1.1 Explanation of Pound-Rebka experiment result

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Abstract

Applying the principle of tautological relationship of gravity and the speed of light (*g=cd*), solved and explained, by conventional physics misinterpreted nature of Pound-Rebka experiment. Also presented is an accurate universal formula for calculating the spectral shift between the measured points of any altitude difference, equivalent to the Special and General relativistic. Eventually, demonstrated is the link between gravitational, transversal and radial dilatations as a result of speed. Implicitly, presented is the evidence of the infinitely variable nature of universal scalar, the speed of light.

1.1.1 A brief description of Pound-Rebka experiment

The Pound-Rebka experiment, carried out in year 1959 at Harvard, is considered to be the last of the three classic proofs of a General theory of relativity. The experiment proved the existence of gravitational spectral shift predicted by a General theory. Due to misinterpretation of the nature of gravity, red shift is explained by the loss of energy of the light signal when leaving the gravitational field which produced the domino effect of invalid formulations (the Theory of Black Holes, the Big Bang Theory, the distinction of gravity of the other three "fundamental forces" ...).So the true nature of the results of the experiment, thus the spectral shift was never understood.

The Pound-Rebka Experiment is quite complex in its technical details but in principle it is very simple. Photons of a precisely determined wavelength λ were emitted from the top and bottom of the 22.5 meter-high Jefferson Tower at Harvard campus. When photons from the top of the tower were measured at its bottom, their wavelengths were decreased (blue-shifted) by a small amount; and when photons from the bottom were measured at its top, their wavelengths were increased (red-shifted) by the same amount Δλ.

1.1.2 Solution

As the speed of light *c*, measured in seconds (299.792.458 m/s) and in measuring surrounding, expands for a corresponding amount of acceleration (9.807 m for the Earth's surface), while the second and meter stretch for the *a/c* amount so the measured velocity remains unchanged, the same speed, as measured in the space portion of the tower height *h* (22.5 m) located on the surface of the Earth, will be dilated by the same ratio a_h. Thus, for cases when the height *h* is much smaller than radius of the planet *r*, i.e., when the acceleration difference between top and bottom of the observed height is approximated, applies the equality (1.1.2.1);

$$h \ll r \Longrightarrow \frac{a}{c} = \frac{a_h}{h} = d_a \qquad 1.1.2.1$$

Where d_a stands for dilatation of Earth's surface space fraction where the measurement is performed. It follows that (1.1.2.2);

$$a_h = \frac{ah}{c} \tag{1.1.2.2}$$

which is equal to (1.1.2.3);

$$a_h = hd_a \tag{1.1.2.3}$$

The resulting amount (7,35x10^{-07} m) is the acceleration in the time fraction *h/c* seconds, i.e. at the time of flight (TOF_c). It is the same equation for the acceleration (0.0.8, 0.0.18) measured in the described time (*h/c* s). Therefore, to calculate the corresponding dilatation d_h, we use the equality (1.1.2.4), which is also equivalent to dilatation equation (0.0.7);

$$d_h = \frac{a_h}{c} \tag{1.1.2.4}$$

The resulting amount is fully compliant to wavelength change Δλ measured in pound-Rebka Experiment (2,45x10^{-15} m) (1.1.2..5);

$$d_h = \Delta\lambda \tag{1.1.2.5}$$

Therefore, we have relation (1.1.2.6);

$$\frac{a}{d_a} = \frac{a_h}{d_h} = c \tag{1.1.2.6}$$

As the space-time of the tower height stretches for the amount a_h, the space-time fraction of measured light speed is stretched by a factor d_h. Thus, measured from any point of the tower, the speed of light remains unchanged.

