Energy Balance of Relativity

Executive Summary

Relative motion considers at least two systems of reference: the supposed to be stationary one and the one in motion. Events that may happen in the system of reference in motion certainly happen in the stationary system as well. The general rule of any relativistic consideration is that events must be examined from the point of view of all systems of reference, where they simultaneously occur. And the results can only be accepted as correct if they comply with the laws of physics from the point of view of *all* systems being examined.

We investigate in this book the energy balance of systems of reference in relative motion with the final objective of comparing a system of reference in acceleration for infinite time with *Gravitation*.

The investigation is conducted in three stages:
Chapter I is the review of the Special Theory and the review of the foundation of the General Theory of Relativity.
Chapter II is the introduction of the thesis. This chapter gives the formula for the time relations of systems of reference in relative motion, characterises the unity of the mass-energy balance, defines categories of intensity of events and event concentration, describes the motion with v=lim c, the acceleration for infinite time, investigates the blue and red shift of electromagnetic waves and gives the premium formula of the blue and red shift sequence for use.
Chapter III is an outline of a hypothesis.

Chapter I

The *general problem* with the Special Theory of Relativity is that the real *reciprocal character* is missing from the concept. Two systems of reference in relative motion are equal parts of the same relation. The time relations must be valid from the point of view of both systems of reference, independently of which one is taken as the supposed to be stationary system of reference and which one is considered as being in motion. Because of the missing reciprocal character, the time formula in the Special Theory for systems of reference in relative motion is inadequate.

There is also a *misunderstanding* and misinterpretation of the transformation of space coordinates in the Special Theory. Distances, *measured* in systems of reference in relative motion, are different, but not because inert bodies or systems of reference in motion undergo contraction or change of any kind in their geometrical size. *De facto* static geometrical data are constant and invariant. The coordinates of these data are measurements, e.g. results of events, function of the time flow, depending on the relative, supposed to be status of the systems of reference. Therefore, the measured coordinates are variant.

The energy balance proves that the collision of electromagnetic waves with inert bodies or systems of references in acceleration in a space without gravitational field results in a similar effect as Einstein *a priori* attributed to Gravitation in his paper “On the influence of Gravitation on the Propagation of Light” of 1911. The energy balance also shows the natural correction of the frequency of electromagnetic waves in collision. Any adjustment of the speed of light in this case is not just unnecessary, but obviously makes no sense.

The consequence of the collision of electromagnetic waves with inert bodies or systems of reference in motion is an energy exchange. The collision from in front results in a certain increase of the frequency of electromagnetic waves, while the inert body or system of reference in motion gives off part of its kinetic energy in the same value. The collision from behind means the opposite: electromagnetic waves give off part of their radiation energy and the kinetic energy of the inert body or system of reference in motion increases by the same value.

The proper description of the energy exchange of the collision extends the meaning of Doppler's formula and opens further dimensions for its usage. It characterises all phases of the energy-mass transfer including expanding acceleration and accelerating collapse.

The incorrect time formula in the Special Theory, the misunderstanding of the relativistic effect on the space coordinates and, in parallel, the *a priori* conclusion on the effect of Gravitation lad Einstein to the statement in his paper on "The Foundation of the General Theory of Relativity" in 1916, that the Euclidean geometry can not be applied to describe rotating space-time continuum systems of reference.

The chapter is going to prove that while space coordinates can not be projected in a conventional way, indeed, there is no problem with the Euclidean geometry. The approach is what must be changed. The proper time formula itself resolves the issue. The adequate relativistic use of the space coordinates, the consequence of the time relations, shows the Euclidean geometry holds good and results in a proper description even for non-uniform systems of reference in rotation, the expanding and rotating space-time continuum.

While no event (motion) means: no time definition, the motion modifies the time flow, expands the space and the key parameter is the *acceleration*, the valid alternative for understanding Gravitation.

The main objective of this book is the thesis in Chapter II, but before starting with this, an important question must be addressed: how can a hundred-years-old theory, proven by experiments, be questioned?

Our concerns relate to the explanations, the interpretation of the experimental results.

Chapter II

This chapter introduces the thesis.

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The establishment of the correct time relation between systems of reference in relative motion is crucial. Events happen in time and the use of an improper time formula results in an incorrect energy balance.

The motion modifies the time flow. Time flows faster within systems of reference in motion. The proper time formula is the inverse of what is suggested by the Special Theory.

$$d\tau_{(motion)} = \frac{dt_o}{\sqrt{1-\frac{v^2}{c^2}}}$$

(The list of marks and abbreviations is given next to the Table of Contents after the Executive Summary.)

