

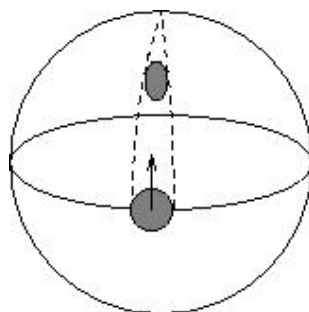
Can geometry produce work?

GR textbooks begin with a “massive body” ([Wikipedia](#)) that *somehow*, and for some unknown reason, would create particular [influence](#) in *non-flat* 4D spacetime (watch the clip [below](#)), and then “the [Christoffel symbols](#) play the role of the gravitational force field and the metric tensor plays the role of the gravitational potential”, etc.

Can non-tensorial [Christoffel symbols](#) produce **work**? What kind of “[influence](#)” is that? It doesn’t look like [electromagnetism](#). All we know for sure is that gravity can alter the [rate of time](#), as demonstrated in [GPS navigation](#) and [time dilation](#). But again, the *rate* of time ([W.G. Unruh](#)) cannot produce **work** either.

Let’s read the experts in GR. Quote from John Baez and Emory Bunn, [The Meaning of Einstein’s Equation](#), January 4, 2006, Sec. [Spatial Curvature](#):

“On a positively curved surface such as a sphere, initially parallel lines converge towards one another. The same thing happens in the three-dimensional space of the Einstein static universe (cf. [Einstein 1918](#) and [Hubble](#) - D.C.). In fact, the geometry of space in this model is that of a 3-sphere. This picture illustrates what happens:



“One dimension is suppressed in this picture, so the two-dimensional spherical surface shown represents the three-dimensional universe. The small shaded circle on the surface represents our tiny sphere of test particles (say, an [apple](#) - D.C.), which starts at the equator and moves north. The sides of the sphere approach each other along the dashed geodesics, so the sphere *shrinks* (emphasis mine - D.C.) in the transverse direction, although its diameter in the direction of motion does not change.”

This last sentence may sound comprehensible only to my [dog](#). I can certainly see that “the sphere shrinks” in the drawing above, but the ‘shrinking’ *itself* cannot produce **work**. Apples are *physical* objects, not some fictitious “[vacuum](#)” devoid of matter. Let me offer an explanation of the question posed in the title.

Consider two kitchen scales, A and B, on a table at rest, and two apples on them, with different weight, say, an apple with 200g on scale A, and another apple with 400g on scale B. How would you relate their “[trajectories](#)” in 4D spacetime to the non-tensorial [Christoffel symbols](#), so that the latter will produce different **weight**?

Obviously, an apple with weight 400g will resist [acceleration](#) *harder* than 200g apple. Obviously, *something* is doing work by pressing the scales A and B on the table.

What is it?

If you can answer this question in [the framework of GR](#), you may discover the coupling of geometry to matter sought by [Felix Klein](#), [David Hilbert](#), and [Hermann Weyl](#), among many others. Also, you might (eventually) *vindicate* the claim by [Kip Thorne](#) and his [LIGO collaborators](#) about their “discovery” of so-called GW150914 (p. 13 in [Zenon](#)). You might also qualify for Nobel Prize for your astounding discovery of [renormalizable](#) perturbative quantum gravity based on “gravitons” with mass $m_g \leq 7.7 \times 10^{-23} \text{ eV}/c^2$: see the ground-breaking experiment proposed by Kip Thorne at p. 24 in [BCCP](#). Good luck.

If you cannot answer the question, read [Über Die Gravitationsfeldrelativitätstheorie](#). In a nutshell, gravity can produce enormous work (for example, [Earth tides](#)), but we need first to explain why we observe only one “charge” with [positive](#) energy density. This is totally unexplained puzzle, and theoretical physicists talk only about ‘positive mass conjecture’ (references are available upon request). The idea suggested in [GTR](#) is very simple: recall QM operators ([ibid.](#), p. 7). They are *not* geometric points. They take some stuff, denoted **P**, at the input and convert it into *another* stuff Q at the output. The latter becomes *physical* stuff (Q), which is ‘geometric point’ that can be located at the apex of the [light cone](#). But **P** (from [Plato](#)) is *not* on the [light cone](#). We observe only Q-stuff, with [positive](#) energy density only. So, QM operators act $P \rightarrow Q$.

For comparison, consider another operator from particular pattern (Gesetzmäßigkeit): if I gently stroke [Linda’s head](#) (L), she will wave her tail (Q): $L \rightarrow Q$. In this case, I can track the entire sequence of events in $L \rightarrow Q$ with light. Not so in QM: **P** is *physically unobservable* (pp. 6-7 in [BCCP](#)), as we know since 1935, thanks to [Erwin Schrödinger](#).

