OLEMACH THEOREM: ANGULAR-MOMENTUM CONSERVATION IMPLIES GRAVITATIONAL-REDSHIFT PROPORTIONAL CHANGE OF LENGTH, MASS AND CHARGE

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Abstract

There is a minor revolution going on in general relativity: a "return to the mothers" – that is, to the equivalence principle of Einstein. Recently, the Telemach theorem was described. Here now, the completely independent but fully convergent "Olemach theorem" is introduced. It connects omega (rotation rate), length, mass and charge in a static field. The predictable consequence of the two theorems is a return to the hard core of general relativity at the expense of some peripheral features. A connection to cosmology is mentioned along with a promising technological development.

Introduction

"Think simple" is a modern parole. The young generation is called-upon to help shape a new advance. Much as in ham radio initiation, the "80 meter band playground" is the optimal entry although greeted with a smile by the old practitioners, in physics the classical domains (special relativity and statistical mechanics) provide the royal entry door. A simple pertinent result is offered.

A New Question

The slow-down of time "downstairs" in gravity is Einstein's perhaps most astounding discovery. It follows from special relativity in the presence of constant acceleration in case the latter covers a vertically extended domain. Einstein's famous long rocketship with its

continually thrusting boosters remains fertile as a mental playground. This equivalence principle[1] was "the happiest thought of my life," he always said (cf.[2]).

To date, no one doubts any more the finding so derived that time is slowed-down downstairs compared to upstairs. The reason has to do with the fact that signal sequences sent upstairs arrive there with enlarged temporal intervals since the nose of the rocketship has picked up a constant departing speed during the finite time the signal was on its way up from the bottom. Famous measurements (starting in 1959 and culminating in the Global Positioning System) abundantly confirmed Einstein's seemingly absurd prediction. From this 1907 insight he was later able to derive the "general theory of relativity" which remains an intricate edifice, not all corners of which are fully understood until now. For example, many mathematically allowed (but unphysical) transformations got appended over the years, and no well-paved road to the right and left of the canonical thread is available up to this day. To witness, an attempt begun by Einstein's assistant Cornelius Lanczos at building a bridge toward Clifford's earlier differential-geometric approach[3] still remains unconsummated.

In an "impasse" like this, it is sometimes a good idea to go back to the early days when everything was still simple. Do there perhaps exist any "direct corollaries" to Einstein's happiest thought that are bound to retain their grip in any later more advanced context?

A starting point could be angular-momentum conservation. Angular momentum enjoys an undeservedly low status in general relativity. This makes it tempting to check what happens when angular momentum is explicitly assumed to be conserved, more downstairs in Einstein's rocketship where all clocks are slowed in their ticking rate in a locally imperceptible fashion. The answer that is bound to be valid is "conservation of angular momentum," of course. However, it is possibly worth having a look how the conservation of angular momentum, present in special relativity, manifests itself in this particular case.

Olemach Theorem

To find the answer, a simple "thought experiment" is introduced: A frictionless horizontally rotating bicycle wheel is suspended at its hub so that it can be lowered reversibly from the tip to the bottom end inside our accelerating rocketship (or in gravity). (Imagine

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[1] A. Einstein, On the relativity principle and the conclusions drawn from it (in German). Jahrbuch der Radioaktivität **4**, 411–462 (1907), p. 458; English translation: http://www.pitt.edu/~jdnorton/teaching/GR&Grav_2007/pdf/Einstein_1907.pdf , p. 306.

[2] M.A. Hohensee, S. Chu, A. Peters and H. Müller, Equivalence principle and gravitational redshift. Phys. Rev. Lett. **106**, 151102 (2011). http://prl.aps.org/abstract/PRL/v106/i15/e151102

[3] C. Lanczos, Space through the Ages: The Evolution of geometric Ideas from Pythagoras to Hilbert and Einstein.   New   York: Academic   Press   1970,   p. 222. (Abstract: http://imamat.oxfordjournals.org/content/6/1/local/back-matter.pdf)

famous experimenter Walter Lewin make this rotating wheel the subject of one of his enlightened M.I.T. lectures on the Internet.) If the precision of the measurements performed is assumed to be ideal: What will occur?

