

<http://www.god-does-not-play-dice.net/about.html#GR>

Addendum

I cannot offer a mathematical presentation of 'potential reality'. If I knew it, I wouldn't be writing these lines — please read the note from [January 21, 2011](#). The best way to understand the task is to imagine that the [GR octopus](#) had two fixed colors, say, *either* red or blue. Following the terminology of Niels Bohr, these two alternative colors will be considered *complementary*.

In such (highly contrived) case, the "number" Φ , denoting the possible explications of octopus' color, will take the value **2**, yet its "intrinsic color" will be, again, UNdecidable, just as the state of the lamp in Thompson Lamp paradox:

Imagine a lamp that is turned 'on' at some instant labeled with **0**, and is left 'on' for 1 min, then turned 'off' for 0.5 min, then 'on' for 0.25 min, etc., *ad infinitum*. Do we have a limit? Obviously yes: 2 min. There are obviously *finite* things around us, which build up the [3-D space](#), such as a [table with length 1 m](#). Fine, but what is the state of the lamp in the instant/point labeled with '2 min'? And what **was** the state of 'the lamp *per se*' at the initial instant, **0**?

UNdecidable (recall Gödel's Theorem), like the intrinsic *color-less* octopus. It has *always* been present 'out there' as UNdecidable [potential reality](#), along with the fleeting *observable* states of the lamp, cast on a *perfect continuum*: in the [local mode of spacetime](#), the duration of our *color-less* octopus is **zero**. Zilch. Non-existent.

The contemporary differential geometry says **nothing** about the UNdecidable potential reality, which we perceive as 'geometry'. People explore, study, and teach GR like '[bartenders](#)'. Even with QM, which I believe is far less unclear, people tend to ignore the fundamental lesson from [KS Theorem](#).

Anyway, the point I wish to make here is this: the unique "number" Φ , denoting the possible explications of 'potential reality', is not fixed. The *comprehensible* "value" of Φ varies in the interval (**2, aleph-null**) — please see "Aleph-null bottles of beer on the wall" [here](#). Notice that the "values" of Φ in this interval are pertinent to 'something we can comprehend'.

If $\Phi = 1$, we will be unable to grasp the meaning of 'potential reality', because our brains use *relational* cognition: we can understand something, call it A, only if we can point to something else, not-A, with respect to which A makes sense. Thus, our brain needs at least **two** explications of 'potential reality', to make it comprehensible.

We cannot understand $\Phi = 1$ or $\Phi = 0$. It is a [Noumenon](#) — 'the perfect monad *without* windows', after Leibniz. Or simply [John 1:1]. It can only be described mathematically. It is a special form of 'emptiness' or "zero", which is opposite to 'zero *something*'. The latter refers to something that has existed in some form or shape, while in our case we should

perhaps use 'zero *nothing*'. I have denoted it, *faute de mieux*, with "zero", and have placed this 'zero *nothing*' in the l.h.s. of Eq. 1 on p. 35 from [ExplanatoryNote.pdf](#).

In summary, the unsolved problems of the full nonlinear GR, most notably those related to the [energy conservation](#) issue [2], stem from 'the laws of an instant' ([Karel Kuchar](#)). In the case of GR "octopus" (cf. (ii) [above](#)), the "instant" is *quasi-local*, in the sense that it encapsulates the nonlocal feedback and "dark" energy-momentum contributions from '[the whole school of fish](#)'. There is no mathematical presentation of such bi-directional "negotiation" in current GR textbooks, simply because it does not, and cannot "happen" on a spacelike hypersurface: in the Escher drawing [above](#), the "duration" of the bi-directional "negotiation" is **zero**, like the proper time of photon's flight "between" its emission-and-absorption ([Kevin Brown](#)).

All this "happens" in an [atemporal handshaking medium](#) connected to the spacelike hypersurface "[over a point](#)" only; hence the "dark" energy-momentum contributions from '[the school of fish](#)' are distributed **smoothly** [3] on the whole spacelike hypersurface *en bloc* (watch the video clip [above](#)).

Which is why in QM textbooks there is no "source" of the quantum waves that is "waving" ([Anthony Zee](#)): the *wave pattern* results from the *correlation* of all 'spatially self-enclosed' ([Einstein](#)) [quasi-local fish](#) along the [Arrow of Space](#), much like the wave pattern in the movement of centipede's legs; ditto for [GWs](#).

Notice that a fleeting, truly dynamical "color" at particular quasi-local point from octopus' skin does **not** exist as a [fixed](#) physical reality '*out there*', as in case (i) [above](#), which is why one can "remove" it by hand (modulo higher derivatives), as pointed out by [Hermann Weyl](#). This is the essence of Einstein's [Equivalence Principle](#) — recall 'the right answer to the wrong question' in MTW, [p. 467](#).

The *right question* to ask is this: surely gravitational effects exist ([ibid.](#)) as physicalized (transferred to the righthand side of Einstein's field equations) 'influence from geometry', but why is that the gravitational energy-momentum **itself** cannot be localized? Because, just like the [Platonic ideas](#), it is '[potential reality](#)' and lives in the *reference fluid* of GR (we cannot detect the 'influence from mind' on the human brain either, as we can only observe its "dark" physical effects *embedded* into the brain dynamics, or other [physical systems](#)). If the gravitational energy-momentum **itself** were possible to be localized as 'physical reality', this would have literally killed GR by exposing the underlying quantum-gravitational "ether" ([Merced Montesinos](#)). Stated differently, the gravitational energy-momentum **itself** does not possess "weight", and the inertial mass of an accelerating particle is **not** some simple "back-reaction to its own gravitational field" ([Wolfgang Rindler](#)), as we're accustomed to think after Newton's [Third Law](#). We're dealing with an 'absolute structure': see James Anderson below.

