The dark matter and radiation backgrounds predicted from a new principle and a new gravitational theory

Rafael A. Vera. Departamento de Física. Facultad de Ciencias Físicas y Matemáticas. Universidad de Concepción. Chile *

Abstract

The new principle comes from the general condition of consistency of the Einstein's equivalence principle and experiments in which bodies and observers are in different G potential (GP). From it, bodies located in different GPs are not equivalent with respect to each other. Their physical differences are linearly related to their differences of GP. The same principle and explicit relationships have been obtained before from a new theory on gravitation based on a particle model made up of radiation in stationary states. The new principle is not consistent the Einstein's hypothesis on the G field energy. The new kind of "linear" black hole, after absorbing radiation, can decay into a cloud of H gas. The increase of G potential due to universe expansion produces a gravitational expansion of every body in same proportion as any other distance. Thus universe expansion does not change the relative distances. Thus the universe age may be infinite. After so long time, galaxies must be evolving in rather closed cycles with luminous and dark periods. During their luminous periods, increasing fractions of stars must become dark matter. During their dark periods, the new kind of black holes can absorb energy enough to explode and generate the new H gas that can start the new luminous periods and so on, indefinitely. Statistically, all of the different phases of the evolution cycles of the galaxies and clusters should be rather uniformly distributed in the universe, in a proportion fixed by their periods. Most of the galaxies must be in their dark periods. They should account for the dark matter and the radiation backgrounds observed in the universe.

Introduction

The current theories on gravitation and cosmology are based on direct relations between quantities measured by observers at rest in different G potential (GP). This is a tacit way to accept the classical hypothesis (CH) on the physical equivalence of reference standards at rest in different GP.

For example, general relativity (GR) is based on the Einstein's hypothesis on the G field energy (GFE) after which it is assumed that the G energy comes not from the test bodies but from the G field. This is the same as to assume that, after the G work, the rest mass of a body is physically equivalent compared with the initial rest mass, before the G work, i.e., to assume that the CH is true.

In the Einstein's Centennial Symposium on Fundamental Physics, R Vera has been proved that both the CH and the GFE hypothesis are not consistent with wave continuity, which is a fundamental property of electromagnetic radiation [1]. To depend not on such hypothesis, he has proposed a new G theory based on a particle model made up of radiation in stationary state [2]. Such model is clearly consistent with the Michelson-Morley experiments and with the transformation of matter into radiation, and vice versa.

* rvera@udec.cl

A more fundamental test for the particle model can be done by assuming that bodies and standing waves had different inertial and gravitational properties. In principle such differences could be locally measured either after changes of velocity or after changes GPs, which would violate the Einstein's equivalence principle (EEP).

Effectively, it has been proven that the inertial and gravitational properties of the particle model agree with special relativity (SR), quantum mechanics and with all of the current tests for G theories[2] [3].

Below, the same G relationships and the same disagreements have been directly found from the new principle coming from the consistency condition of the EEP with the results of the genuine G time dilation (GTD) experiments that measure time intervals of non local (NL) clocks. They have been stated as *non-equivalence principle (NEP) for bodies located in different GP.*

Thus, by starting all over either from the NP or from the new G theory [2] [3], it is no longer necessary to depend on any arbitrary hypothesis because the NP is better defined and more general than the EEP. Thus the new universe scenario predicted by them is radically different from the traditional one. Thus it is not necessary to look for the origin and nature of the dark matter and of the radiation backgrounds of the universe because they come out, naturally, as the missing parts of the new kinds of evolution cycles that should be occurring in the universe.

The crucial results of the genuine gravitational time dilation (GTD) experiments

In the genuine GTD experiments, the time intervals of *clocks* located in different G potentials have been directly compared. They are crucial because their results cannot possibly be interpreted in terms of arbitrary hypotheses.

In the Hafele-Keating experiments, for example, several standard clocks were traveling, during a long time interval, in different G potentials. Their initial and final readings, made up in a common GP, were corrected according to SR, and finally compared to each other.

