4. THE GRAVITATIONAL FIELD

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According to the explicit form of the Equivalence Principle, *the G field of the model is a general property of the radiation in stationary states*. Then it is important to study, most carefully, the long-range properties of the radiation from experimental facts.

4.1 The Perturbation Rate of the Space

From section ***2.6.2*** it was concluded that

- *"The universe should be like a "wavelet sea", rather densely populated of wavelets with random phases traveling in all directions, most of the times interfering destructively, in the so-called empty space, and constructively in radiation's and particles".*

- *The properties of the empty space, far away from uncharged matter, can only depend on the average perturbation rate produced by the random-phase wavelets that are actually crossing such space.*

Of course, nobody knows by certain what are the reasons for which a single quantum like a photon does not spread. This is a very fundamental property because, if this were no so, matter and the universe would also be dissipated, vanish. Thus, for the moment, this is something that must be postulated as a well tested observed fact. This is done in the same way as in the case of the constant value of the (super local) speed of light postulated in special relativity. However some relative properties of wavelets, given at the end of this work, could reasonably account for such general properties quantum's and particles.

4.2 The Long Range Gravity Field

For an isolated and stable particle model, *the escape probabilities for the model quantum is zero*. Then, in one way or another, the model wavelets must be in phase with respect to each other but only within the model and its short-range reflection boundary. Beyond the last boundary, *only wavelets with random-phase wavelets can go back and forth from the model*. This means that.

a) The net wavelet amplitude in the long-range space around the model is zero.
b) The long range G field of the particle model can only be due to the random phase wavelets associated to the stationary radiation confined in it.

c) Far away from ordinary bodies the empty space must be crossed with a high density of all sorts of random phase wavelets traveling in all directions. This should account for the rather isotropic properties of such space.
d) The NL properties of the space in any general NL position (r) should be fixed by the NL perturbation rate of the space produced by all of the wavelets crossing such space. Let us call it $w_{r*}(r)$.
e) The G field of the particle model can only be due to the gradient of $w_{r*}(r)$, which would depend only on the wavelets coming back and forth the model's quantum.

4.2.1 The energy dilemmas in gravitational fields.

In current gravity theories it is normally thought that the G field is similar to the electric field, i.e., that the G field is associated with some energy density. Thus Einstein and most people have believed in that the G field is the one that puts on the energy during the G work. Curiously, such assumption has never been fairly proved.

[This was just the starting point of the present work, because it is not reasonable to go on further studies leaving behind such fundamental question.].

For such purpose, the present approach is based on a more explicit form of the Equivalence Principle. Because in this one leave no room for arbitrary assumptions. According to it, the general properties of the particle model and of the space around it are fixed by general properties of radiation quanta.

In order that the model can be stable, the radiation confined in it must not escape from it. Since the G field is open, this conditions means that the net wavelet amplitude around the model, away from its reflection boundary, must be zero all of the way up to infinity. This means that the wavelets would interfere to each other constructively only in the particle model. In the rest of the space the same wavelets would be interfering destructively, with null net amplitudes, i.e., with *random-phases*. This leads to a chain of conclusions that will also be verified below by different methods:

1. The net wavelet amplitude must be zero[1]. The same holds for the probability that real energy can exist in a long range G field

2. The G field itself has no energy. It is not an additional source of G field.

3. A static G field cannot exchange energy during a G fall of a particle model because such field itself has no energy (*No energy exchange law for G fields*).

4. A free falling particle model cannot exchange energy with the G field because it is made up of stationary radiation that, according to wave continuity, cannot exchange energy with static conservative fields.

5. The NL mass-energy of a particle model falling freely in a static G field remains constant, with respect to an observer in a fixed G potential, because there is no real energy exchange between the field and the model (*NL mass-energy conservation during a free fall*).

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[1] Using real bodies made up of a large number of particles with random movements relative to each other can make a self-consistency test for this last point. According to statistics, such random movements increase the randomness of the wavelets. This means that the relative probability for the existence of some energy in the space around real bodies is even smaller than for a single particle model.

6. During a free fall the NL mass-energy of the body remains constant because a fraction of the NL mass-energy of the body is *virtually* transformed into kinetic energy of the same body. This is equivalent to say tat the body is using up its own internal mass-energy to increase its own kinetic energy.