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The first step on the road to revise the principle of equivalence is to answer the question: does the acceleration, the motion with *a=const,* modify the time flow?

The answer is: Yes, it does. The acceleration speeds up the time flow. The differential form of the equation predicts a non-linear time flow and path description:

$$\frac{d\tau_a}{dt_o} = \frac{1}{\sqrt{1-\frac{a^2 t_o{}^2}{c^2}}}$$

$$\tau_a = \frac{c}{a}\arcsin\frac{at_o}{c}; \qquad s_a = \frac{c^2}{a}\left(1-\sqrt{1-\frac{a^2 t_o{}^2}{c^2}}\right)$$

The time flow in systems of reference in motion is modified, because three dimensional systems of reference, while moving in space, do not and can not influence the propagation of light. The *description* of the propagation of light, therefore in the system of reference in motion is longer than in the stationary one. The bigger product of $c{\cdot}\Delta t$ with *c=const* results in a longer duration, consequently, a faster time flow. The description of the light propagation (its observation) is declined in the given system of reference in motion and gives obviously a longer path than in the stationary system of reference.

Light has no vector components. Any supposed light vector component is equal to the genuine value of the light vector. Therefore, its velocity is one and the same in any direction. It means the time relation in a given system of reference in motion is independent of the direction of the motion.

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What is the work necessary to accelerate a system of reference? There is another question, no less important to be answered: why is it necessary to investigate this when it can be found in every textbook?

Because we are looking for the work-formula which corresponds to the laws of physics from the point of view of both systems of reference, the one in acceleration and the other one in which the acceleration takes place. While the value of the acceleration from the point of view of the stationary system of reference is constant, it is variant from the point of view of the system of reference in acceleration.

To establish the correct work formula of the acceleration for both systems of reference, the acting force value, product of *m·a* must be adjusted. And it leads to the definition of a *relativistic* or *acting* mass.

$$dm_o = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}dm_v$$

$$dm_o = \frac{1}{\sqrt{1-\frac{a^2 t_o^2}{c^2}}}dm_a$$

The value of the relativistic mass at *v=0,* at rest, is equal to the inert mass: $m_{inert} = m_{rel}$

$$W_a = m_a c^2\left(1-\sqrt{1-\frac{a^2 t_o{}^2}{c^2}}\right)$$

$$\Delta t_o = t_o - 0$$

The definition of the *relativistic mass* makes it possible to determine the absolute value of work necessary for accelerating a system of reference with *a=const.* As expected, it is equal from the point of view of both systems of reference.

This work formula using the inert mass also gives the Newtonian equation. It proves there is only one law of *physics* to apply. The origin is the same, the expressions are different.

$$W = m\frac{a^2 t_o^2}{2}$$

Einstein's work and energy formulas are in fact *intensities,* their actual appearance in the given system of reference. The work intensity expression for the stationary system of reference gives it in its well-known shape.

$$w_a = \frac{m_a c^2}{\sqrt{1-\frac{a^2 \Delta t_o^2}{c}}} - m_a c^2$$

The considerations about inert and relativistic masses bring up important findings:

$E_{rest} = mc^2$ is the value of the full energy of the inert mass at rest without any motion;

$E_{motion} = mc^2$ is also the full value of the total kinetic energy. Since the inert mass in full motion *(*when *v=c)* has no meaning, it is presented by its *virtual* value.

The *energy-mass unity* is in dynamic balance between these two ends. The *energy reserve at rest* is a new category for characterising the status between these end points.

$$m_v c^2 \sqrt{1-\frac{v^2}{c^2}} = m_v c^2 - W$$

The inert mass value characterises the total *absolute* energy at rest. The relativistic mass value characterises the *actual* energy of the mass in motion. In everyday practice we measure relativistic masses.

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The motion modifies the time flow and this raises a new question to be answered: does the modified time flow change the energy demand of events?

The one and the same event must have the same absolute energy in any system of reference in motion.