In other more accurate experiments, the information from the NL clock has been transmitted up to the observer by using electromagnetic radiation. Thus the time intervals between the arrivals of consecutive electromagnetic signals are measured. *Such values don't depend on the frequency of the radiation coming up to the observer*, i.e., they cannot be fairly interpreted in terms of changes occurring to the photons.

From the positive results of the GTD experiments it is concluded, definitively, that *two standard clocks located at rest in different GPs have different frequencies compared with each other, respectively. Such differences are linearly related to the differences of GP of the clocks.*

Then the GTD experiments have a single and well-defined interpretation which is in clear contradiction with the classical hypothesis on the absolute invariability of the bodies after a change of position with respect to other bodies.

Then, in general, the relative frequency of a NL clock with respect to some well-defined observer depends not only on its velocity but also on its GP with respect to the observer. Then the observer's position is most important. Here and in previous works, this one has been indicated by a subscript [2], [3].

Here, for simplicity, it is assumed that the GTD experiments are done by a single observer at rest in some well-defined radial position *A* of a static central G field.

In a previous step, such observer may throw upward a standard clock with some local kinetic energy that, from SR, is $DE_A = m_A(V,A) – m_A(0,A) = Dm_A(V)$, in which $m_A(0,A)$ is its local rest mass-energy, in energy units, at *A* The clock would stop in some NL position *B*, whose difference of GP with respect to the observer is $Df_A(B) = DE_A/m_A(0,A)$.

In a second step, a GTD experiment is made up just when the NL clock is at rest at *B*. The current result of such experiment is:

$$\frac{n_A(0,B)`-n_A(0,A)}{n_A(0,A)} = \Delta f_A(B) = \frac{\Delta E_A(B)}{m_A(0,A)} \qquad (1)$$

Here, the first member is called "the proportional difference of frequency of the clock at *B* with respect to the clock at *A*". This one turns out to be just equal to the dimensionless form of the difference of GP between the positions *B* and *A*. i.e., Dj/c^2

From this result is clear that:

- The clock at *B* is not equivalent to the clock at *A*, i.e., that the CH is wrong.
- The current relationships between quantities measured by observers in different GPs are physically "inhomogeneous" because their reference standards are not physically equivalent with respect to each other.

Discussion

It is often argued that *the positive results of the GTD experiments would be not due to real differences of frequencies of the clocks but to frequency changes occurring during the trips of photons traveling between them*.

This argument has nothing to do with GTD experiments because *the time intervals measured in such experiments are absolutely independent on the frequency of any photon that might be used in them*. This fact is obvious in the Hafele-Keating ones in which no electromagnetic signals were used at all.

Notice that in this argument, the GTD experiments, that don't depend on photon's frequencies, have been tacitly and arbitrarily replaced by G red shift (GRS) experiments that do depend on frequencies of photons. This last kind of experiments has no information on whether the frequency shift has occurred in the atoms or during the trip. This is a tacit way to use GR instead of real experimental facts.

Notice that this replacement is a way to change of theme so as to take advantage of the facts that the results of GRS experiments have been traditionally interpreted and predicted according to GR. However such prediction is the result of two consecutive errors.

1. *For the trip AB of the atoms, there is a classical error* of assuming that clocks at rest at *A* and *B* are physically equivalent with respect to each other. Such assumption is in contradiction with (5) that shows that there is a proportional difference of frequency of the NL clock at *B* compared with the clock at *A*,

which is equal to $+Df_A(B)$. The same proportional difference holds for the frequencies of any atom because, from the EEP, the local frequencies of atoms and clocks are related to each other by universal constants. Then all of them must change in identical proportion after any common circumstance.

Then, for the trip *AB* of the atoms and clocks, there is a classical error (sub estimation) of - $Df_A(B)$.

2. *For the trip BA of the radiation, there is a second error* of assuming that the frequency of the electromagnetic waves, with respect to the observer at *A*, would "increase". Such hypothesis is not consistent with the experiments on GTD because, from the point 1, the eigen frequencies of the *atoms at B already have the proportional blue shift of* $+Df_A(B)$ *compared with those of the atoms at A*. On the other hand, the blue shift found fom GRS experiment is just $+Df_A(B)$. *Then the frequency of the electromagnetic waves, with respect to the clock at A, is conserved during the whole trip.*

   The same conservation law can be demonstrated from wave continuity, which is the best tested property of electromagnetic waves [2].

