

Quantum Spacetime

Dedicated to 138th birthday of Albert Einstein, 14 March 2017

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Abstract

The question whether quantum gravity could eliminate spacetime as fundamental structure is addressed by suggesting possible solution to 'quantum spacetime', ensuing from the experimental fact of observing macroscopic trajectories in Wilson cloud chamber. The latter are produced by consecutive energy exchanges between a single quantum particle and its macroscopic environment, and also have finite duration/life time, which pose fundamental challenges to the current understanding of 'quantum reality' viz. quantum spacetime. As Erwin Schrödinger stressed in 1935, "a variable has no definite value before I measure it; then measuring it does *not* mean ascertaining the value that it *has*", which implies that the quantum reality is not physical reality (*res extensa*) but *physicalizable* reality dubbed *res potentia* – "just in the middle between possibility and reality" (Werner Heisenberg 1958). Thus, we model the quantum spacetime by both geometrical points, as envisaged in the real number line, and *atemporal* Platonic objects pertaining to *res potentia*.

Metaphysics of Spacetime: Matter and Geometry

Local properties of spacetime: Matter and fields provide **individuation** of spacetime points by *local* physical content: “anonymous” or bare (purely geometric) spacetime points of some “vacuum spacetime” cannot exist.

Global properties of spacetime: The spacetime topology, the phenomenon of causality, and the temporal and spatial orientability of spacetime cannot be defined **locally** – they are *global* properties of spacetime, produced by an **atemporal** Platonic state of the entire Universe as ONE, dubbed **res potentia** (Slides 13 and 14).

The local and global properties of spacetime constitute the necessary and sufficient conditions for spacetime. It's a bundle.

General Relativity: The spacetime manifold is infinitely differentiable

Quantum Theory: The spacetime is fundamentally discrete



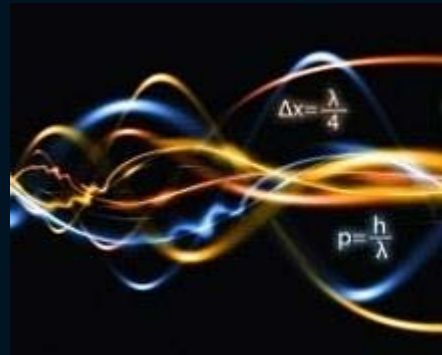
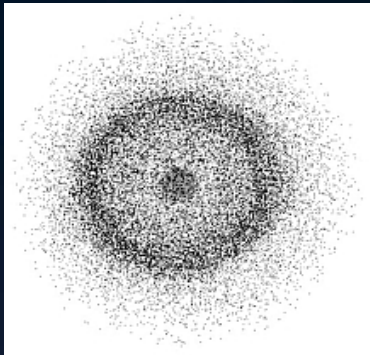
Quantum Spacetime: The spacetime manifold is both perfectly smooth and perfectly discrete, resembling the human memory – there is no physical distance between the *idea* of a tree and the *idea* of a mountain. Ditto to photon's **matrix** (Slide 9) and proton's **matrix** (Slides 10 and 15). Is Planck's **matrix** (Slide 16) 'the true monad without windows' (Slides 13 and 14)?

Classical Reality: Bullet Trajectory



A **bullet** shot in water will produce a trace of bubbles matching its trajectory, until it stops. The consecutive energy-momentum exchanges between the bullet and its environment, as well as the path and duration of bullet's trajectory, are subject to **classical** physics.

