GRAVITATIONAL-REDSHIFT PROPORTIONAL SIZE INCREASE IN RINDLER METRIC

Otto E. Rossler
Faculty of Science, University of Tubingen, Tubingen, F.R.G.

Abstract

The recently described gravitational-redshift proportional size change implicit in the Schwarzschild metric of general relativity and in the equivalence principle, is demonstrated geometrically in the Rindler metric. The result automatically carries over to general relativity (global constancy of *c*). Implications regarding terrestrial collision experiments, metrology, cosmology and unified physics are pointed out.

Keywords: Rindler-based geometric proof, Gravitational-redshift proportional size change, Globally constant *c*, Metrology, Cosmology, Quantum-general relativity problem

Introduction

In previous work, the Schwarzschild metric [Rossler, 2012a] and the equivalence principle both without [Rossler, 2012b] and with Noether's theorem [Rossler, 2013], were each shown to support a new physical observable called "*gothic-R* distance." The proof was formal based on features of the involved equations. Such results are hard to judge regarding their physical significance, because many transformations are formally allowed in general relativity not all of which have "physical substance." Therefore, the following simplified approach is offered.

A new geometric Proposal

The "Rindler metric" [Rindler, 1968] represents a maximally simplified version of general relativity if you so wish. It is described by

$$ds^2 = -x^2\, dt^2 + dx^2 , \tag{1}$$

with $x > 0$. It only considers one space dimension, x, and is concisely discussed in [Wald, 1984, pp. 149-152], for example. It forms a "wedge" in two-dimensional Minkowski spacetime. Its features can be understood geometrically as is well known.

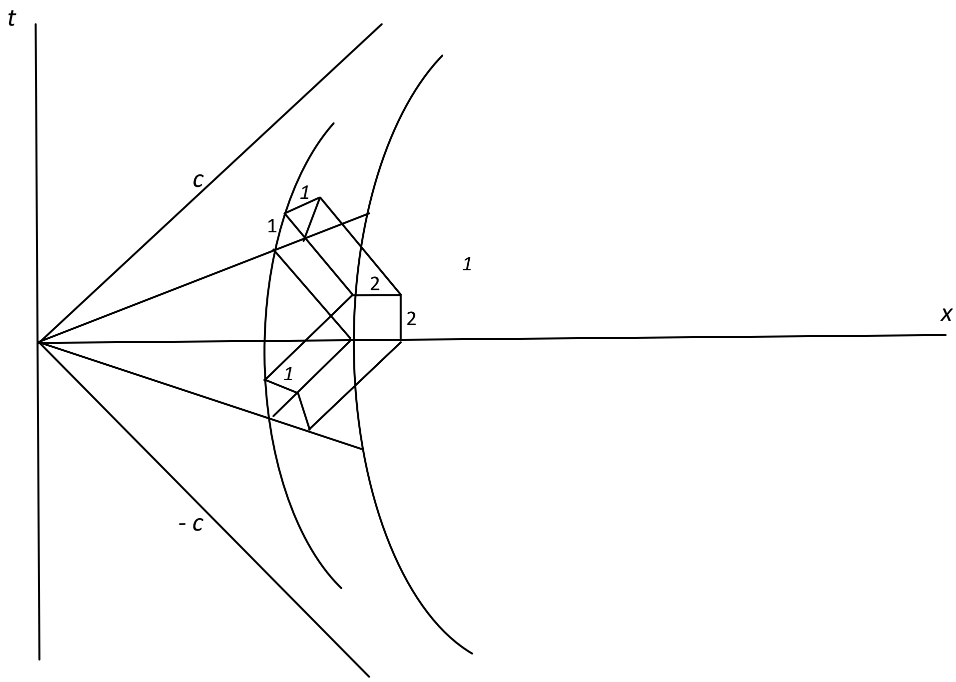

Fig. 1. Rindler wedge, with a sequential bijection involving 3 light rays highlighted: the "*1-2-1 knee*" on the right. See text.