It follows that the meter and second of the top and bottom of the tower differ by the d_h amount. For this reason, the measured result from the larger space-time (bottom of tower *b*, the higher gravity and dilatation, longer meter and second, $m_b = m + d_h$, $s_b = s + d_h$) will be smaller than the measured results in a smaller space-time (top of the tower *t*, lower gravity and dilatation, shorter meter and second, $m_t = m - d_h$, $s_t = s - d_h$). Although both positions measure unchanged light speed ($s_b/t_b = s_t/t_t = c$), the speed of light at the top c_t, and bottom of the tower c_b actually varies by the a_h amount (1.1.2.7, 1.1.2.8), (Figure 1.1.2. a).

$$c_t = c - a_h \tag{1.1.2.7}$$

$$c_b = c + a_h \tag{1.1.2.8}$$

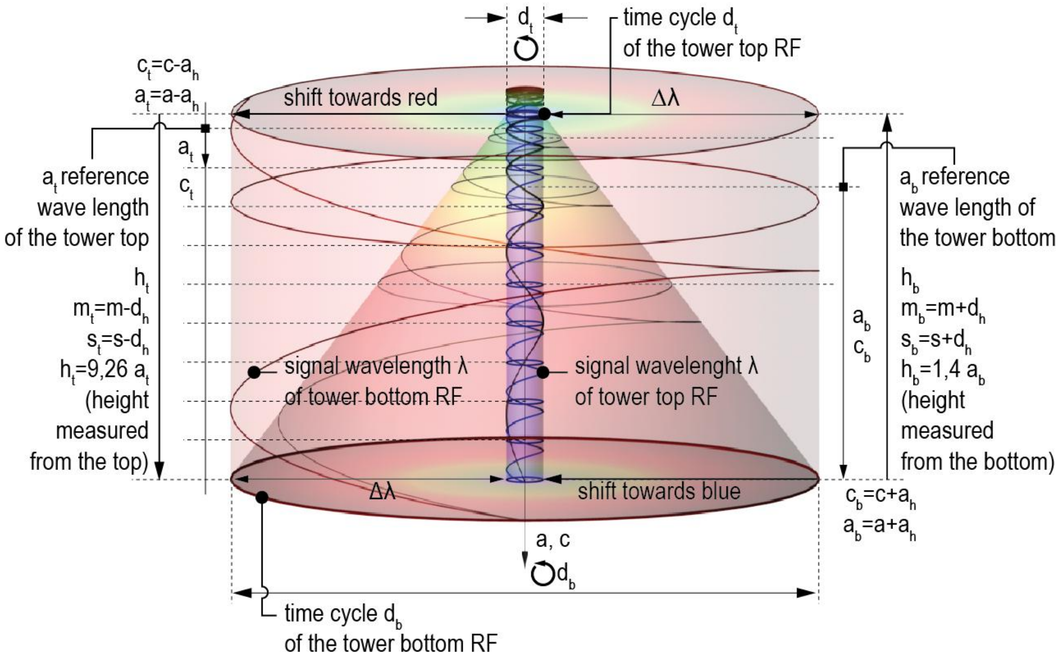

Figure 1.1.2.a *Graphical presentation of space-time relations of the different gravity, depicted in Pound-Rebka experiment model. The result for the height of the tower measured from the top, with its reference measurement units of less gravity, is higher than the results of the same height measured from the bottom. For better readability, the distinction between radiuses of top and bottom of the tower is disproportionately enlarged so in this particular graph, the values of* h_t *and* h_b *are noticeably different. In reality, radiuses of top and bottom of the tower differ by almost negligible amount of* d_h*, i.e. the measured wavelength change Δλ (2.45 x*10^{-15} *m) which illustrates the curvature of space-time of measured hight. Δλ is also a difference in the energy of space-time between top and bottom of the tower. As the bottom of the tower lies in field of higher acceleration, objects thrown from the top will fall to the bottom and not vice versa.*

If the tower height of 22.5 m is replaced by the amount equivalent to the measured acceleration a (9.807 m), the amount a_h will be equal to (1.1.2.9);

$$a_h = \frac{a^2}{c} \qquad 1.1.2.9$$

i.e. (1.1.2.10);

$$a_h = ad_a \qquad 1.1.2.10$$

which is equivalent to gravity relation of one light second space fraction (0.0.8) or acceleration at surface space portion (0.0.18, 2.1.11).