No Quantum Reality In QM Textbooks

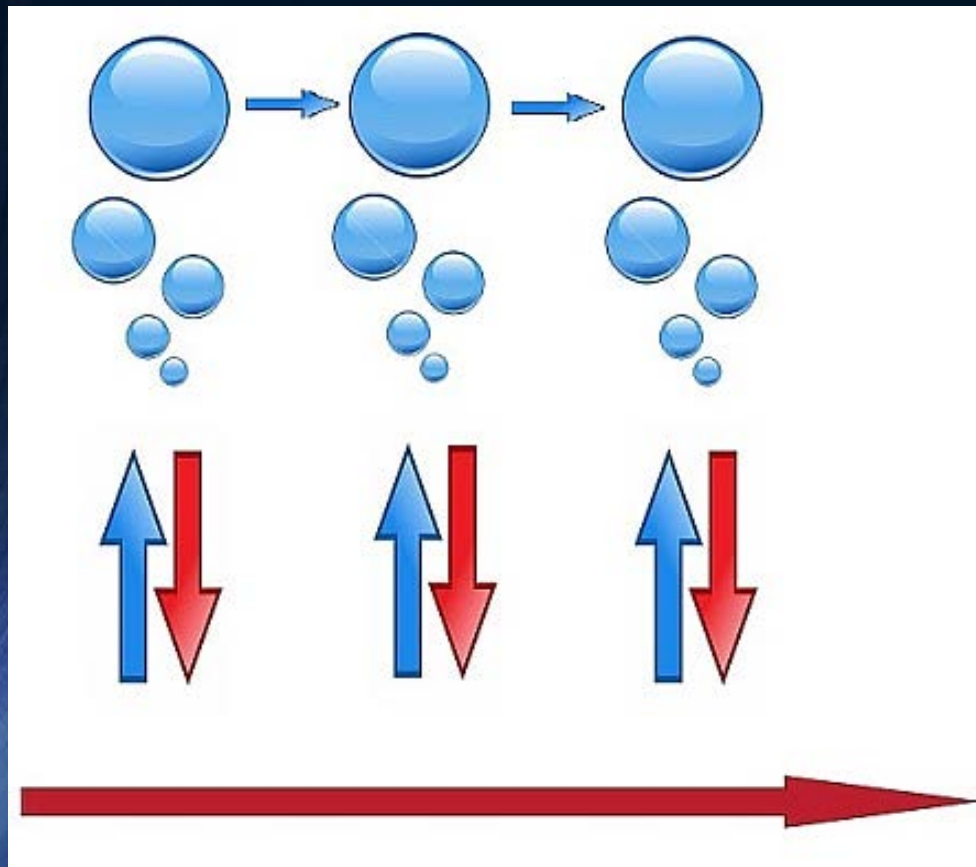


Die Bahn entsteht erst dadurch,
daß wir sie beobachten.
Werner Heisenberg 1927

As Erwin Schrödinger stressed in 1935,
“a variable has no definite value before
I measure it; then measuring it does *not*
mean ascertaining the value that it *has*.
But then what does it mean?”

It means that, unlike bullet's trajectory
comprised from **facts** located in the
past light cone, the quantum reality
cannot be located *anywhere* in the light
cone. It is not a **fact** but **res potentia**.

Quantum Reality: Charles Wilson, 1911



Can we explain the **red** and **blue** arrows in Wilson cloud chamber?

Can we explain *consecutive* energy-momentum exchanges between the quantum **particle** & **wave** and its **macroscopic** environment? Are quantum waves with **complex** phases (Chen N. Yang 1987) physical reality or *physicalizable* reality (Slide 15) “just in the middle between possibility and reality” (Heisenberg 1958)? What is the origin of **time** in Schrödinger equation? Can **clocks** read it?