But *systems of reference*, distinct in motion, are different in their time flow, therefore, they must have *different intensities* in their energy usage. Events do not just happen "faster or slower" in systems of reference distinct in motion, but with "lesser or higher" intensity. Otherwise the energy balance could not be maintained. Consequently, their *event concentration* is different.

$$\frac{dW}{dt_o} = w_o \text{ and } \frac{dE}{dt_o} = e_o$$

$$\frac{dW}{d\tau_v} = w_v \text{ and } \frac{dE}{d\tau_v} = e_v$$

$$\frac{dW}{d\tau_a} = w_a \text{ and } \frac{dE}{d\tau_a} = e_a$$

The mathematical shape of *work* and *energy intensities* is similar to that of capacity. There is, however, a principal difference between the two. The capacity only relates to a certain event and shows the value of work spent for a particular period. The *intensity* of events for a system of reference is uniform and relates to all events within the given system of reference.

The *intensities* are the real appearances of events within the systems of reference. Together with the *event concentration* they relate exclusively to and characterise the systems of reference.

The *event concentration* helps us to describe the *muon escape*, one of the practical manifestations of the existing relativity, giving the correct explanation for finding cosmic muons on the surface of the Earth.

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The principle of equivalence is re-examined. The acceleration is taken for infinite time.

This is a motion with speed $i = \lim a\Delta t_o = c$, with constant energy and permanent work demand, with the speed of the motion dropping down, fluctuating constantly.

$$e_{oi} = \frac{m_i c^2}{\sqrt{1 - \frac{i^2}{c^2}}} = const$$

In order to keep the speed and the energy of the motion quasi constant and compensate for the drop-down, work must be envisaged. Therefore, this motion is also a permanent acceleration.

$$W_{a(drop-down)} = m_i c^2 \left(1 - \sqrt{1 - \frac{a_{(n)}^2 \Delta t_o^2}{c^2}} \right)$$

Thus, the motion with $i = \lim a\Delta t_o = c$, the acceleration for infinite time is unique and exclusive. It needs permanent work, and, thus, creates working capability and, in spite of the work spent, its energy remains constant.

System of reference in motion with $i = \lim a\Delta t_o = c$, the acceleration for infinite time, can be used as a *basic platform* to compare systems of reference in motion with each other. The comparison through a basic platform is an important tool to find the correct relation and to exclude the paradox of relativity.

The motion with $i = \lim c$ indicates a question: what is the maximum summarised equivalent speed of an inert body or system of reference in motion with $v=const$, achievable within a system of reference in motion with $i = \lim a\Delta t_o = c$? It is always less than c, the speed of light.

$$u = c\sqrt{1 - \frac{(c^2 - i^2)(c^2 - v^2)}{c^4}}$$

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After all this background we arrive at the examination of the *Pound-Rebka-Snider experiment*, the measured *blue shift* of photons, caused by the effect of the supposed to be Gravitation. And the question is posed: may a system of reference in motion with $i = \lim a\Delta t_o = c$, the acceleration for infinite time, result in *blue shift* in collision with light photons?

And the answer is yes! The collision of electromagnetic waves with a system of reference in motion with $i = \lim a\Delta t_o = c$, the acceleration for infinite time, results in *blue shift* of light photons.

$$\Delta E_\gamma = E_\gamma \left(1 - \sqrt{1 - \frac{g^2 \Delta t^2}{c^2}} \right)$$

The calculated value of the *shift* within a system of reference *with no* gravitational field, but in motion with $i = \lim a \cdot \Delta t_o = c$, co-relates well with the measured results.

$$\frac{\Delta E}{E_\gamma} = 2.442 \cdot 10^{-15}$$

Thus, a system of reference *without any gravitational field* may cause *blue shift* and, of course also *red shift*. The comparison with a shift, which is supposed to be caused by Gravitation is unavoidable. And there is a point to note: photons do not accelerate and can not be accelerated. Why?

Because the energy of full motion and full rest of photons are equal, just their energy-mass status is different. The energy of motion means full energy without any mass, the energy at full rest means the mass itself. There is no room for the increase of the energy of the photon from its own sources. The transformation of the inert mass into energy with reaching the speed of light is complete.

$$E_{motion} = mc^2 = \\ = E_{rest} = mc^2$$

The *source* of the energy surplus and energy deficit of the *blue* and *red shifts* is the kinetic energy of the system of reference in motion with $i = \lim a \cdot \Delta t_o = c$. It gives off part of its energy in the case of the *blue shift* and takes off part of the energy from the radiation in the case of the *red shift*. And we need not to be surprised, since this recognition is in full compliance with what Einstein stated in his ground-breaking paper in 1905 where he asked 'Does the Inertia of a Body depend upon its Energy-content?' Yes, it does. "If the theory corresponds to the facts, radiation conveys inertia between the emitting and absorbing bodies." (Quotation from Einstein, Source: "Does the Inertia of a Body depend upon its Energy-content?" Principle of Relativity, Dover Publications, Inc).