$$a = cd_a \qquad 1.1.2.11$$

In the same scenario, the value of d_h will be equal to the square dilation of measured space section (1.1.2.12);

$$d_h = d_a^2 \qquad 1.1.2.12$$

We conclude that a_h is the acceleration of speed *a*, while *a* is the acceleration of velocity *c*. That matrix of nested accelerations and acceleration nests is infinite in both directions (1.1.2.13);

$$\frac{{}_{\infty}a}{{}_{\infty-1}a} \ldots = \frac{{}_{3}a}{{}_{2}a} = \frac{{}_{2}a}{{}_{1}a} = \frac{\boldsymbol{{}_{1}a}}{\boldsymbol{a}} = \frac{\boldsymbol{a}}{\boldsymbol{a_1}} = \frac{a_1}{a_2} = \frac{a_2}{a_3} = \cdots \frac{a_{\infty-1}}{a_{\infty}} = d_a \qquad 1.1.2.13$$

${}_{1}a$ in the above equality is nested acceleration of value *a*, thus the amount of a_h, while the acceleration *a* is nested acceleration of value a_1, which is the speed of light *c*. a_1 is the acceleration nest of value *a*. The result of all relations of described infinite series is equal to acceleration dilatation d_a.
According to a valid relation (1.1.2.11), the scenario described above is an illustration of the variable value of the light speed *c* measured with variable wavelength by constant wave-time d_a. If we fix, in relation (1.1.2.11), empirical constantly measured velocity *c*, it is true (1.1.2.14);

$$\frac{a/n}{d_a/n} = \frac{a}{d_a} = \frac{an}{d_a n} = c \qquad 1.1.2.14$$

Thus, the product of any ratio from the relation (1.1.2.13) with any ratio from the equation (1.1.2.14) is equal to a constant wave length, i.e. the value of acceleration *a*. Every acceleration wave by its wave-time measures constant speed of light. It is the nature of the perception of constant propagation and duration, within all of dynamic space-time systems of the Universe. In relation to the system of the observer, infinitely small or infinitely large wave in its infinitely short or long period of time measures the speed of light unchanged. The difference of their space-time appearance in the space-time of the observer is equivalent to the frequency difference of their wavelengths and wave-times in reference wavelength and wave-time of the observer. Manifestation of the same uniform law, universally applicable within all space-time systems, is the consequence of described scalar principle relations. Persistence of speed within the system and its variability among the systems is the nature of perceived appearance of the world.

As noted above, equity derived from the relation (1.1.2.1), apply to cases where we approximate that measured points, because of their negligible difference in altitude, share the same system of acceleration. Due to the different acceleration of points that are not on the same distances from the centre of their unique space-time vortex for which the measurement is performed, we derive a universal spectral shift relation, equivalent to the Special and General relativistic.
In relation (1.1.2.1), in place of acceleration *a* we incorporate geometric mean of accelerations of the

lower and upper points, i.e. gravity g_n of measured portion of space section *h* (1.1.2.15);

$$\frac{g_n}{c} = \frac{g_h}{h} \qquad 1.1.2.15$$

According to the valid equality for gravity g_n (0.0.33), where *n=r+h* it is true (1.1.2.16);

$$\frac{ra}{c(r+h)} = \frac{g_h}{h} \qquad 1.1.2.16$$

The amount g_h is therefore equal to (1.1.2.17);

$$g_h = \frac{rah}{c(r+h)} \qquad 1.1.2.17$$

As applies the equivalence (0.0.16), we write (1.1.2.18);

$$g_h = g\frac{h}{r+h} \qquad 1.1.2.18$$

where *g* is the gravity of the reference light unit of time, in our case a second, measured from the celestial body centre. According to a valid statement (0.0.7) it is true (1.1.2.19);

$$d_h = d\frac{h}{r+h} \qquad 1.1.2.19$$

where *d* is the light second dilation of the observed celestial entity.