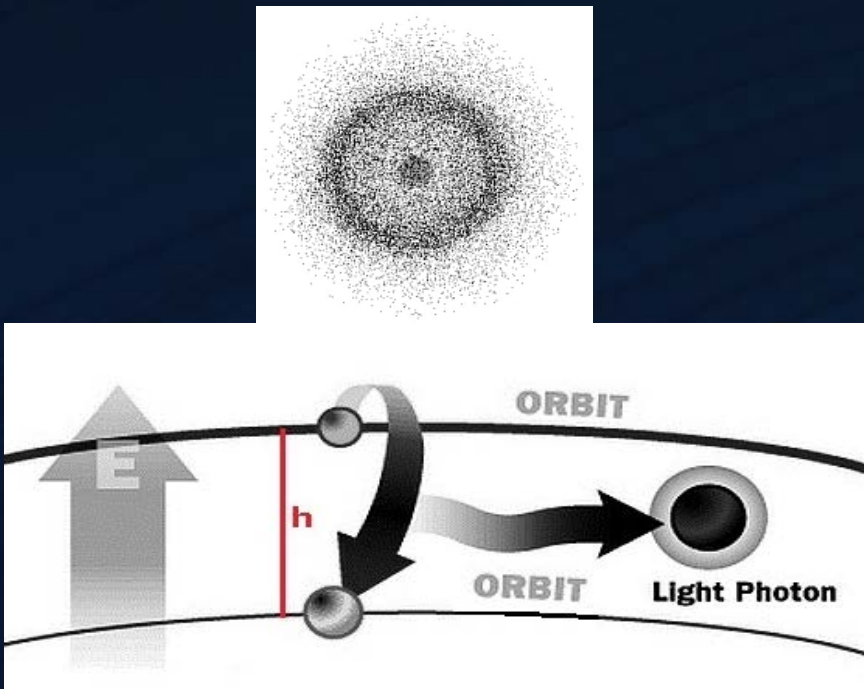
Yes and **No**: The **matrix** (Chakalov 2016).

Atemporal Quantum Reality

Every macroscopic event from bullet's trajectory has causal support from its unique past states, which are **facts** located exclusively in the past light cone. The sequence of such facts presents bullet's identity.

The invisible **red** trajectory (if any) of a single **quantum** "bullet" in Wilson cloud chamber (Slide 7) does *not* have causal support from its "collapsed" states amplified to visible **water** droplets, but from its **atemporal** quantum reality – the quantum **matrix** as *res potentia*. The latter is not a **fact**, as it does not live in *any* section of the light cone. It keeps the **atemporal** *Genidentität* of quantum phenomena and exists with *certainty*. To paraphrase Albert Einstein, God casts the die (the **atemporal matrix**), not the **dice** (proton's **mass**, Slides 10 and 15).

Atemporal Quantum Reality: Emission of Light

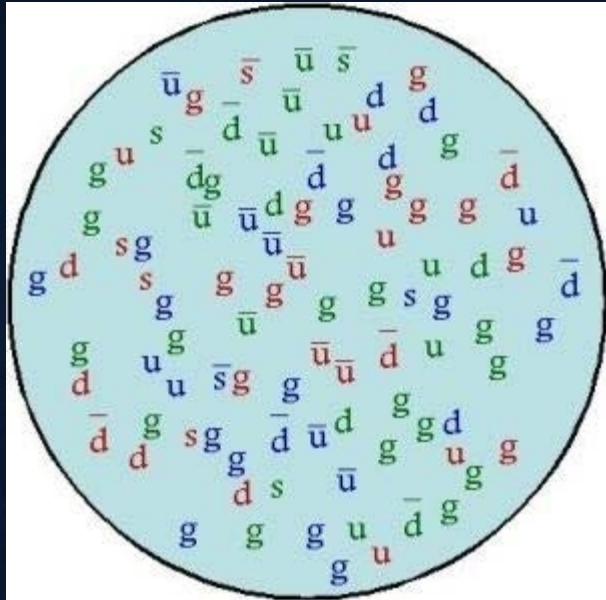


Physically, the photon was **non-existent** before it was emitted: see Schrödinger 1935 (Slide 6) and Milonni 1993 Ch 2.6.

Suppose a light bulb emits photons with rate app. 1.8×10^{20} photons per second. All photons are *identical*, and have particular wavelength related to the "distance" (if any) between the two "orbits" (if any) of electrons, denoted in the drawing with **h**.

How come nothing goes wrong in producing 1.8×10^{20} identical photons per second, *ever*? According to John Wheeler (1973), the identity of particles of the same type is "a central mystery of physics."