7. During the stop, the model NL rest mass-energy decreases due to the kinetic energy given away (or given up) during the stop.

8. The final particle model at rest in a lower G potential is no longer strictly the same with respect to the original particle before the fall[2].

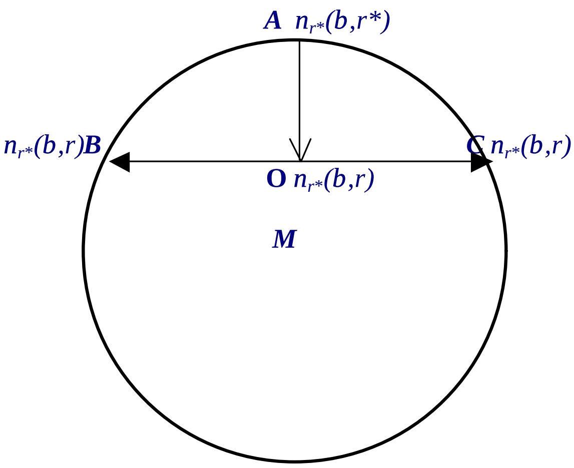
It is obvious that above conclusions are in clear conflict with the current beliefs and theories.

Due to the high importance of the no exchange law, this one has been verified exhaustively in this book, from several *theoretical and experimental ways*, above and below, and in the APPENDIX B. This has been done using both theoretical methods and more strictly homogeneous descriptions of well-known experiments made up with real bodies. This is consistent with the results obtained elsewhere in this book. This includes self-consistent interpretations of the so called "*gravity tests*".

The lack of real energy in a G field is the source[3] of fundamental differences between the present theory and general relativity. This is consistent with lack of real success of theories trying to unify gravity with short-range forces and with the failure in the real detection of the presumed gravity waves.

4.2.2 The no *e*xchange law derived from gedanken experiments

Fig. 4.1 describes a *gedanken experiment* made up with an electron pair (e^--$e+$), also called positronium atom, falling freely, from a rest at ***A***, in the static G field produced by a central body (**O**) of rather infinite mass compared with that of an electron. Assume that annihilation occurs in any arbitrary radius *r* after emission of two symmetrical gamma rays propagating themselves in opposite directions[4]. The frequencies of these photons are measured when they cross a sphere of radius *r** where the observers ***A, B*** and ***C*** are located.



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[2] It has lower (red shifted) NL frequency with respect to the original model before the fall. This has been clearly verified below, after a more homogeneous interpretation of the phenomena of *G time dilation* and *G red shift*

[3] Of course, *these conclusions put into relief fundamental errors in current physics.* Such errors *come from improper use of special relativity, or the EP, for non-local cases in G fields. This makes believe in that the G fields and the EM fields have similar properties, which is not strictly true.*

[4] It is well proved that the gamma rays carry out just the same mass-energy of the original particle system.

Fig. 4.1 *Gedanken experiment in which matter annihilation occurring anywhere during a free fall* ***AO*** *in a strictly static central field. This may eventually occurs at* ***A****(r*), before the fall, and in any arbitrary radius (r). The net energy leaving the sphere cannot depend on where annihilation occurs.*

Assume that annihilation occurs at ***O****(r)* (First two members of E4.1). According to NL frequency conservation, the NL frequencies of each of the two photons resulting from matter annihilation remain constant during their trips ***OB*** and ***OC*** (Second and third member of E4.1). According to the global mass-energy conservation of the system, *the net energy escaping from the sphere must not depend on where the annihilation occurs.* Then such energy must be identical to the one occurring when annihilation occurs at $r*$ (first and last member of E4.1, i.e., E.4.2).

$$h\boldsymbol{n}_{r*}(\boldsymbol{b},r) = h\boldsymbol{n}^{1}_{r*}(r) + h\boldsymbol{n}^{2}_{r*}(r) = h\boldsymbol{n}^{1}_{r*}(r*) + h\boldsymbol{n}^{2}_{r*}(r*) = h\boldsymbol{n}_{r*}(0,r*) \quad \text{E4.1}$$

$$h\boldsymbol{n}_{r*}(\boldsymbol{b},r) = h\boldsymbol{n}_{r*}(0,r*) \quad \text{E4.2}$$

$$m_{r*}(\boldsymbol{b},r) = m_{r*}(0,r*) \quad \text{E4.3}$$

This proves that *during a G fall, the NL (relativistic) mass-energy and the average NL frequency of a particle model, with respect to a fixed observer, remains constant.* This happens regardless of its velocity changes occurring during the fall[5]. From E4.2 and E4.3, this law may be called *NL mass-energy-frequency conservation*[6].