The *origin* of gravity is also $P \rightarrow Q$, because again we observe only Q-stuff, once at a time, as recorded with a physical clock: read [A4](#) on p. 4 in [GTR](#). Namely, the [Platonic](#) origin of quantum gravity (**P**) does *not* live on the [light cone](#). We can see with light only its waving *tail* (Q). People claim that the [trajectory](#) of the *physicalized* tail implies some non-flat 4D spacetime (watch the clip [below](#)). But we cannot see our Linda (**P**). She has *already* disappeared at the very instant of observation, just like [Macavity](#). See Escher’s ‘[drawing hands](#)’ and my note on the spacetime interval [here](#).

To sum up, the *origin* of gravity (**P**), called also ‘[John](#)’, does *not* act on any physical stuff. What actually acts on the physical world is the *physicalized* ‘[John’s jacket](#)’ (Q). And since in $P \rightarrow Q$ the former is *physically* absent, the latter (Q) becomes *self-acting*, like your [brain](#). Hence the *origin* of classical gravity (**P**) is *not* physical field, [but Q is](#). Yet Q only *facilitates* the Platonic origin of gravity (**P**), like a [hand](#) in [4D glove](#) (Q).

Moreover, [GTR](#) offers the path to quantum gravity from the outset: read my endnote [here](#) and pp. 2-4 in [Gravitational Energy](#), and notice the Heraclitean *flow* of events (recall the puzzle [above](#)) depicted with the vector **W** in the drawing at p. 8 [therein](#).

Needless to say, Einstein was fully aware of the problems in his General Relativity (see p. 13 in [Gravitational Energy](#)):

The right side is a formal condensation of all things whose comprehension in the sense of a field-theory is still problematic. Not for a moment, of course, did I doubt that this formulation was 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 (Gesamtfeld) of as yet unknown structure.

My theory is also incomplete, firstly because “the total field (Gesamtfeld) of as yet unknown structure”, suggested by Plato many centuries ago (p. 9 in [BCCP](#)), lacks mathematical presentation: we need new [Mathematics](#).

Feel free to download the latest version of this paper from [this http URL](#).

[D. Chakalov](#)

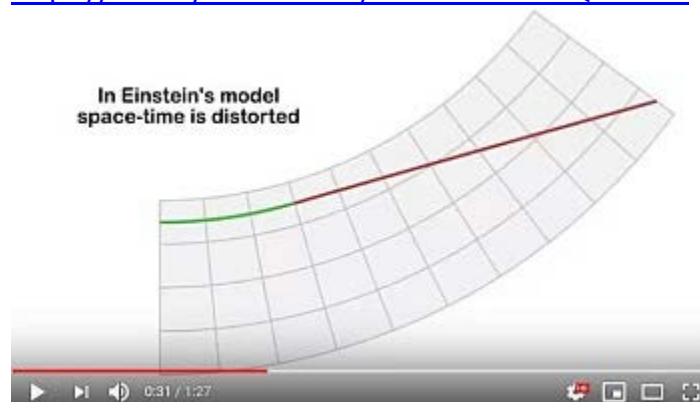
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Addendum 1

General Relativity: Einstein vs. Newton

<https://www.youtube.com/watch?v=DdC0QN6f3G4>



“In Einstein’s model space-time is distorted.” Fine. But there is no *explicit* time parameter τ in GR: read [Carlo Rovelli](#), [Bill Unruh](#), and [Charles Torre](#). Why? Because the Heraclitean *flow* of Time, shown with the **radius** of the ‘inflating balloon’ ([Hubble](#)), is missing in [Einstein’s equations](#). The misleading drawing by John Baez and Emory Bunn [above](#) shows “Einstein static universe” from 1918 **without** the crucial *unphysical* inflating **radius**.

We read that “space acts on matter, telling it how to move. In turn, matter reacts back on space, telling it how to curve.” (J.A. Wheeler, p. 1 in [Gravitational Energy](#).)

Fine. But which goes **first**? Space acting on matter (telling it how to move) or matter acting on space (telling it how to “curve”)? See again Escher’s ‘[drawing hands](#)’ and my note on the spacetime interval Δs^2 (R.M. Wald, Ch. 11, p. 286) [here](#). Simple, isn’t it?

In [GTR](#), the statement by J.A. Wheeler [above](#) is amended as follows:

Spacetime acts on matter, telling it how to move-and-rotate. At [the same instant](#), matter acts back on spacetime, telling it how to *alter* the *rate* of Time in the invariant spacetime interval Δs^2 .