In Fig. 1, an extended long rocketship is represented by the line segment on the x axis that lies in between the two hyperbolas. The rocketship is subject to a continuous locally constant acceleration towards the right. Each of its points picks up speed in the form of a hyperbola in the *x*,*t* diagram. This is because the speed of light *c* (that is, plus or minus 45 degrees) represents the upper limit in the future as well as in the past (below the *x* axis). One sees that the trajectory of the rocketship's tip (turning upwards and to the right) continues on what has come up symmetrically from below (where the rocketship was on an approaching course despite the same constant acceleration towards the right). Note that the rear end of the rocketship on the left of the strip is subject to a stronger acceleration than is the tip on the right (this is necessary for the extended long ship to stay together [Rindler, 1968; Bell, 1976]. The longitudinal axis of the ship, pointing exactly to the right on the *x*-axis at external time $t = 0$, gets slightly rotated leftward as the ship is moving up in time and simultaneously to the right in space. (Remark: The after a while no longer horizontal rocketship can always be "scrolled back" by a time transformation to let it graphically resume the horizontal position shown in the Figure, no matter how high up or deep down it is at the time.)

Now the new implication. One sees three parallel light rays emitted upwards from the corners of a (potentially infinitesimally small) unit-spacetime element – the diamond-shaped rhombus marked *1,1* at the rear end of the approaching rocketship (lower-left). The three parallel rays reach the corners of a square-shaped unit spacetime element at the tip of the rocketship on the middle line marked *2,2*, in order to be reflected back-down again onto a unit spacetime diamond at the bottom in a symmetric fashion (upper left). The salient point in this geometric construction is the observation that the spacetime element at the tip (the *2*-square) is *twice as long* along both its vertical and its horizontal axis (marked "*2,2*") as is the locally equally square-shaped unit-spacetime element with its locally vertical and horizontal axes (marked "*1,1*") that forms its source at the bottom (lower-left) and its sink at the bottom (upper left). That is, a unit-square in space and time is mapped bijectively by light onto a double-units square in space and time in the upwards direction, and from there back down again onto a unit square. So both time and space are dilated in parallel more downstairs in the constantly accelerating rocketship.

The factor *2* was picked for convenience. Any number > *1* up to *infinity* can be implemented in the bijection, by one's elongating the rocketship's bottom backwards to the left. Note that in nature, only factors of up to almost *2* occur on the macro level (on the surface of neutron stars) because still more densely compressed stars become black holes as Oppenheimer and Snyder first saw in 1939 [Oppenheimer, Snyder, 1938].

Discussion

The transformation depicted in Fig. 1 is a famous implication of special relativity with acceleration included [Rindler, 1968]. The implied mapping – highlighted by the three ascending, first rightward and then leftward bound parallel light rays in the middle – is not totally unfamiliar. Its *temporal* (more or less vertical) parts cut out by the ascending triple light rays are well known: The vertical *1,2,1* sequence explains the "gravitational redshift" (and in the downgoing upper leg "blueshift") described in 1907 by Einstein [Einstein, 1907]. However, the mapping's *spatial* (more or less horizontal) part cut out by the same triplet of parallel lines in the Rindler metric, with the same *1-2-1* ratio valid in space as in time, represents a new finding. Along with the old temporal result, the new spatial result carries over to general relativity – as most results obtained in the Rindler metric do [Wald, 1984].

The new "spatial corollary to the gravitational redshift" found in Fig. 1 is a direct consequence of the symmetry present in the Rindler metric. It for some reason escaped attention up until now despite the fact that it looks trivial to the eye once spotted. It means physically speaking that the *slower-ticking clocks* located downstairs in the constantly accelerating rocketship (or in gravity) are accompanied by proportionally *elongated meter sticks*. If this new reading of the Rindler metric is correct, the ratio *L/T* ("unit-length over unit-time interval"), and with it the speed of light *c*, becomes globally constant in the Rindler metric and by implication in gravitation.

The size-change result comes not as a total surprise. The Rindler metric here confirms a conclusion that was first found to be implicit in the Schwarzschild metric [Rossler, 2007; 2012a] and then also in the equivalence principle [Rossler, 2012b]. The result moreover follows from Noether's theorem [Rossler, 2013] as mentioned. However, the above geometric demonstration obtained in the Rindler metric represents the simplest derivation up until now.

In the wake of the graphical proof of Fig. 1, the Rindler metric supports a new bijective *x,t* mapping across different height levels mediated by light rays. This mapping implies global validity of the speed of light *c* in the longitudinal direction. The Rindler-result carries over to general relativity. Spacetime therefore acts as a "magnifying glass" in gravitation – not only in time where this fact is well known since 1907 [Einstein, 1907] but also in space. Space and time acquire equal rights – like two genders.