4.2.3 The no energy exchange law from free fall and gravitational time dilation experiments

The results of *a free fall experiment* made up from $r = r* + H$ and a stop at $r*$ can be stated in a non-dimensional form. Thus the fraction of mass-energy released, locally, during the stop at r* is, according to special relativity:

$$\frac{\Delta E_{r*}}{m_{r*}(0,r*)} = \frac{m_{r*}(\boldsymbol{b},r*) - m_{r*}(0,r*)}{m_{r*}(0,r*)} = (\boldsymbol{g}-1) \approx \frac{gH}{c^2} \quad \text{E4.4}$$

According to the G time dilation experiments and to the equivalence principle, the frequencies of the clocks and of the emission frequencies of all of the atoms, located at a height H over the observer at $r*$, are shifted in the same proportion, compared with those of the local ones. This is done according to the generic relation:

$$\frac{gH}{c^2} \approx \frac{\boldsymbol{n}_{r*}(0,r*+H) - \boldsymbol{n}_{r*}(0,r*)}{\boldsymbol{n}_{r*}(0,r*)} \quad . \quad \text{E4.5a}$$

According to the Equivalence Principle, the photon energies and the mass-energies of the atoms should change in the same proportions after identical changes of G potentials. Then E4.5a can be written as:

$$\frac{gH}{c^2} = \frac{h\boldsymbol{n}_{r*}(0,r*+H) - h\boldsymbol{n}_{r*}(0,r*)}{h\boldsymbol{n}_{r*}(0,r*)} = \frac{m_{r*}(0,r*+H) - m_{r*}(0,r*)}{m_{r*}(0,r*)} \quad . \quad \text{E4.5b}$$

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[5] This is a characteristic of "self-propelled bodies" that use up their internal energies to accelerate themselves.

[6] This gedanken experiment cannot be done with *charged bodies, like electrons.* According to charge conservation, single electrons cannot possibly be transformed into electromagnetic radiation. This is consistent with the fact that *electric fields that do not show phenomena similar to G time dilation and G red shift*.

After comparing E4.4 and E4.5b,

$$m_{r*}(\boldsymbol{b}, r) = m_{r*}(0, r*+H) = cons\tan t \quad . \qquad \text{E4.6}$$

Then, from the free fall and G time dilation experiments it may also be concluded that:

"During a free fall in a static G field, the NL mass of a body, with respect to a fixed observer, is constant".

The same results come out, obviously, after using G red-shift experiments.
From E3.8 and E4.6 the final NL rest mass, after the stop, is:

$$m_{r*}(0, r*) = m_{r*}(\boldsymbol{b}, r*)\sqrt{1-\boldsymbol{b}^2} = m_{r*}(0, r*+H)\sqrt{1-\boldsymbol{b}^2} \quad . \qquad \text{E4.7}$$

The final NL rest mass of the body is smaller with respect to the initial one.
The mass-energy released during the stop is.

$$\Delta m_{r*}(r*) = m_{r*}(0, r*+H) - m_{r*}(0, r*) = m_{r*}(0, r*)[g-1] \quad . \qquad \text{E4.8}$$

Notice that the energy released comes not from the external G field. It is just a fraction of the original NL mass-energy that the body had when it was located at the height H.

4.2.4 Main differences with conventional theories

Strictly, in order that the real changes occurring to the bodies cannot be detected locally, after changes of velocity and of G potentials of the measuring system, such changes must occur "linearly", in just the same proportion. Any nonlinear change could be detected locally, thus violating the EP. This in clear contradiction with the non linearity of the field equation of General Relativity and with the explicit assumption in that the G field itself has some energy that is exchanged with the bodies during their displacements in the field.