Atemporal Quantum Reality: Proton's Mass

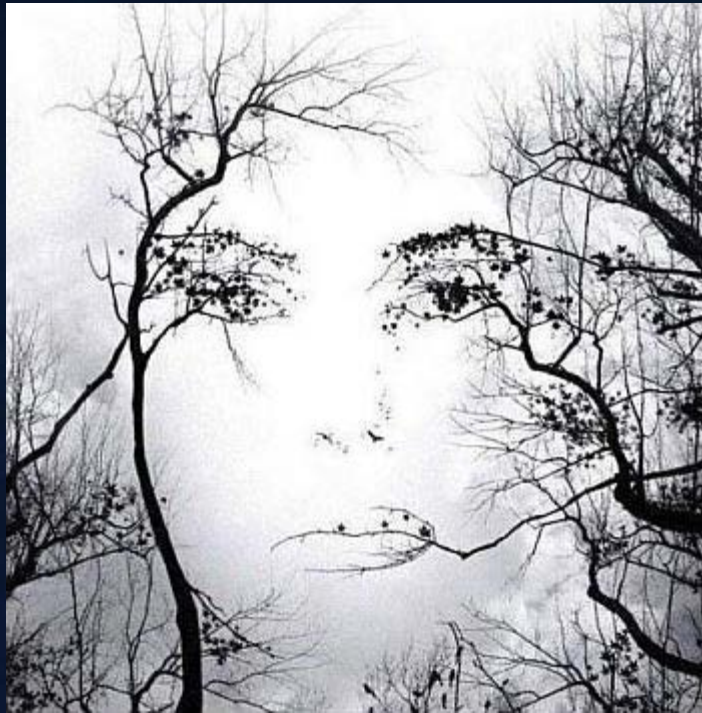


How about spin-2
Higgs-like boson
at 14 TeV?

Only about 1% of proton's mass can be traced to **quarks** (two up quarks and one down quark), whereas 99% of its mass belongs to Quantum Chromodynamics (QCD) binding energy. Imagine zillions of quarks (u,d,s), antiquarks (u,d,s with a bar on top), and gluons (g) zipping around near the speed of light, banging into each other, and appearing and disappearing from QCD vacuum (Strassler 2010): they are able to assemble proton's **mass** of $938 \text{ MeV}/c^2$ with error margin of just *one* part in 10^{45} (Dolgov 2012), for at least 10^{29} years.

What phenomenon could create 10^{82} **identical** protons?

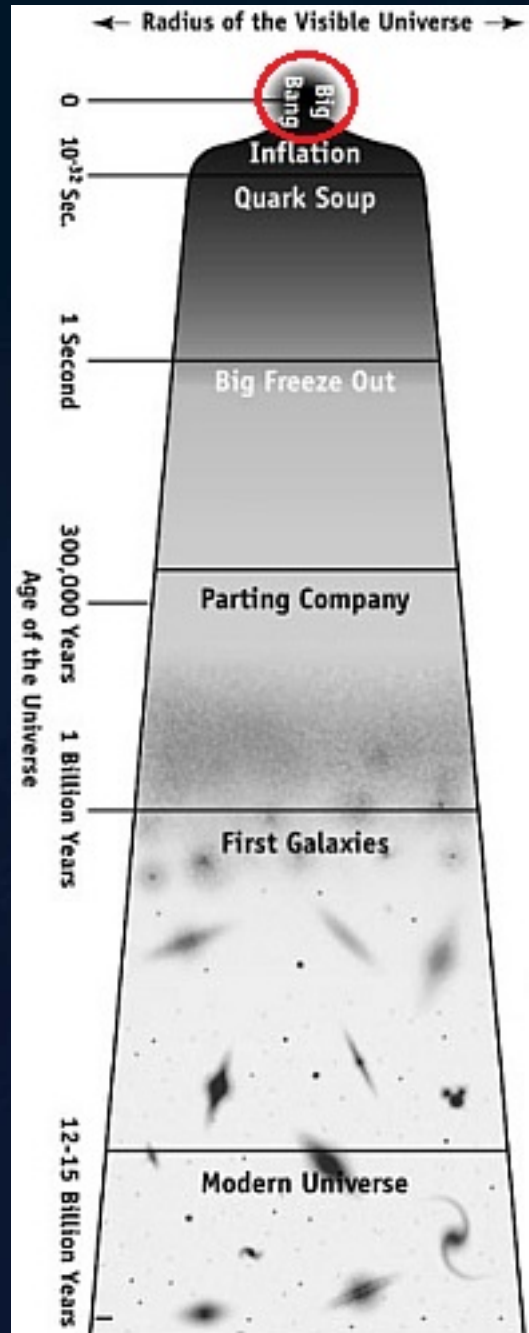
Atemporal Quantum Reality: The Human Brain



