# SPATIAL THINKING FOR INNOVATION: THE LEONARDO-MAXWELL-EINSTEIN METHOD, REVIVED

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**Abstract**

Free-running spatial intuition is like analog computation: it is indispensable for scientific progress despite its intrinsic inaccuracy. Do return to the first beginnings of a gold vein, was Maxwell's advice. Returning to the gold vein of Einstein's "happiest thought" leads to three other shiny results. Many accepted findings crumble as the barefoot method shows its mettle. A new cosmology is implicit and so is a new source of energy.

**Keywords**: Maxwell's advice, Analogical thinking, Telemach theorem, Globally constant c, No space expansion, Global participation

## Introduction

Spatial thinking makes use of the built-in "analog computing power" of the brain, according to Roger Shepard who first investigated "mental rotation" (see Shepard and Cooper, 1982). While inaccurate and misconception-prone, this type of thinking is much more speedy and powerful than the stepwise algorithmic method that has won out in science for the better part of a century. A return to the old method is advocated. It is suited for encouraging the planet's youthful majority.

Maxwell had learned the method of "lonely hill-climbing" from his mentor, Faraday, who had received no formal education. The seminal Michelson experiment was proposed and initiated by the late Maxwell as is not very well known (Maxwell, 1880). Einstein's famous "happiest thought of my life" (as he always called it) belongs into the pictorial category.

Not all acts of the free-roaming imagination break new ground. From his own experience, Maxwell proposed a royal road for doing science: to deliberately return to the first origin of a subsequently recognized "gold vein" when it had not yet blossomed into an industry. Then "close to this point" you will invariably hit on another gold vein using the

same type of thinking (cf. Everitt, 1983). In the following, an example of this "variational approach" in a generalized sense is offered.

**Einstein, Leonardo, Africa**

Leonardo is the most shining pictorial thinker of the past – with the bicycle, the automobile, the helicopter and the airplane to his credit, to mention only contraptions already realized (Richter and Wells, 2008). Up to this day, the institution of the "patent office" pays tribute to the power of this type of thinking. Einstein's happiest thought befell him in such an environment.

To date, a very astounding invention along these creative lines is the Peepoople plastic toilet which effectively reduces the gap between the maximally underprivileged third of humanity and the rest (Makau and Tolhuijs, 2010). By the way, the 1994 invention of Lampsacus hometown of humankind on the Internet (Kriese and Rössler, 2000) had the same spirit but remains unconsummated, with Google, Wikipedia and Facebook forming partial steps.

**The Happiest Thought Proves four Times Happier**

Everyone knows the story of the wide-open full-size window in the Swiss patent office and the heavy stomach of a young patent clerk (about his fleeting intuition that if he jumped out of the window right now, the aching pull of his stomach would instantaneously cease): spatial thinking is visceral, so to speak (cf. Pais, 1982).

In free fall, there is no gravitational pull in existence any more, and hence the laws of special relativity, discovered by himself two years before, are bound to rule (Einstein, 1907). A royal road towards a full understanding of the mystery of gravity had thereby opened itself up. Einstein's seminal idea proves even happier as we shall see.

**The Tall Tower on Earth**

Picturing in the mind a tall tower would bring the breakthrough. The tower can be juxtaposed mentally to an equally long slender rocketship in outer space that is accelerating at Galileo's acceleration of 1 g. The latter situation – unlike gravity itself – is totally transparent. Newton had seen the weightlessness before (Damour, 1987), but lacked the new instrument of special relativity.

The first insight obtained by Einstein from the mental picture was the decisive one. It seemed absurd but proved robust: a light pulse sent up from the accelerating rocketship's bottom will arrive at the tip a moment later in time owing to the finite speed of light $c$; so that the tip has picked up additional speed in the meantime. A "constant Doppler shift" therefore applies to light sent up from the bottom. It reduces the frequency of the ascending light and is accordingly called "gravitational redshift" (Einstein 1907).

This seminal insight turned out to be a bonanza. A thousand things would spring forth from it, with general relativity standing at the end.

**Apparent or Real – That is the Question**

Was the observed temporal elongation of all signals sent up with the speed of light inside the accelerating rocketship a mere observational effect, or are the clocks at the bottom genuinely ticking slower perhaps?