Namely, the local *deflation* of Δs^2 creates attractive gravity, like going from Bob (B) to Alice (A), and the local *inflation* of Δs^2 creates repulsive gravity, like going from Bob (B) to Carol (C): p. 12 in [GTR](#) and p. 2 [above](#). See the 'general rule' ($1 + 0 = 1$) in p. 2 in [Gravitational Energy](#) and the 'drawing hands' below.



The Platonic hand (P) in 4D glove (Q).
Examples from QM in [The Physics of Life](#).

The arrow of Time *cannot* be modeled with *temporal orientability* of spacetime: see the enormous smashing errors by Robert Geroch and Gary T. Horowitz in 1979 [here](#). The *orientability* of 3D space by "a choice of spatial parity" ("left-handed and right-handed triads", *ibid.*) is also *false*. The fact that in 3D space we can invert 2D *left* rubber glove into its mirror image of 2D *right* rubber glove ([parity inversion](#)) does *not* represent the fundamental *asymmetry* in spacetime topology: [time reversal symmetry](#) ($t \Leftrightarrow -t$) and left glove \Leftrightarrow right glove symmetry ([parity inversion](#)) do *not* model the fundamental *asymmetry* along the 3D "axis" of [Small and Large](#). That is, if you have a large 3D ball in front of you, you cannot "*invert*" it *inside-out*, so that you will wind up *inside* the ball. Do you know how mathematicians would catch a lion in Sahara? Check out p. 19 in [Hyperimaginary Numbers](#) and Mark Armstrong at p. 26 in [BCCP](#). The non-trivial topology of spacetime is a big can of worms, which has been quietly swept under the carpet by the established mathematicians and theoretical physicists.

Further information on [the flow of Time](#) is available to qualified individuals: read the last paragraph of p. 15 in [Über Die Gravitationsfeldrelativitätstheorie](#).

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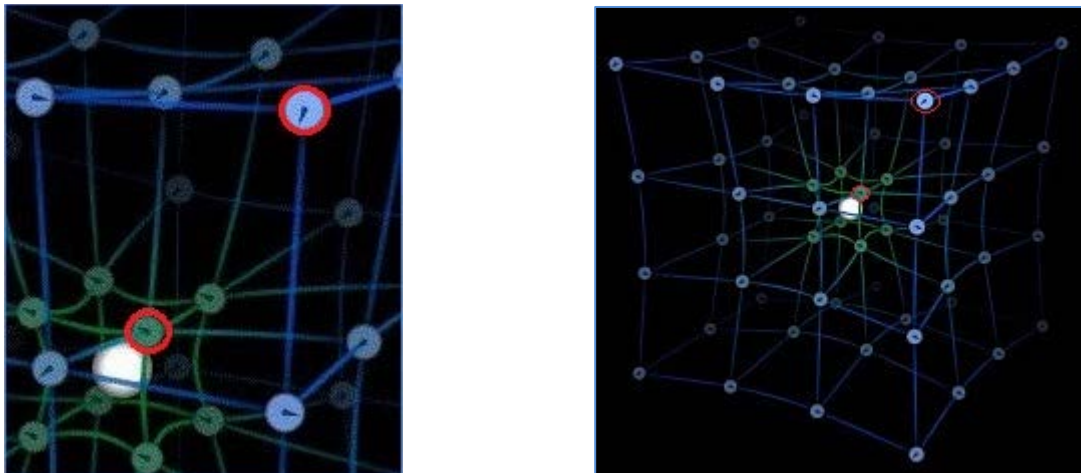
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Addendum 2

This is what we know about [gravity](#): read [William G. Unruh](#) and compare the local *rates* of time read by the two (highlighted) clocks in the animation ([time.gif](#)) below.



Read the principle of GTR at p. 4 [above](#). There is no *explicit* time parameter τ in GR: read [Carlo Rovelli](#) and [Charles Torre](#), as well as Adam Helfer, Mihaela Iftime, and my comments at p. 4 in [The Atemporal Platonic World](#). The latter is always **nullified** in the *squared* spacetime interval Δs^2 (R.M. Wald, Ch. 11, p. 286): click [here](#). If it were possible to “discover” a *local* expression for gravitational field energy density (*ibid.*), the gravitational field will be local tensorial observable ([L. Szabados](#) and [MTW p. 467](#)) and gravity will become a *classical force field*. Therefore, GR cannot be a *bonafide* classical theory. But it cannot be quantum theory either. We need [quantum gravity](#). We need [Mathematics](#).

More in [Über Die Gravitationsfeldrelativitätstheorie](#) and [Gravitational Energy](#).

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