Do you see branches of **trees**?

According to a research at Cambridge University, it doesn't matter in what order the letters in a word are, the only important thing is that the first and last letter be at the right place. The rest can be a total mess and you can still read it without a problem. This is because the human brain does not read every letter by itself, but the word as a whole.

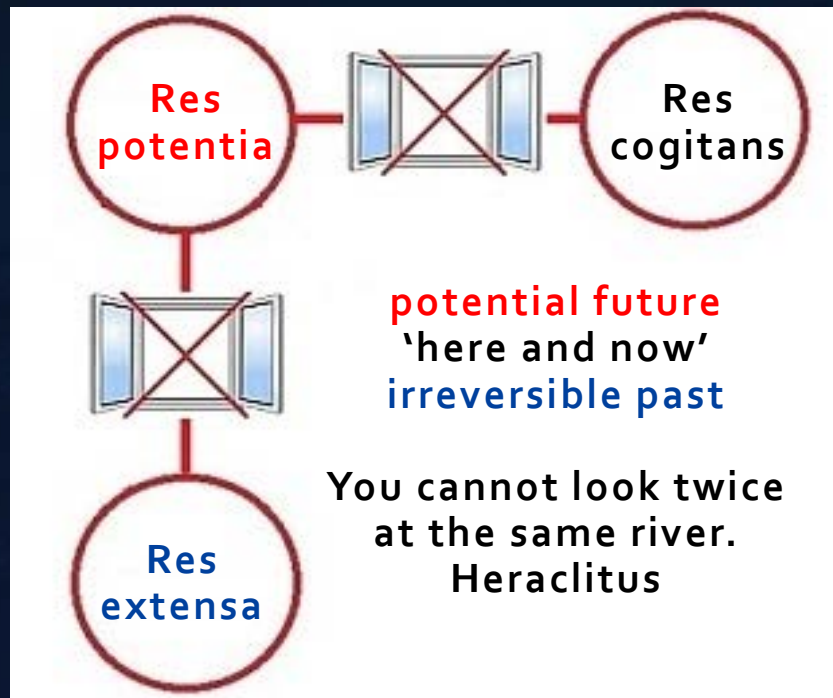
If the human **brain** can employ the **matrix**, the Universe can do it as well: God is the power of the Universe as a whole to organize itself.



Atemporal Quantum Reality: Quantum Cosmology

Without quantum cosmology based on the quantum-gravitational **matrix** of spacetime, we would need some Biblical “miracle” to raise a robust Lorentzian metric within 10^{-30} seconds “after” the “big bang”, starting *much earlier* at 10^{-35} seconds “after” the “big bang”, when the **classical** (not **quantum**) spacetime would be about 1 cm across and a causally connected region would have been only 10^{-24} cm across (the horizon problem), in such way that one could **later** “inflate” the spacetime by a factor of 10^{78} and then *safely* keep the Lorentzian metric for at least 13.798 billion years rooted on the Planck scale at which the spacetime “points” are *totally* fuzzy and the principle of **locality** has lost *any* meaning.

Was Gottfried Wilhelm Leibniz Right?