The law of "angular momentum conservation in a plane" reads at slow (nonrelativistic) rotation speeds: "angular momentum = rotation rate times mass times squared radius = constant," or in symbols

$$J \; = \; \omega \; m \; r^2 \; = \; \text{const.} \tag{1}$$

From the mentioned paper of Einstein we learn that omega – like any other ticking rate – differs across heights in a locally imperceptible fashion being reduced downstairs[4]. Note that a rotating frictionless wheel represents an admissible realization of a "ticking clock." The height-dependent factor that reduces the ticking rate downstairs in gravity, derived by Einstein as a function of the gravitational potential[5], can be called K , with K put equal to unity upstairs for simplicity and K > 1 downstairs.

K can approach infinity very deep downstairs (at the bottom of a maximally long Rindler rocket or at the horizon of a black hole). Note also that K would become equal to "absolute unity" at the tip of an ideal (infinitely long) Rindler rocket[6] or in the absence of any gravitating mass in outer space. But as mentioned in the previous paragraph, the K value upstairs is simply put equal to unity here.

If angular momentum J is to stay constant despite the fact that the rotation rate ω is reduced downstairs, then either m or r or both must have changed down there in order to make up for the local change in ω according to Eq.(1). While infinitely many nonlinear pertinent change laws for r and m are conceivable, the simplest ("linear") law keeping angular momentum J constant downstairs in Eq.(1) reads

$$\omega' \; = \; \omega/K$$
$$r' \; = \; r\,K$$
$$m' \; = \; m/K \tag{2}$$
$$q' \; = \; q/K \; .$$

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[4] A. Einstein, On the relativity principle and the conclusions drawn from it (in German). Jahrbuch der Radioaktivität **4**, 411–462 (1907), p. 458; English
translation: http://www.pitt.edu/~jdnorton/teaching/GR&Grav_2007/pdf/Einstein_1907.pdf , p. 306.
[5] ibid
[6] W. Rindler, Relativity: General. Special, Cosmological. Oxford University Press 2003.

In this equation, the fourth line was added in order to remind us of the fact that the ratio m/q – rest mass-over-charge – is a universal constant for every class of baryonic particles in physics, so that the fourth line follows from the third. The non-primed variables on the right refer to the upper-level situation (K = 1) while the primed variables pertain to a lower floor, with K monotonically increasing toward the bottom.

The first line of Eq.(2), but with ω replaced by the ticking rate t of a local clock (Einstein's result), yields an equally correct law in combination with the remaining three lines. The latter law was recently described elsewhere under the name "Telemach" (an onomatopoetic name since Time, Length, Mass and Charge are all linearly involved)[7]. The new equation (2) has the asset that its validity can be derived much more easily than that of Telemach.

Specifically, the prediction of a change in ω automatically causing a change in r and/or m follows from the validity of angular-momentum conservation, Eq.(1). There are infinitely many ways to ensure the constancy of J in our two-dimensionally rotating situation (for example, by keeping both m and q constant while letting only r change, so that r' = r K^1/2). However, Eq.(2) is simpler as mentioned since all change ratios are linear in K.

Furthermore, to home in on the third line first, we know from Einstein's seminal paper[8] that local photon frequency, and hence photon mass-energy, scales linearly with 1/K (third line of Eq.2). And we further know from quantum electrodynamics that photons and particles are locally inter-transformable by a fixed factor (if the particle in question is freshly released into free fall in accordance with Einstein's famous principle of general covariance). A familiar example is positronium creation and annihilation, whereby two 511 keV photons are equivalent to one positron and one electron. Therefore, the third line of Eq.(2) represents an indubitable fact in today's physics – a truth Einstein could not possibly foresee in 1907 but would certainly have embraced.