100 years' experience proves this statement perfectly corresponds to the facts.
The expression of the value of the blue shift through the virtual value of the photon's inert mass gives the gravitational potential. In other words, the *blue* and *red* shifts are linearly proportional with the altitude in a space without gravitational field, as is the gravitational potential.

$$\Delta E_\gamma = E_\gamma \left(1 - \sqrt{1 - \frac{g^2 \Delta t^2}{c^2}} \right) = \\ = mgh$$

Here we have found the reason for the *drop-down* of the energy of the motion with $i = \lim a\Delta t_o = c$, that necessitates the work to be envisaged. It is for compensating for the energy taken off by the blue shift of photons.

The sequence of *blue and red* shifts of electromagnetic waves results in energy transfer, the transfer of the *energy surplus* provided by the kinetic energy of the system of reference in motion with $i = \lim a\Delta t_o = c$, the acceleration for infinite time. The surplus premium, taken off by the *blue-red shift* sequence to be utilised, is:

$$\Delta E_{(red-blue)} = \Delta E_{(red)} - \Delta E_{(blue)} = E_\gamma \frac{g^2 \Delta t^2}{c^2} \cdot \frac{1 - \sqrt{1 - \left(g^2 \Delta t^2 / c^2 \right)}}{1 + \sqrt{1 - \left(g^2 \Delta t^2 / c^2 \right)}} > 0$$

The above equation is the main message of this thesis.

The motion with $i = \lim a\Delta t_o = c$ raises the question about the value of the frequency of the collision, predicted by Einstein to be of an infinite value. Doppler's formula defines it as a frequency, quasi equal to the frequency of light, corresponding to the speed difference between c and $i = \lim c$.

$$f_E = f \sqrt{\frac{1 + \frac{|c-i|}{c}}{1 - \frac{|c-i|}{c}}} \cong f$$

The thesis is consistent and valid on its own, but also has its conclusions. The character of the findings, however, necessitates formulating them in the next chapter.

Chapter III

This chapter is a hypothetical outline. It has three sections with different hypothetical messages.

Section 10 summarises the arguments and findings and states: *the sphere symmetrical expanding acceleration of the Earth, the motion with i*=lim $a\Delta t_o$=*c for infinite time,* is a realistic alternative for the understanding of the meaning of Gravitation.

- *Gravitation* is *energy*, the supposed to be system of reference, which provides the energy for the *sphere symmetrical expanding acceleration of the Earth*, the system of reference *in motion with* $i = \lim a\Delta t_o = c$ for infinite time.
- The *sphere symmetrical expanding acceleration of the Earth, a motion with i=lim c* obviously *modifies* our existing view on the *gravitational free-fall*.
- The collision of electromagnetic waves with the accelerating surface of the Earth, the blue shift, *increases* the energy of the electromagnetic waves, but *most importantly*, the kinetic energy of the Earth in sphere symmetrical expanding acceleration, motion with $i = \lim a\Delta t_o = c$ can be transformed through *blue and red* shift sequence *into energy to be used.*

With Section 10 the thesis introduced in Chapter II can be considered as completed.

Section 11 is an outline demonstration of the energy balance of the hypothetical sphere symmetrical expanding acceleration of the Earth and light photons. *Gravitation* provides the energy and light photons control the process and keep the balance. *Earth is in sphere symmetrical expanding acceleration around and away from its centre.*

In order to quantify the dimension of *i* the speed of the sphere symmetrical acceleration and *z*, the *event concentration* on the surface of the Earth an assessment of first approximation was performed and values found:

$$i = c\sqrt{\frac{6\cdot 10^{24}}{6\cdot 10^{24} + 2.96\cdot 10^{-6}}}$$ which is indeed $i = \lim c$

$$z = \sqrt{1 - \frac{6\cdot 10^{24}}{6\cdot 10^{24} + 2.96\cdot 10^{-6}}}$$ which is indeed $\lim z = 0$, practically zero

Section 12 gives the outline of a hypothesis of the *sphere symmetrical expanding acceleration* and *accelerating collapse* in general, a *pulsation of the energy-mass unity* for infinity.

The description of the pulsation is given in accordance with the adjusted (comprehensive) Doppler formula introduced in Chapter I. It establishes the energy-mass status of the *Black Hole*, the pure energy concentration without mass. The other end of the process is also introduced, identifying it as *White Room*, the fully exploited energy, the fully expanded status of the mass at rest.