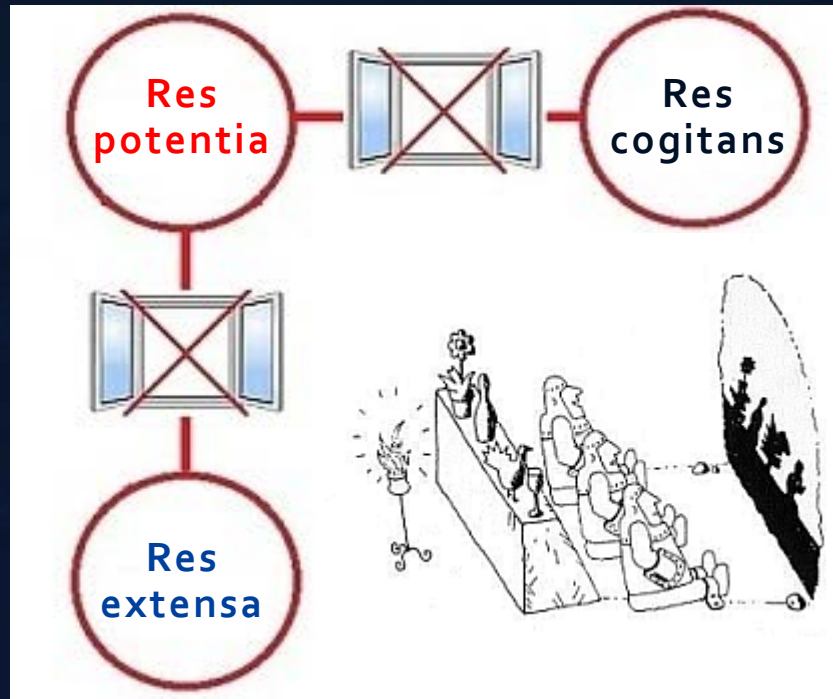


Are there “windows” to the quantum vacuum (Milonni 1993), the origin of *res extensa*?

Or “windows” to the Noetic world, the origin of *res cogitans*?

Is the Platonic world of *res potentia* ‘the true monad without windows’? (Leibniz *Monadology* § 7)

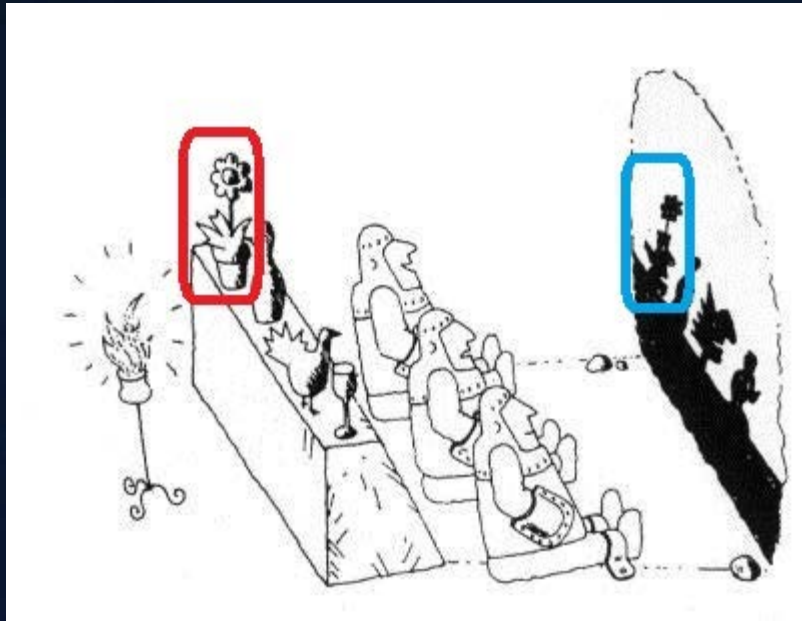
To explain **res potentia** and the doctrine of *trialism*, imagine the following situation: you are an Eskimo, and you have never seen and will never see an elephant in your life. Yet you can make observations on elephant's *trunk* by two complementary devices measuring either properties of *your* arm or properties of *your* nose.