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[7] O.E. Rossler, Einstein's equivalence principle has three further implications besides affecting time: T-L-M-Ch theorem ("Telemach"). African Journal of Mathematics and Computer Science Research **5**, 44-47 (2012), http://www.academicjournals.org/ajmcsr/PDF/pdf2012/Feb/9%20Feb/Rossler.pdf

[8] A. Einstein, On the relativity principle and the conclusions drawn from it (in German). Jahrbuch der Radioaktivität **4**, 411–462 (1907), p. 458; English translation: http://www.pitt.edu/~jdnorton/teaching/GR&Grav_2007/pdf/Einstein_1907.pdf , p. 306.

The still remaining second line of Eq.(2) could be explained by quantum mechanics in the wake of the third line[9]. However, to do this is redundant here since once the third line is accepted, the second is fixed because of Eq.(1).

Thus, Eq.(2) has been demonstrated to hold true (note that the m/q invariance yielding the fourth line has already been dealt with above). As a subordinate remark, Eq.(2) possesses a curious side-feature: the absolute speed of a point on the rim of a rotating massive ring is an invariant across heights (Ali Sanayei, personal communication 2013). As to nomenclature, note that the name "Olemach" is an alternative to "Oremaq" which at first sight is a closer-fitting onomatopoetic shorthand for the law of Eq.(2); but the closeness in content to Telemach[10] (where length was termed L and charge Ch) lets the abbreviation "Olemach" appear more natural.

Discussion

A new fundamental equation was proposed, Eq.(2). It teaches us a novel fact about nature if correct: In the accelerating rocketship of Einstein (as well as in general relativity under "ordinary conditions"), angular momentum conservation plays a pivotal, previously underestimated role.

The most important result is that Eq.(2) implies that the speed of light, c , has become a global constant. To see this, note that r and t (t = 1/ω) both scale with K , so that their ratio r/t = r'/t' remains invariant. Therefore, if r/t = c on one level of height (like at the tip of an infinitely long Rindler rocket), it remains so on all levels. Thus, c = globally constant .

Second, local rest mass m and local charge q do now inherit the underprivileged role of being only "locally unchanged" that was formerly occupied by c . Hereby the fact that charge q is by now no longer conserved in physics, after a reign of almost two centuries, surely is the most unbelievable consequence of Eq.(2). An empirically testable implication of this finding is that the manifest charge of neutron stars is bound to be reduced due to the order-of-unity redshift valid on their surface by a factor of up to almost 2. And the electrical properties of both quasars and miniquasars likewise acquire new features which call for a renewed modeling attempt.

Third, the perhaps most easy to remember qualitative consequence of Eq.(2) is that "stretching" has been added to "curvature" as an equally fundamental differential-geometric

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[9] O.E. Rossler, Einstein's equivalence principle has three further implications besides affecting time: T-L-M-Ch theorem ("Telemach"). African Journal of Mathematics and Computer Science Research **5**, 44-47 (2012), http://www.academicjournals.org/ajmcsr/PDF/pdf2012/Feb/9%20Feb/Rossler.pdf

[10] ibid

feature of general relativity. Note that r goes to infinity in parallel with K by the second line of Eq.(2): $r' = rK$. This finding is in accordance with Clifford's early intuition[11]. While an arbitrarily strong curvature remains valid near the horizon of a black hole, where K in Eq.(2) diverges to infinity as mentioned, this curvature is now accompanied by an infinite stretching in r . Therefore, a new kind of "volume conservation" (more precisely, conservation of the curvature over stretching ratio) has become definable in general relativity in the wake of Eq.(2).