Thus the no exchange law is also in opposition with a large number of works in current literature trying to unify shorter-range fields with long-range G fields.
In spite of the fundamental differences between E fields and G fields, Einstein[2], postulated his non-linear field equation by assuming that both the G fields and the E fields themselves have some energies, and that such energies can be exchanged with the one of the test bodies[7]. Here it is proved that this assumption is not simultaneously consistent with the Equivalence principle and with the gravity experiments. To the contrary, the E fields turn out to be fundamentally different from the G fields in every respect.

Notice that the energy of an E field is obvious from the fact that such field is *a fraction of* a closed (uncharged) system, the same as any fraction of the particle model. The opposite turns out to be true for the G field case. Because G fields are open fields and, therefore, they are not parts of closed systems. Indeed they normally are far away from the internal fields of the G sources.

[7] It is interesting to observe that, due to the lack of better arguments Einstein rather repeated the same ideas in different words[2].

During a free fall, to the contrary of current beliefs, the G field provides just the momentum necessary to liberate a fraction of the body NL rest mass. The energy released during G work comes not from the field but from the body.

The body does the G work. This one is done at the cost of some internal red shift its quantum's in stationary states. This one occurs after a change of G potential and stop, when a fraction of the mass-energy of the body is given away.

These basic differences between such fields have also been verified in the APPENDIX B, from the EP and homogeneous descriptions of the gravity experiments.

4.2.5 Why these kinds of errors persist in the literature?

It is reasonable that the main reasons are:

Reason 1. We live in a rather local world in which most of the phenomena depend on short-range interactions between rather local bodies that do exchange energy between them. Most of them are electromagnetic ones. Then *most people have never thought seriously in that G fields can be much different to other kinds of fields.*

Reason 2. Most people do not realize that the ordinary physical language becomes ambiguous and meaningless for NL cases in G fields. Paradoxically, the theory of General Relativity puts into relief that the local language (Special Relativity) used in electromagnetism becomes ambiguous and not well defined just for non-local cases in G fields. Thus the illegal use of special relativity for non-local cases in G fields is still likely to be the most serious cause of the persistence of these errors.

Current observers do not realize that, after some common changes of G potential of their instruments, *all of them, their clocks and their local unit systems are no longer the same with respect to the earlier ones*. Due to the linearity of the changes, the local physical laws have the same form after the same changes of field potentials. Thus, for simplicity and for practical reasons, everybody normally assign the same numerical value to the local standards. In this way, everything looks most simple because apparently nothing has changed. But the truth is that "everything has changed" (with respect to the previous state of that the system has before the G potential change). *Only external observers that have not changed in the same way as the object can observe such changes after using, for example, conservative properties of light.*

Reason 3. The Einstein's Equivalence Principle can make believe either in that "*nothing has changed*" or in that such changes are unimportant. The two beliefs are wrong because the truth is that "*everything has changed*" in identical proportion and those changes are most important in strong fields.

Reason 4. It is currently stated that "*the relativistic mass of a body increases during the G fall*".

Such statement is numerically true but without a real physical meaning. Because the word "increase" means, in this case, a difference between two masses measured in different G Potentials. Such difference is not homogeneous and, therefore, meaningless. This is due to the fact that the two observers have standards that are different with respect to each other. *Such difference is as absurd as saying that 8 US$ - 7 yen = 1 US$*

Such ambiguous statement makes believe in that the larger local masses are due to some assumed energy given up by the G field. Below, it is proven that *this is not true!*

Reason 5 Most *people believes in that the mass of a body is bounded to increase when it increases of velocity with respect to the observer.*

This is true only if the some external force gives up the corresponding energy to the body. However this is not true for self powered objects. In such cases the bodies accelerate by themselves after using up their own internal energies, after the momentum's given up by some "*static*" external force[8]. Since no external energy comes from some external system, according to *mass-energy conservation*, the relativistic mass of the body remains constant[9].

In the case of a free fall in a static G field, *it is not trivial which part of the system is the one that puts on the energy*. The two alternatives are:

1. *The G field*,

2. *The test body*.