You can never imagine the common source of *your* arm (*res cogitans*) and of *your* nose (*res extensa*), which you blindly called *trunk* (*res potentia*), because the latter does not have arm-like “windows” nor nose-like “windows”: it (not He) is ‘the true monad *without windows*’. (Leibniz *Monadology* § 7)

You may suggest, after Leibniz, that what *you* see as an arm (*res cogitans*) is always **pre-correlated** with what *you* see as a nose (*res extensa*) by **pre-established** harmony. But again, you’re an Eskimo and cannot even imagine the ‘trunk’ (*res potentia*).

Atemporal Quantum Matrix: Proton's Mass



We predict *physicalizable*
"shadow" of brand new
spin-2 boson at 14 TeV

Proton's **quantum matrix** does not have any "windows" (Leibniz), and the chained Eskimos (Slide 14) can only observe its *physicalizable* "shadow" of $938 \text{ MeV}/c^2$ (Slide 10) cast on the wall at Plato's cave.

It is predicted (Chakalov January 9, 2003) that the number of **quarks** will jump to 8 and more, in Fibonacci sequence. The Baldy's Law 'some of it plus the rest of it is all of it' is **not** valid in the quantum world.

Was Max Planck Right?

There is no matter as such! All matter originates and exists only by virtue of a **force** which brings the particles of an atom to vibration and holds this most minute solar system of the atom together. We must assume behind this force the existence of a conscious and intelligent Geist (bewußten intelligenten Geist). This Geist is the **matrix** of all matter.

Max Planck

Das Wesen der Materie, Florence, 1944

Was Max Planck Right?

Truth never triumphs – its opponents just die out.

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.

Max Planck
Philosophy of Physics, 1936

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Frequently Asked Questions

Q1. What is **res potentia**?

A1: Platonic world with two projective “walls” and no “windows” (Slide 13); see also Heraclitus.

Q2: Why we cannot detect it?

A2: Because of the “speed” of light: **res potentia** is *perfectly* hidden **inside** (Sic!) the instant ‘here and now’. For comparison, imagine that you stay in front of a wall, and at t_1 you toss a ball at it, in such way that the ball will bounce back and hit you later at t_2 : you will be watching the consecutive states of the ball during the entire interval $t_2 - t_1 > 0$. But you cannot replace the ball with a photon, because the null interval between its emission at t_1 and absorption at t_2 will be *exactly zero*: $t_2 \equiv t_1$ denotes *one single* 4D event ‘here and now’ projected as **res extensa** in the **irreversible past**, whereas the Platonic **res potentia** is *always* residing in the **potential future** of *the same* 4D event ‘here and now’ at $t_2 \equiv t_1$ (cf. *Hyperimaginary Numbers*, December 2016, p. 5 and ref. [18]). Notice that we introduce fundamental *flow of events*, after Heraclitus.

Q3: How does **res potentia** work?

A3: Check out the doctrine of *trialism* in Slide 14: there is no physical link between *your* unphysical arm (**res cogitans**) and *your* 4D nose (**res extensa**), as explained by Leibniz in 1714 (*Monadology* §7).

Q4: What can we make from it?

A4: Physical theology: God (John 1:1; Luke 17:21; 1 John 4:8) is residing **inside** every 4D event ‘here and now’ at $t_2 \equiv t_1$ (cf. A2). It (not “He”) is mathematical object, hence there is no need for any religion. Also, once we unravel the so-called hyperimaginary numbers, we could try to develop quantum gravity and cosmology, as well as spacetime engineering (cf. *Hyperimaginary Numbers*, December 2016, Sec. 4).



I want to know
God's thoughts;
the rest are details.

Albert Einstein

Happy 138th birthday, Albert!
You were a good man and
outstanding physicist.

May God enwrap you in His
thoughts and give you endless
joy and happiness.

D. Chakalov
March 14, 2017