Gravitational energy: The wegtransformierbar elephant

Look at the drawing below: what do you see?

_____

Obviously, this is an elephant walking on tight rope, only it fell off at the very *instant* you looked at it, just like T.S. Eliot's cat Macavity. Which is why we can *think* about 'geodesic' (H. Ohanian and L. Szabados); details in *The Atemporal Platonic World.* Some explanation is obviously needed.

The 'elephant' here stands for the energy of gravity, that is, the energy from geometry: the grin on the face of Cheshire cat, but *without* the cat, as observed by Alice.

Which goes first?
Space acting on matter (telling it how to move), or matter acting on space (telling it how to "curve")? Wrong question!

See Escher's 'drawing hands'. Their *atemporal* negotiation is *already* completed at every instant from the metric time τ.

"Space acts on matter, telling it how to move. In turn, matter reacts back on space, telling it how to curve."
 J.A. Wheeler in *Gravitation*, p. 5.

Thanks to the equivalence principle in GR (MTW p. 467), the influence of gravity can *always* be gauged away at any point. To quote A. Afriat and E. Caccese: "Vanishing is an important criterion: a complex whose components are *wegtransformierbar* cannot be physically real — one whose components all vanish cannot 'coincide' with one whose components don't."

But the two components don't have to "coincide". Instead, "both fluxes cancel, and thus leading to a vanishing 'flux', i.e., $t_{\mu\nu} = 0$." (M. Montesinos). How could this happen? Because, to quote again M. Montesinos, "there is a **balance** (emphasis mine – D.C.) between the 'content' of energy and momentum densities and stress associated with the matter fields (...) and the 'content' of energy and momentum densities and stress associated with the gravitational field (...)

$$\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow$$

$$\leftarrow\leftarrow\leftarrow\leftarrow\leftarrow \quad (23)$$

... in a precise form, such that both fluxes cancel, and thus leading to a vanishing 'flux', i.e., $t_{\mu\nu} = 0$. Once again, the vanishing property of $t_{\mu\nu}$ for the system of gravity coupled to matter fields is just a reflection of the fact that the background metric is dynamical. More precisely, $t_{\mu\nu} = 0$ tells us that the 'reaction' of the dynamical background metric is such that it just cancels the effect of 'flux' associated with the matter fields. It is impossible (and makes no sense) to have a locally non-vanishing 'flux' in this situation. If this were the case, there

would be no explanation for the origin of that **non**-vanishing 'flux' (emphasis mine – D.C.). Moreover, that hypothetic non-vanishing 'flux' would define privileged observers associated with it (the ether would come back!)."

But what if the 'balance' (cf. Eq. 23 above) at $t_{\mu\nu} = 0$ is valid only for **individual** points from the (geodesic) rope above? Can we think of **non**-vanishing 'flux' over the entire 'rope'? Let me reproduce the illustration with a football at p. 5 in *The Atemporal Platonic World*.
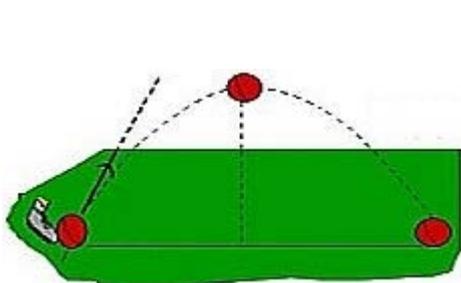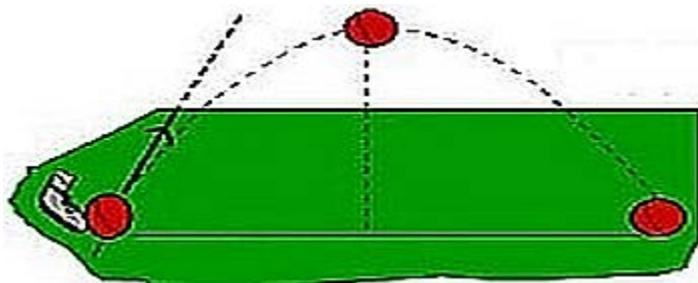

Fig. A   Fig. B

If the football is *gravitalized*, it can acquire "energy and momentum from the gravitational field" (H. Ohanian) and "the *intangible* energy of the gravitational field" (H. Bondi) will become *perfectly* 'tangible'. For example, the football in Fig. A can *gain* energy-momentum, as shown in Fig. B, or lose it. Moreover, if we kick the football straight up in the air, we will expect at some point to stop raising upward and go down, and perhaps hit your head, like Newton's apple falling from an apple tree. But if the football is *gravitalized*, it may continue to fly up in the air with *acceleration*, as if it were propelled by some mythical "dark energy" (cf. Anomalous Aerial Vehicle at p. 16 in BCCP).

Briefly, the 'balance' (cf. Eq. 23 above) at $t_{\mu\nu} = 0$ is valid only for **individual** 'jackets' from the rope above, because at each and every **individual** point/jacket the *total* energy is exactly **balanced** — **nullified** and hence **"conserved"** — in the so-called 'evolution equation' (p. 4 in Zenon and p. 3 in BCCP). The quantum-gravitational 'John' is *wegtransformierbar* **Platonic** reality: at any consecutive instant from the *observable* metric time τ (C. Rovelli), the *intangible* energy of the gravitational field (H. Bondi) is *already* (Sic!) converted into *perfectly* tangible, localizable *positive* energy in the *right-hand* side of EFE, and the **Platonic** state of gravity, dubbed 'John', is *completely* **re-nullified** — once-at-a-time τ , as read with a clock. This is 'the new normal' *gravitalized* state at which "the gravitational field delivers no energy or momentum to the nongravitational matter" *anymore* (H. Ohanian). Will do it again, at the *next* instant τ viz. at the **next** 'new normal' *gravitalized* state.

The evolution equation above models the ability of Nature to unleash *unlimited* positive energy density in the physical world by *tweaking* the cancellation mechanism producing positive mass, ranging from "positive energy density of about 6×10^{-10} joules per cubic meter" (J. Baez) to 3×10^{47} joules of energy in less than a minute, in gamma-ray bursts (GRBs). The upper bound (if any) on positive energy release is obviously unknown, as nobody knows how much energy was needed to create the universe at 'time zero'. Point is, forget about 'energy conservation' (H. Bondi), even in a mundane timelike geodesic (H. Ohanian). Simple, isn't it?

More about 'negative mass' from G. Horowitz. Watch the explanation of the balance (not conservation) of energy by P. Steinhardt. Notice my proposal to harness the "anomalous" gravitational rotation in Fig. **E** at p. 18 in BCCP, and read p. 28 (last) therein.

D. Chakalov
27 January 2020
Last update: 28 January 2020, 11:50 GMT

Download the latest version at this http URL.