear”.



Yet the Beginning at ‘time zero’ is *always* present, albeit hidden by the “speed” of light. Read again [Quantum of Spacetime: Zenon Connection](#) (25.04.2021, 26 pages).



Einstein created tensor calculus to represent General and Special relativity. How likely does it seem that a unified theory of everything will require new form of mathematics, and will it be another branch of Calculus?

Dimi Chakalov, Founder of Spacetime Engineering  
Updated Dec 26

How likely does it seem that a unified theory of everything will require new form of mathematics? I thank Keith Ramsay for the detailed professional answer. May I offer my (certainly biased) opinion, as [food for thought](#).

The notion of empty set, which we use to explain what we call "zero", is essentially incomplete, and here we might need a new form of mathematics. The empty set refers to 'zero *something*', e.g., the number of bananas you've stuck into your ears while reading these lines. This is an empty set with zero cardinality.

But since our cognition is relational, we may ask, how about 'zero *nothing*'? Philosophically, the *monad* (Leibniz) has no 'windows' through which *anything* (the human cognition included) can interact with the *monad*, and hence the latter is 'zero *nothing*'. In QM with Hilbert dimensions  $\geq 3$ , we have a peculiar UNcolorized Hilbert sphere ([Helena Granström](#)), which correspond to "something" we cannot even imagine. Why? Because we can think **only** about stuff that has a 'color'.

Is the Kochen-Specker Theorem hinting at a QM monad? What if a unified theory of everything requires the [Leibnizian monad](#)? A penny for your (colored) thoughts!



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## Revisiting the pink unicorn (a.k.a. GW150914)

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Dimi Chakalov &lt;dchakalov@gmail.com&gt;

Sun, Feb 20, 2022 at 12:59 AM

To: misi@flatironinstitute.org, will.farr@stonybrook.edu, bailey.sykes@monash.edu, alex.jenkins@ucl.ac.uk, aditya.vijaykumar@icts.res.in, kaloper@physics.ucdavis.edu, huyiming@mail.sysu.edu.cn, mairi.sakellariadou@kcl.ac.uk, yo@thp.uni-koeln.de, hess@nucleares.unam.mx, gaztanaga@gmail.com, korol@star.sr.bham.ac.uk, andrea.valle@unito.it, hubsch@howard.edu, vivian.i.sabla.gr@dartmouth.edu, maciek.wielgus@gmail.com, debora.lancova@pf.slu.cz, s.pereira@unesp.br, amvfisico@gmail.com, jf.jesus@unesp.br, holandarfl@fisica.ufrn.br, zs8479@princeton.edu, rita.t.costa@princeton.edu, cr4482@princeton.edu, egiorgi@princeton.edu, fpretori@princeton.edu, yshlapen@princeton.edu, dafermos@math.princeton.edu, burrows@astro.princeton.edu, sgiombi@princeton.edu, jeremy@astro.princeton.edu, aionescu@math.princeton.edu, klebanov@princeton.edu, quataert@princeton.edu, anatoly@princeton.edu, verlinde@princeton.edu, steinh@princeton.edu, jstone@astro.princeton.edu

Dear Colleagues,

Suppose you hear about a theory of pink unicorns dancing with red herrings, predicting a very specific effect, which has been proven with astonishing success: read the facts -- just the bold facts -- about GW150914 in

[http://www.god-does-not-play-dice.net/p\\_9.jpg](http://www.god-does-not-play-dice.net/p_9.jpg)

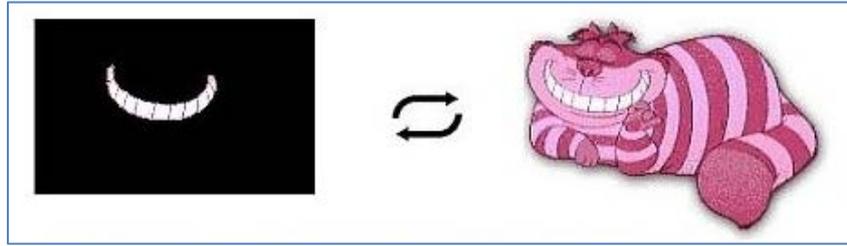
Who will be the first to say that the Emperor is naked?

Sincerely,

Dimi Chakalov  
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Moreover, despite the fact that we know nothing about the wave pattern of *very strong* GWs in the immediate vicinity of “the most powerful explosion humans have ever detected”, Kip Thorne and his collaborators believe that the same *totally unknown* GW pattern was *absolutely not* (Sic!) altered due to non-linear interactions of strong GWs with matter and fields in the cosmos for over one billion years (it should be *many more* years, cf. B. Schutz) before being detected on 14 September 2015, so that now you can see the beautiful drawing above.