Just as we don't explain heat with some tiny little hot particles, it shouldn't be surprising that the very entity which endows matter with inertia does not have "weight", and of course "does not serve as a source term in the righthand side of Einstein's field equations" (MTW, [p. 467](#)). Locally, its lifetime or "duration" is **zero** — see Kevin Brown above. What we do **not** know is the *origin* of inertia, firstly because we lack mathematical presentation of the **self-wrapping** faculty of spacetime as "spatially self-enclosed" ([Einstein](#)).

Hence the underlying *reference fluid* of GR — the color-less skin of our [GR octopus](#) — is still to be discovered. We cannot formulate the [non-linear law of motion](#) in GR from "energy-

momentum conservation, which is itself a consequence of the field equations" [2], because the energy-momentum conservation is being *dynamically adjusted* in the *reference fluid* of GR along the *Arrow of Space*: each and every fleeting "horizontal" 3-D hypersurface — an absolute 'now' from the Arrow of Space — is *an already-correlated* universe in which the energy from the gravitational "field" is being **almost exactly canceled** (i.e., not *exactly* canceled to zero net energy, because the value of "dark energy" from "empty space" is miniscule yet **finite**) by the energy from the Type I matter fields, which in turn does **not** allow the exposure of quantum-gravitational "ether" ([Merced Montesinos](#)) or the *reference fluid* of GR.

Subsequently, there could be theoretical possibility for extracting energy from 'empty space' (see [above](#)), by *tweaking* the mechanism of introducing *inertia* (I suppose tweaking the *phase* of the two [atemporal gravitational waves](#)) and increasing the amount of the miniscule-yet-finite "dark" energy which can be released in the physical 3-D space, ranging from 6×10^{-10} joules per cubic meter ([John Baez](#)) to an equivalent in energy to 5 (five) solar masses emitted in under 60 seconds in the form of [X-rays and gamma rays](#), or roughly 10^{54} ergs/pulse in [GRBs](#). Such variable amount of *positive* energy density springs from the *righthand* side of Eq. 1 on p. 35 from [ExplanatoryNote.pdf](#); the *total* energy of The Universe is *always* conserved during the [Arrow of Space](#), as it should be.

"See, that wasn't so hard, was it?" ([Sean Carroll](#)).

The mathematical basis of GR, offered by current differential geometry and topology, is inadequate and unclear — the **fine structure** of the "point" is missing. It is inherently *quasi-local*, and is cast on the ultimate "canvas" of the universe — the *reference fluid* of GR. It pertains to 'absolute structures' which do **not** obey the 'generalized principle of action and reaction' (James L. Anderson, *Principles of Relativity Physics*, Academic Press, New York, 1967, [p. 339](#); see also p. 73). These 'absolute structures' cannot show up in GR in the form of the alleged "Dirac observables" ([if any](#)), because they do **not** belong to the realm of physical reality '*out there*', as in the two cases (i) and (ii) [above](#), which is why they can only be **camouflaged** as Diff(M)-related "gauge" ([Domenico Giulini](#)).

Regrettably, there is no other way for the reference fluid *of* GR to show up *in* present-day GR. The latter is "merely a makeshift in order to give the general principle of relativity a preliminary closed expression. For it was essentially not anything more than a theory of the gravitational field, which was somewhat artificially isolated from a **total field** of as yet [unknown structure](#)" ([A. Einstein](#)).

Don't blame GR; fix the math instead, and you may discover the [Machian quantum gravity](#).

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February 6, 2011

Last update: February 16, 2011, 22:49 GMT

<http://www.scribd.com/doc/48314966/Addendum>

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

[2] Eric Poisson, Adam Pound, and Ian Vega, The motion of point particles in curved

spacetime, [arXiv:1102.0529v2 \[gr-qc\]](#). Major update of Living Reviews article: February 2, 2011.

pp. 104-105: "In this section we consider the motion of a point particle of mass m subjected to its own gravitational field in addition to an external field. (...) In all cases the coupled problem of determining the field and the motion of the particle is nonlinear. (...) In general relativity the law of motion follows from energy-momentum conservation, which is itself a consequence of the field equations.

"The dynamics of a point mass in general relativity must therefore be formulated with care.

"We shall describe a formal approach to this problem, based on the fiction that the spacetime of a point particle (cf. Bob Wald [here](#) — D.C.) can be constructed exactly in general relativity. (This is indeed a fiction, because it is known [141] that the metric of a point particle, as described by a Dirac distribution on a world line, is much too singular to be defined as a distribution in spacetime. ...)."

[3] Matt Visser, Jerk, snap, and the cosmological equation of state, [arXiv:gr-qc/0309109v4](#), p. 5:

"Exotic matter is powerful stuff: Apart from possibly destroying the universe in a future "[big rip](#)" singularity [7], if the exotic matter clumps to **any extent** there is real risk of even more seriously bizarre behaviour — everything from violations of the positive mass condition (that is, objects with negative asymptotic mass), through traversable wormholes, to time warps [4, 14, 15, 16, 17]."