A fourth consequence is that some "late additions" to general relativity cease to remain valid if Olemach (or Telemach) is correct. This "tree-trimming" (as it may be called) concerns some previously accepted combinations between general relativity and electrodynamics like the famous Reissner-Nordström solution, which now lose their validity since charge is no longer a global invariant.

As a fifth point, the beautiful "Kerr metric" which is used as a description of a rotating black hole, loses its physically realistic status. The reason is the new infinite distance to the horizon valid from the outside that is implicit in the second line of Eq.(2) (since K diverges as we saw). The improved new infinitely stretched-out metric then includes, in the case of a rotating black hole, a new topological feature: Since the horizon of a rotating black hole rotates infinitely slowly compared to the outside world whilst keeping its angular momentum via Eq.(1), a new topological feature is predictably implicit: a "Reeb foliation in space-time" surrounds every rotating black hole[12]. There may exist further fundamental consequences of the law of angular-momentum conservation (Eq.1) holding true in both special relativity and the equivalence principle.

At this point, cosmology can be mentioned. The new equal rights of curving and stretching ("Yin and Yang") suggest that only asymptotically flat solutions remain available in the very large (a suggestion going back to Clifford[13]). The new topology of the universe comes at a pivotal moment in time because it coincides with a new development in many-particle theory. Statistical thermodynamics recently acquired a sister discipline called statistical cryodynamics[14]. Cryodynamics is governed, not by ultimately repulsive inter-

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[11] C. Lanczos, Space through the Ages: The Evolution of geometric Ideas from Pythagoras to Hilbert and Einstein. New York: Academic Press 1970, p.

[12] O.E. Rossler, Does the Kerr solution support the new "anchored rotating Reeb foliation" of Fröhlich? (**25** January 2012), http://lifeboat.com/blog/2012/01/does-the-kerr-solution-support-the-new-anchored-rotating-reeb-foliation-of-frohlich

[13] C. Lanczos, Space through the Ages: The Evolution of geometric Ideas from Pythagoras to Hilbert and Einstein. New York: Academic Press 1970,p.

[14] O.E. Rossler, The new science of cryodynamics and its connection to cosmology. Complex Systems 20, 105-113 (2011), http://www.complex-systems.com/pdf/20-2-3.pdf

particle potentials but by attractive Newton-Einstein potentials. Light-fast particles under this condition get statistically cooled rather than heated-up in their kinetic energy when traversing heavy-slow particles (so photons negotiating randomly moving galaxies). This development in cosmology is mentioned because Olemach (with its volume-preserving version of general relativity) also supports an infinite eternal cosmology, cf.[15].

This prediction derived from Eq.(2) amounts to a drawback regarding cherished physical beliefs. The convergent development in cryodynamics now offers a bonus, however: it is worth big money. Fusion technology is brought within close reach because a new method of locally cooling a hot plasma is implicit in cryodynamics[16][17]. Therefore, the new development in general relativity triggered by Olemach is, perhaps, worth being embraced not only for theoretical reasons.

To conclude, a new perspective opens itself up if angular momentum conservation in special relativity's equivalence principle is focused on. Two fundamental disciplines – general relativity and statistical mechanics – undergo a parallel boost. An improved long-term picture of the universe comes in sight. The "80-meter band of physics" – as Einstein's happiest thought can be called – stands wide open for newcomers ready to join in the digging.

Credit Given

The above result goes back to an inconspicuous abstract published in 2003[18] and a dissertation written in its wake[19].

Acknowledgment

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[16] O.E. Rossler, The new science of cryodynamics and its connection to cosmology. Complex Systems 20, 105-113 (2011), http://www.complex-systems.com/pdf/20-2-3.pdf

[17] O.E. Rossler, Cryodynamics can solve the energy problem by stabilizing ITER: A prediction. Talk given at Interdisciplinary Symposium on Complex Systems, ICNAAM 2012, Kos, Greece, on September 25, 2012. See "Trillion Dollar Zwicky," www.youtube.com/watch?v=s73D0VIofFo

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