Are we so stupid and gullible? Einstein’s GR is *essentially* incomplete, firstly because it cannot explain how the spacetime could *act back* on matter by “telling it how to move” (MTW p. 5) – “there is no mutual action of gravitational fields *on* matter” (Hans Ohanian). According to GR textbooks (MTW p. 467), the *wegtransformierbar* gravity is not a ‘natural force’ (Zhaoyan Wu). It cannot explain even the Earth tides (p. 8). It is still a work in progress. Nobody can claim that GW150914 has “confirmed” *anything*. You just don’t know how gravity works; for example, how gravity transports mass-energy by EM radiation (p. 12). The *linearized* approximation of gravity is for the birds. What if the non-linear gravity can transport force-and-spin as well (p. 9)? Voila.



Symbolic presentation of [Einstein's equations](#).

Think of gravity as an adjective, say, 'blue'. You can't say 'this is a blue', without referring to some physical object, which is the "source" of the "adjective", e.g., 'this is a blue sky' or 'this is a blue flower', etc.

How is the gravitational energy associated with its source? Namely, how is the energy of the Cheshire cat *without* the cat (at the left-hand side) associated with the Cheshire cat but *without* its bare geometric shape?

The only available hypothesis on gravitational radiation<sup>1</sup> *cannot* answer the question above, as we know since the inception of General Relativity. The theory is *essentially* incomplete. It cannot explain how the spacetime could *act back* on matter by "telling it how to move" (MTW p. 5) — "there is no mutual action of gravitational fields *on* matter" (Hans Ohanian). According to GR (MTW p. 467), the *wegtransformierbar* gravity is *not* a 'natural force' (Zhaoyan Wu). It cannot explain even the [Earth tides](#).

Take for example the neutron star merger at roughly 50 Mpc from Earth, detected on [17 August 2017](#): "A short gamma-ray burst was independently identified in the same sky area by the Fermi and INTEGRAL satellites for high energy astrophysics, which turned out to be associated (Sic! - D.C.) with the gravitational event (Elena Pian, *Front. Astron. Space Sci.*, [25 January 2021](#)). But how is gravity *associated* with EM radiation? The first, and completely unsuccessful, effort to explain the puzzle was from [1914](#).

Nobody can claim that [GW150914](#) has "confirmed" *anything*. We just don't know how gravity works; for example, how gravity *transports* mass-energy by EM radiation, such as the gamma-ray burst detected on [17 August 2017](#). The [linearized approximation](#) of gravity is for the birds. Forget it. What if the *non-linear* gravity can transport [force-and-spin](#) as well<sup>2</sup>?

We need [quantum gravity](#).

D. Chakalov  
28 February 2022, 19:59 GMT  
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1. Thomas Mädler and Jeffrey Winicour (2016), Bondi-Sachs Formalism. *Scholarpedia*, 11(12):33528, [revision #196873](#).

2. In the quantum-gravitational world, every event 'here and now' is jointly determined by its history fixed as 'fact' and by its potential **future** in the form of *propensities* – “just in the middle between possibility and reality” ([Werner Heisenberg](#)). The end result is the **self-acting fifth force**.

See below an excerpt from *Spacetime Engineering 201*. The **self-acting** 4D 'glove' – the Cheshire cat [above](#) – is *animated* by the **fifth force** and acquires an *additional energy-momentum* and **angular momentum**, thanks to which the Cheshire cat becomes *gravitalized self-acting* 4D 'glove'.

NB: There is no generic “gravitational energy” nor “gravitational angular momentum”. Likewise, there is no “mental force” in **the self-acting brain**. The force of Life is the **fifth force**. I believe the *non-linear* gravity can transport **force-and-spin** as well, by *directly* injecting it in the *right-hand* side (**Sic!**) of the symbolic equation [above](#). Yes, we need **quantum gravity**.

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## Addendum 1

If you think of the **fifth force** ([p. 6](#)) as some *physical* field, you will have to call this new physical field “**dark matter**” and “**dark energy**” ([Addendum 5](#)), and speculate extensively about “**black holes**”. Don't.



The **monad** itself has no *windows* through which something can enter or leave (Leibniz, *Monadology* 7). The **Platonic** hand has no *windows* either. We see only its 4D glove, and can deduce the existence of **Platonic** hand only from the **self-acting** faculties of its glove.

To grasp intuitively the holistic **fifth force** ([p. 4](#)), think of **Platonic** hand embedded in its 4D glove, thanks to which the 'glove' becomes **self-acting** ([p. 7](#) in the *Notes*, [SE.pdf](#)). It's not like [Baron Munchausen](#). The **Platonic** hand does *not* act like an external physical force, but only *through* its 4D glove (e.g., the shoal of fish at [p. 4](#)), which is how the physical glove acts **on itself** by the *universal* holistic **fifth force**.