For cases where the light signal moves in the radial direction relative to vector of gravity, the Special Theory of Relativity, Doppler spectral shift toward the blue predicts by the formula (1.1.2.20);

$$f_b = \sqrt{\frac{1-v/c}{1+v/c}}f_e \qquad 1.1.2.20$$

The general theory of relativity, the gravitational spectral shift towards the red predicts by the formula (1.1.2.21);

$$f_r = \sqrt{\frac{1-\frac{2GM}{(r+h)c^2}}{1-\frac{2GM}{rc^2}}}f_e \qquad 1.1.2.21$$

As is valid (1.1.2.7, 1.1.2.8), when speed *v*, included in relativistic equality (1.1.2.20), is equivalent to the value of g_h from expression (1.1.2.18) i.e. the difference in speed *c* manifested as acceleration, both relativistic equations are expressed by unique relationship (1.1.2.19). Therefore applies (1.1.2.22, 1.2.23);

$$v = g_h \Longrightarrow \sqrt{\frac{1 - v/c}{1 + v/c}} = 1 - d\frac{h}{r + h} \quad 1.1.2.22$$

$$\sqrt{\frac{1 - \frac{2GM}{(r+h)c^2}}{1 - \frac{2GM}{rc^2}}} = 1 + d\frac{h}{r + h} \quad 1.1.2.23$$

Because of its mathematical equivalence, as opposed to an extremely high but limited degree of Einstein's formula precision, the above principle count absolutely accurate values.

Since speed *v* is expressed as a space *s* (*h*m) per time unit *t* (1s), we equalize the values of speed *v* and space *h*. So when *v*=*h*, the conversion of dilation d_v (0.0.42), as a result of transversal velocity *v*, manifested through the spectral shift, in the gravitational spectral shift *z* measured at a height *h* from the reference radius *r*, is done by the formula (1.1.2.24);

$$v = h \Longrightarrow z = d_v \frac{2g_n}{v} = g_n \frac{v}{c^2} \quad 1.1.2.24$$

Where g_n is calculated by relation (0.0.33) considering *n*=*r*+*h*, and where *z* and d_v, depending on the direction of motion in relation to the measurement position, have a positive or negative sign.

According to Galileo's formula for calculating the distance *s* travelled at constant acceleration *a* in time *t* (1.1.2.25);

$$s = \frac{at^2}{2} \quad 1.1.2.25$$

except in one specific case, the ratio of the difference between speed and covered path of the entity in free fall, will be constantly reduced or increased. That mirroring point is second unit of time (in our case, second) of free fall. In second unit of time, the speed and distance travelled are equal (Figure 1.1.2.b);

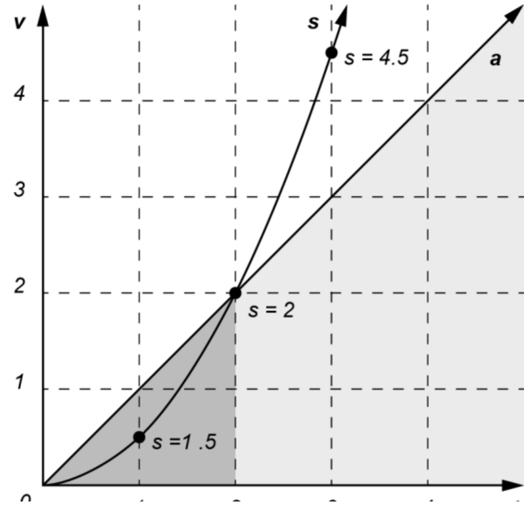

Figure 1.1.2.b *Acceleration vt diagram representing relations between speed v and distance travelled s, where s, according to the equality (1.1.2.25), matches the surface of the corresponding triangle 0vt. In the second unit of time, distance travelled and speed are equal.*

For the above applies (1.1.2.26);

$$t = 2 \Longrightarrow \frac{2a}{v} = 1 \qquad 1.1.2.26$$

Quoted statement is a reference space-time position, i.e. the point of mirroring of radial and transversal dilatations. The statement explains the nature of conversion (1.1.2.24), where instead of acceleration *a*, we place the value of the geometric mean of accelerations among points of measured height difference *h*, i.e. gravity g_n.