Most people, including Einstein himself, have implicitly ignored second alternative. Here it is proved that the last alternative is the only one really consistent with the Equivalence Principle!

The differences coming from selecting the first alternative are negligible but only for the very weak G fields of ordinary life. Thus General Relativity and the present theory give the same approximations for the same gravity tests both because they are based on the same Equivalence Principle and because the tests are made up in very weak fields. Such differences should become most important in strong (untested) fields in which the influence of the error becomes important.

Reason 6. Due to the high success of the Einstein theories, most of the times any idea in conflict with the General Relativity is implicitly or explicitly, classified as "odd and crazy". Such ideas are likely to be discouraged or rejected by referees or the editors, without a fair reading of works that disagree with General Relativity. Indeed, such ideas have been virtually killed long before that they can be born in the mind of most of the students, during learning stages, due to the strong faith on what is written in current books.

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[8] Static forces give up just momentum. They do no give up energy (work) because there is not a true displacement of the application points

[9] For example, an idealized runner would accelerate himself after using his own energy and with the momentum supplied by the *static road forces* generated on his shoes, during each step. *The road does not give up energy but just momentum.* According to special relativity, *the runner relativistic mass does not increase during the acceleration because no external energy is given up to him.* After each step, a small fraction the original rest mass-energy of the runner, like chemical potential energy, is converted into an identical fraction of its own moving (relativistic) mass, called kinetic energy. Thus, the moving (relativistic) mass of the runner, relative to the static observer in the road, *cannot increase with his velocity because no external energy has been given him up.* In shorter terms, *the earth puts on just the momentum but the runner puts on the energy*.
In an idealized case of a car powered with its own batteries, the mass-energy lost by the battery discharge is compensated with the relativistic mass increase of the whole car. Then the net car mass, relative to an inertial observer, remains invariable in spite of its velocity changes.