The implied global constancy of *c* is maximally important in physics if true. It radically alters metrology [Rossler, 2012b]. Secondly, the "Big Bang" of modern cosmology loses its footing in general relativity, since space-expanding global solutions cease to be valid if the speed of light is a global constant. Thirdly, experiments designed to "bring the big bang down onto earth" merit a second look from a safety point of view [Rossler, 2011]. Fourthly, the famous Hawking radiation of black holes [Hawking, 1974] ceases to be physical owing to the infinite spatial distance of the horizon from the outside world which now parallels the infinite temporal gravitational redshift of the horizon. The horizon (name coined by Rindler), valid in the Schwarzschild metric of general relativity, is mimicked in the rocketship of Fig.1 if its length is extended backwards down to the origin, as is possible in the Rindler metric [Wald, 1984].

Owing to its simplicity, the Rindler metric offers a transparent "playground." The task of finding an error in previously obtained results to the same effect [Rossler, 2007; 2012a; 2012b; 2013] got maximally facilitated. If this, now trivial-by-design, task fails the early hopes placed by Einstein and his senior friend Abraham in a global constancy of the speed of light *c* [Rossler, 2012a] are revived. The set of mathematically allowed transformations of general relativity is cut down to the select few compatible with the global-*c* result. A "stretched-out general relativity" predictably follows. In it, "Flamm's paraboloid" of the Schwarzschild metric is replaced by the "generic pseudosphere" (looking like the upper half of Fig. 12.11,b in [Rindler, 2001] but infinitely elongated at the bottom). Any attempt at falsification of the *c*-conserving Fig. 1 is solicited even though the chances appear to be slim. In the negative case, the whole discipline of general relativity is about to be morphed.

To conclude, the "gravitational-redshift proportional size change" demonstrated in the Rindler metric entails the existence of a condensed "global-c general relativity." The incompatibility of general relativity and quantum mechanics ceases to exist. The Big Bang and the safety of a terrestrial collider experiment are casualties of Fig. 1 – unless an error in the geometric argument can be pointed out.

Acknowledgment

I thank Wolfgang Rindler for many educating exchanges over the years. (For J.O.R.)

References:

O.E. Rossler, Abraham-like return to constant *c* in general relativity: "*R*-theorem" demonstrated in Schwarzschild metric. Fractal Spacetime and Noncommutative Geometry in Quantum and High Energy Physics 2(1)**,** 1-14 (2012a).

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 (2012b).

O.E. Rossler, Globally constant speed of light *c*: A bonanza in physics. European Scientific Journal 9(12), 14-19 (2013).

W. Rindler, Counterexample to the Lenz-Schiff argument. Am. J. Phys. 36, 540-544 (1968).

R.M. Wald, General Relativity. Chicago: University of Chicago Press 1984.

J.S. Bell, How to teach special relativity. Progress in Scientific Culture 1(2), 1976; reprinted in: J.S. Bell, Speakable and Unspeakable in Quantum Mechanics. Cambridge: Cambride University Press 1987, pp. 67-80.

J.R. Oppenheimer and H. Snyder, On continued gravitational contraction. Phys. Rev. 56, 455-459 (1939).

A. Einstein, Relativitätsprinzip und die aus demselben gezogenen Folgerungen (On the relativity principle and the conclusions drawn from it). Jahrbuch der Radioaktivität 4, 411–462 (1907).

O.E. Rossler, Abraham solution to Schwarzschild metric implies that CERN miniblack holes pose a planetary risk (September 27, 2007), http://www.wissensnavigator.ch/documents/OTTOROESSLERMINIBLACKHOLE.pdf, reprinted in: Vernetzte Wissenschaften – Crosslinks in Natural and Social Sciences (P.J. Plath and E.C. Hass, eds.). Berlin: Logos Verlag 2008, pp. 263–270. [Correction: The phrase "infinite proper in-falling time" must read "finite proper in-falling time"].

O.E. Rossler, Black holes are different – a report made to the UN Security Council (July 30, 2011). http://lifeboat.com/blog/2011/07/black-holes-are-different-%E2%80%93-a-report-made-to-the-un-security-council
S.W. Hawking, Black hole explosions. Nature 245, 30-31 (1974).
W. Rindler, Relativity, Special, General, Cosmological. Oxford, Oxford University Press 2001, p. 278.