Everything hinges on this question. Einstein opted for the second alternative. GPS pioneer Ronald Hatch told me 12 years ago that he had installed a special switch in the satellites: "just in case" Einstein's absurd belief that the cesium clocks in the satellites would be ticking faster up there were to bear out. It proved a wise decision.

Alfred Schild more than 50 years ago devised a simple diagram showing light rays going up between two horizontal lines denoting local time downstairs and upstairs, respectively (Schild, 1960). Essentially the same diagram, but with light rays going both up and down in a zigzag between mirrors, was drawn independently in 1998 (Rössler et al., 1998). Note that the curved connecting lines drawn by Schild can indeed be drawn straight since it is only the end points that matter. One sees from the full diagram that shorter time intervals, downstairs, are mapped upon longer time intervals, upstairs and vice versa, in a bijective fashion, as the Tubingen chaos school realized 36 years later (Rössler et al., 1998, p. 371). We had – in collaboration with Dieter Fröhlich – at first hoped that a non-bijective (chaos-generating) "folded map" would be applicable, but the overlap-free criss-crossing "WM diagram" turned out to be even more rewarding.

The clocks downstairs in the rocketship and in gravity thus really tick more slowly than upstairs, as Einstein had seen in 1907. This "**gravitational clock slowdown**" pictured in the mind arguably represents the biggest surprise in the history of science. If so, it also is the biggest gold vein.

**First added Corollary: Gravitational Mass reduction**

If light arrives upstairs redshifted, the photons come in with less energy than they seemed to possess downstairs on emission (since everything appeared normal down there). They nevertheless must have possessed their lower energy on emission already since clock's ticked more slowly down there without this fact being manifest locally. Photons can be locally transformed into particles and vice versa as is well known: A "positronium atom" is locally generated out of two 511 kilo-electron-volt photons (Feynman, 1961). It therefore must have a proportionally lower mass downstairs. Note that a "PET scan" – a "Positronium

Emission Tomograph" used to make high-resolution pictures of the brain etc. (cf. Harpen, 2004) – can indeed be operated at different height levels.

Owing to this "Feynman intertransformability" between mass and light holding true on all height levels, all masses locally at rest downstairs are reduced, by the gravitational redshift factor valid compared to upstairs, in a locally invisible fashion: "**gravitational mass reduction.**"

**Second added Corollary: Gravitational Size increase**

We saw with Einstein that all temporal wavelengths (ticking intervals) are increased downstairs, both in the long rocketship and in gravity. This fact does not yet automatically imply that all spatial wavelengths are equally elongated downstairs. This is because the speed of light $c$, while locally preserved, could "in principle" be reduced by the redshift factor in a locally imperceptible fashion downstairs. This conclusion of a no longer globally invariant speed of light $c$, reluctantly drawn by Einstein in 1907, caused him to drop the subject of gravitation for 4 years. This resigned response was unavoidable at the time since quantum mechanics lay in the future still.

To date, the Bohr radius formula of full-fledged quantum mechanics guarantees, as Heinrich Kuypers showed in his doctoral dissertation (Kuypers, 2005), that an atom that locally looks normal but has a lower mass, must be increased in size by the very factor by which its mass is reduced. Had Einstein had this quantum result available in 1907, the locally invisible reduction of $c$, so reluctantly embraced by him, could have been avoided.

Thus the local spatial wavelength is increased, downstairs, in parallel with the local temporal wavelength for every locally generated photon. Photon wavelength determines spatial length – as the modern definition of the meter directly attests to. The consequence is "**gravitational size increase**." It implies as a corollary that $c$ re-gains its noble pre-1907 status. In other words: t**he speed of light, $c$, is a globally valid universal constant of nature**.

**Third added Corollary: Gravitational Charge decrease**

If the masses of all locally-at-rest particles are reduced downstairs by the redshift factor compared to upstairs, as we saw, and if the mass-to-charge ratio is a local invariant in nature as is well known, then the charge of all charged particles is reduced, in parallel with their rest mass downstairs, both in Einstein's long rocketship and in gravity itself (Rössler, 2008, 2012).