4.3 The NL phenomena Occurring During a Free Fall

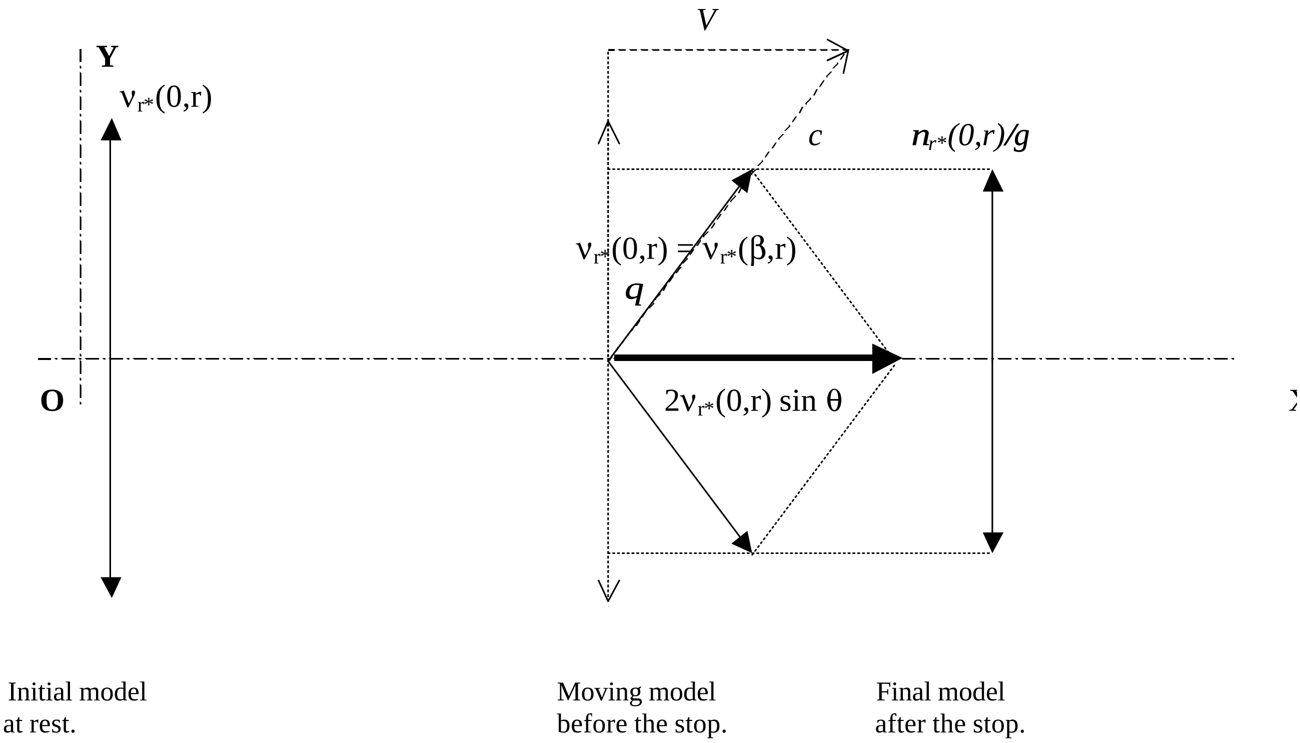

Fig. 4.2 Vector *diagrams for a model free fall from a rest at r^0 and a stop at r.*

Assume in Fig. 4.2 *a* that a particle model is initially at rest at some NL position r^0, with its dual vectors oriented along the ***OX*** axis, in a transversal G field gradient along the ***OY*** direction. Suppose that the model is released when the two wave fronts are starting their trips in opposite directions from ***O***.

In a space with isotropic properties, the particle model would reproduce by itself in just the same position, i.e.; it would stay at rest forever. In order that the can accelerate along the OY direction, without the help of external photons, some "*gradient of the NL refraction index of the space*" must exist along such direction. According to well tested refraction properties, "*the refraction phenomenon does not changes the frequency of the radiation*", i.e., "*changes the momentum but without exchanging energy*. The same is true from the NL mass-energy conservation shown above from theory and experiments. During the internal trips of the waves, the gradient of the NL refraction index of the space would deviate the model radiation components from their original orientations, proportionally to the time, thus causing an acceleration proportional to the gradient of the NL speed of light. In this way the final model velocity must come from a large number of small rotations of the model quantum vectors occurring during each trip.

Assume that the model falls between the radii r^o and r and that the final rotation angle of the dual vectors is ***q***. This means a final model velocity $b(r) = \sin q = V_{r*}(r)/c_{r*}(r)$. According to *Fig. 4.2,* the final *quantum vector of the model* is:

$$Q_{r*}(b,r) = hn_{r*}(b,r)\sin q = m_{r*}(b,r)\, b(r) = p_{r*}(b,r)\, c_{r*}(r) \; . \qquad \text{E4.9}$$

In which the NL momentum of the model is[10]

$$p_{r*}(b,r) = \frac{Q_{r*}(b,r)}{c_{r*}(r)} = \frac{m_{r*}(b,r)}{\left[c_{r*}(r)\right]^2} \mathrm{V}_{r*}(r) = m_{r*}^{newt}(b,r)\,\mathrm{V}_{r*}(r) \;. \qquad \text{E4.10}$$

Notice that the conventional relationships come out naturally, from plain properties of the stationary radiation. The relation between the Newtonian mass (m^{newt}) and the mass-energy (m) is straightforward, and in strict agreement with the relativity equivalence between Newtonian mass and energy:

$$\mathrm{m} = E = m^{newt}c^2.$$

Notice also that the net NL quantum vector of the model is always the difference between the two quantum vectors of the model. This one comes from the plain rotation of the radiation quantum vectors, whose absolute values are constant. *"Such rotation is associated with a general contraction of the transversal projections the dual vector components*", by the common factor *cosq*. Such projections fix the rest values of the dual vectors in the new model NL positions[11], called $\nu_{r*}(0,r)$ and $\lambda_{r*}(0,r)$, respectively.

According to this and E4.3 or E4.6, *the gravitational contraction factor* is:

$$\cos q = \frac{n_{r*}(0,r)}{n_{r*}(b,r)} = \frac{n_{r*}(0,r)}{n_{r*}(0,r^o)} = \sqrt{1-b^2} = \frac{1}{g} \;. \qquad \text{E4.11}$$

It is important to realize that this kind of contraction is different from the "kinetic contraction", due to differences of velocity respect to the observer. The last one is "longitudinal" and "temporal" one, i.e.; it vanishes during the stop. On the other hand "*the gravitational contraction is total, transversal and longitudinal one, and permanent*", i.e., <u>it does not vanishes during the stop</u>.