Implicitly, it is true that the speed of the body in a free fall, in constant accelerating surrounding, measured on the whole and half of the measured path differ by a factor of √2, which is the distinguishing factor among orbital and escape velocities (Figure 1.1.2.c).

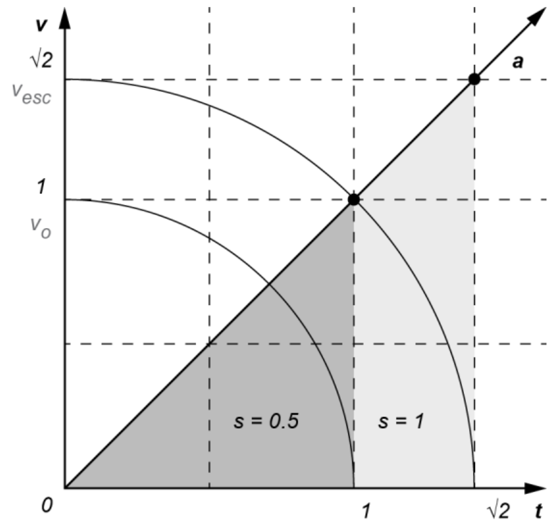

Figure 1.1.2.c *Graphic representation of the velocity of the body in a free fall measured on the whole and half of the distance travelled. Their difference is a factor of √2, which is equivalent to the relation between orbital and escape velocities.*

The above is an illustration of relations among transversal dilatations d_v as a consequence of orbital v_o and escape velocities v_{esc} with gravitational dilation d as a result of the speed c (0.0.48, 0.0.49).

Therefore, when in the above case the speed v equals to two values of the acceleration a, transversal d_v and the radial gravitational dilation z are approximately equal (1.1.2.27);

$$v = h = 2a \Longrightarrow d_v \approx z \qquad 1.1.2.27$$

The nature of their minor difference (6.587 × 10^{-21} for Earth's surface) is that we consider that the transversal systems, perpendicular to the gravity vector, remain in unchanged gravitational orbit. In contrast, radiuses of gravitational orbits of radial systems in the above case differ by the amount of *2a*. Because of described, in such a case, the amount of conversion factor (1.1.2.24) is somewhat smaller than one.

According to valid statement (0.0.7), when the radial velocity equals to the amount of g_h (1.1.2.18), its gravitational dilatation d_c as a consequence of speed c is equal to the radial dilatation z of measured height difference h (1.1.2.28);

$$v = g_h \Longrightarrow d_c = z \qquad 1.1.2.28$$

For these cases, the conversion of transversal dilatation d_v as a result of velocity v, to the radial dilation z is carried by the formula (1.1.2.29);

$$v = g_h \Longrightarrow z = d_v \frac{2c}{v} \qquad 1.1.2.29$$

Listed relations prove that the gravitational spectral shift is the manifestation of constant light speed difference between space-time orbits, where each of them, in their wavelength upon their wave-time, measures it unchanged. Mirror implicit manifestation of described principle is a constant acceleration of the system.
The Terrestrial examples of described equivalencies and conversions are displayed in the enclosed table (radial_transversal_dilatations.xlsx).

1.1.3 Conclusion

The universal scalar principle (*g=cd*), because of its tautological structure valid in any scenario, by a simple geometric method reveals the true nature of the Pound-Rebka experiment. Implementation of the principle demonstrates the unique relationship that connects the predictions of Special and General Theories of Relativity. Accordingly, the conventional interpretation of the spectral shift toward red, of the signal sent from the bottom of the tower, does not lie in the loss of light energy. Its nature is the manifestation of the reference wave of greater space-time in a reference wave of a smaller space-time orbit. Implicitly, we argue that the conventional theories resulting from described invalid interpretations are not tautological but contradictory. We demonstrate it by specified relations proving infinitely variable nature of speed of light, inextricably linked with infinite scale of duration of time and propagation of space. Contradictory and counterintuitive paradigm of indivisible quanta of space and time is the result of locally fixed, non scalar and non universal interpretation of the law of nature.