This "**gravitational charge decrease**" is apparently hard to absorb by the scientific community (although no counter voice has been raised in the literature so far). On the one

hand, the law of charge conservation is more than 250 years old (”the Electrical Fire is real Element, or Species of Matter, not *created* by the Friction, but *collected* only”; Benjamin Franklin, June 5, 1747). On the other hand, Shu-Yuan Chu showed that “when the metric depends on a hidden dimension, only a gauge-invariant combination of the charge and mass of a particle: $Q^2/16\pi G - M^2$, is a constant of motion, but not M and Q separately” (Chu, 1996). This independently arrived at combination lets the present new “binding of charge Q to rest mass M” appear natural also in general relativity.

**Telemach**

Three corollaries to Einstein’s gravitational clock slowdown (T) were shown to likewise follow from his happiest thought: equally strong changes in length, mass and charge (L, M, Ch). The famous 1907 Einstein theorem of gravitational time dilation (call it “T”) therefore reads in full “T, L, M, Ch.” The 4 symbols admit the joint acronym “Telemach” – a version of the name of Ulysses’ son Telemachus (Rossler, 2012, 2013).

**Discussion**

Einstein’s spatial intuition got exploited one more time in close adherence to Maxwell’s advice. The “barefoot method” worked like a charm. Only the necessary “second step” – integrating the spatial-intuition-based geometrically proven global constancy of c into the algebraic formalism of general relativity – still remains to be accomplished. This necessary continuation requires a deep familiarity with the algorithmic complexity of Einstein’s almost a century old 1915 edifice of general relativity. Fortunately, the general theory of relativity’s “conformal invariance” (see Frauendiener and Sparling, 1999) renders it flexible enough to accommodate the new result. Of the many possible physical interpretations that can be given to general relativity, now only a tiny subset remains eligible in the face of Telemach.

Characterizing the new restricted general relativity (RGR) will take its time. At the present moment in time, only some “negative predictions” can be made already. The retrieved **global constancy of c** (Rossler, 2007) hereby has the single most far-reaching implication: all “expanding solutions” to the Einstein equation lose their physical validity (Rossler, 2013). This amounts to a catastrophe for cosmology at first sight (although it – if true – of course represents the opposite of a catastrophe). This revolution – “no big bang” – happens to converge with a recent development in statistical mechanics (Rossler, 2011) which while leading to the same conclusion is sweetened by a down-to-earth application: the prospect of a rapid taming of the sun’s fire on earth (Rossler, 2012; Rossler et al., 2013).

Telemach's second major implication is the **breakdown of charge conservation**. As a consequence, the amazing electro-gravitational engines seen at work on neutron stars, quasars and microquasars are in for a new quantitative model. Terrestrial applications of charge non-conservation are so far absent.

The third major impact of the "quadrupled Einstein gold vein T-L-M-Ch" concerns **black holes**. The latter have new properties due to the new infinite temporal and spatial distance of their horizon from the outside world. They can no longer Hawking evaporate and lose one of their famous three "hairs" (charge – so that only mass and angular momentum remain). Hence they are undetectable when freshly produced on earth. Moreover, they grow exponentially inside matter. A prestigious experiment designed to produce miniature black holes on earth hence needs to be re-evaluated (Rossler, 2007). An indirect safety argument goes like this: if ultra-fast natural miniature black holes, generated by cosmic rays hitting stationary particles, leave ultra-dense white dwarfs unscathed as the evidence shows, artificial earth-borne ultra-slow black holes are predictably innocuous in view of the much lower density of earth. However, there is a dismal possibility left to be excluded: that the ultra-slow artificial cousins get braked inside earth by a new quantum effect (work in preparation).

To conclude, spatial analogical thinking invariably carries surprises. Is it **ethical** to return to Maxwell's 19$^{th}$ century method of solitary mental hill-climbing, in our own advanced 21$^{st}$ century? The fact that the scientific community withholds judgment for 5 years regarding Einstein's resurrected universal c comes not unexpected. Several Nobel prizes would thereby lose their distinction, not with regard to the ingenuity rewarded but for supporting a falsified paradigm (the Big Bang). Is Einstein's thinking strong enough to fuel another scientific revolution? Science currently embraces concerted, billion-dollar projects and co-operations since jump-like progress is considered a thing of the past. This attitude has the side effect of preventing the youthful majority from taking a leading role in scientific progress. Leonardo, Maxwell and the early Einstein could turn this imbalance around.

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