During the fall, the NL frequency and NL wavelength vectors of the moving model are always parallel to each other. Then "they must rotate after the same angles". According to this their projections on a transversal plane must change in identical proportion, which is fully consistent with the more explicit form of the EP.

Thus the gravitational contraction factors for $\lambda_{r*}(0,r)$ and $\nu_{r*}(0,r)$ are the same. They are equal to *cosq*. But such parameters are related to each other by the NL speed of light, after

$$c_{r*}(r) = n_{r*}(0,r)\, l_{r*}(0,r) \qquad \text{E4.12}$$

Then from and E4.11 and E4.12 the gravitational contraction factor is related to the NL speed of light and to the velocity at each NL position after:

$$\cos q = \frac{n_{r*}(0,r\ )}{n_{r*}(0,r^o)} = \frac{l_{r*}(0,r\ )}{l_{r*}(0,r^o)} = \sqrt{\frac{c_{r*}(r)}{c_{r*}(r^o)}} = \sqrt{1-b^2} = \frac{1}{g} \;. \qquad \text{E4.13}$$

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[10] Notice that in any particular local case, when $r = r^*$, this gives the conventional relation $p = mV$

[11] During the stop at r, according to quantum cycle conservation, the number of quantum events traveling along the OX direction cannot change (momentum conservation). Thus these projections are the constant values of the dual vectors of the model at rest at such NL position r.

For example, from E4.13, the space NL refraction index at r, with respect that at $r*$, is related to the experimental values of g

$$n_{r*}(r) = \frac{c_{r*}(r*)}{c_{r*}(r)} = \frac{c_{r*}(r*)}{c_{r*}(r^o)}\frac{c_{r*}(r^o)}{c_{r*}(r)} = g^2 n_{r*}(r^o) \quad . \qquad \text{E4.14}$$

If the free fall starts at the observer's position:

$r^o = r*, \qquad n_{r*}(r) = g^2$.

The same contraction factor holds for the ratio between the corresponding mass-energies after multiplying numerators and denominators of E4.11 by *h*.

$$\cos q = \frac{m_{r*}(0,r)}{m_{r*}(0,r^o)} = \frac{m_{r*}(0,r)}{m_{r*}(b,r)} = \sqrt{1-\hat{a}^2} \qquad \text{E4.15}$$

Notice *the strict correspondence of this relation with special relativity*.
Thus, from above and E4.13, E4.14, it is inferred that:

1. *The final dual vectors of the rest model, after the stop, are smaller than the moving model has. The non-dimensional factor, with respect to initial values, is* ***1/g****. This accounts, quantitatively, for the results of G red shift and G time dilation experiments.*
2. *The NL speed of light at the end of the fall, with respect to the observer in the starting position, is:* $c_{r*}(r) = 1-b^2$
3. *The G field is characterized by a gradient of the NL speed of light, i.e., a gradient of the NL refraction index*. This is obviously consistent with the deviation of light by *the Sun field and with the lens effect produced by massive celestial objects.*
4. *The final NL eigen values, for all of the stationary states of the bodies at rest at r, are smaller. The contraction factor, for all of them, is the same*.
5. *When the particles are changed to a new rest in a stronger G field, the eigen values of all of them, the NL frequencies, the NL mass-energies, and the NL wavelengths get contracted in same proportion.*

These common contraction factors account for:

a) The invariance of the "local physical laws"
b) The gravitational time dilation and for the gravitational red shift.
c) The energy released during the stop
d) The gradient of the NL refraction index.

Notice that the NL refraction index is higher just in the regions of higher densities of matter, i.e., in regions of higher densities of random-phase wavelets associated to the radiation confined in matter. Then it is reasonable that the gradient of the NL speed of light is caused by a gradient of the NL perturbation rate of the space produced by the random phase wavelets, i.e., that the gross space properties are fixed by the properties of the wavelets.

The role of NL refraction in nature will be discussed later on (below) in **Section 11.**

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