   Then, for the trip *BA* of the radiation there is a traditional error (over estimation) of $+Df_A(B)$.

Since such errors are canceled out[†]*. Then it may be agued that such errors would be not important.*

The present work proves that, to the contrary, such errors are causing most of the problems in physics.

The new formalism fixed by the experimental facts

From above, to relate quantities measured by observers in different GPs, after strictly homogeneous relationships, all of them should be previously transformed to some common unit system of a strictly invariable (SI) observer whose reference standard does not change of GP and of velocity. This is equivalent to a flat (invariable) theoretical reference frame that can be used to describe all of the real physical changes that the non-local (NL) bodies and the NL space can have after changes of velocity and GP. Those due to changes of velocity can be derived from Lorentz transformations. Those due to changes of GP can be derived from new G transformations derived either theoretically or from experiments.

Notice that the new formalism is a plain extension of that used in SR.

The non equivalence principle for bodies in different G potentials

Here, the new principle results from the condition of consistency of the EEP with the results of the *NL experiments* in which bodies and observers are in different G potentials.

- From the EEP, all of them; the frequencies, the masses, the lengths and wavelengths, of any well-defined (uncharged) part of any local system are related to each other by universal constants.

[†] *This is not the first time in the history that a right prediction comes out after two errors of the same magnitude and opposite sign.*

- From GTD experiments it has been found, definitively, that the clocks located in different G potentials are not physically equivalent with respect to each other. Their differences are linearly related to their corresponding differences of GP.

Then a general condition of consistency of the EEP with the GTD experiments is that, after a change of GP of a measuring system, *the basic variables of all of its well-defined parts, like their frequencies, masses and lengths, change linearly, in a common proportion, compared with those of any SI observer that has not changed of GP. From (1), the proportional changes are just equal to the change of GP*:

$$\frac{\nu_A(0,B)-\nu_A(0,A)}{\nu_A(0,A)}=\frac{m_A(0,B)-m_A(0,A)}{m_A(0,A)}=\frac{\lambda_A(0,B)-\lambda_A(0,A)}{\lambda_A(0,A)}=\frac{\Delta E_A}{m_A(0,A)} \quad (2)$$

In (2), the symbols $\nu_A(0,B)$, $m_A(0,B)$, and $\lambda_A(0,B)$ may be any frequency, mass-energy, length or a wavelength, of any isolated part or photon in stationary state of the NL system at rest at *B* with respect to the observer at rest at A, respectively. This may be called the *non equivalence principle (*NEP*) for bodies located in different G potential*. According to it:

This principle is more general than the EEP because it is also valid for the NL cases in which "*bodies and observers are in different GP*". It corresponds with the EEP in any local case in which the difference of GP between the NL object and the observer tends to zero.

Notice that, to the contrary of the EEP, the NEP shows that

1. Some real (absolute) physical differences exist between bodies in different GP, i.e., the CH, is wrong.
2. The properties of a NL body, with respect to any SI observer, depend on the difference of GP between the body and the observer.
3. The *current relationships* between quantities measured by observers at rest in different GP *are inhomogeneous* because their reference standards are physically different compared to each other.

From the 2nd and the last member of (2):

$$\Delta E_A=\Delta m_A(0,B)=m_A(0,B)-m_A(0,A) \quad (3)$$

4. "*The energy released during G work comes not from the G field but from the transformation of a fraction of the mass of a body into free energy*".

   During a free fall from *B* to *A*, special relativity can be applied locally at *A*, just before the stop at *A*. If $m_A(V,A)$ is the relativistic mass of the moving body with respect to the observer at *A*, then, from SR and (3)

$$\Delta E_A(B)=m_A(V,A)-m_A(0,A)=m_A(0,B)-m_A(0,A) \quad (4)$$

$$m_A(0,B)=m_A(V,A)=\text{Constant} \quad (5)$$

5. "*During a free fall, the relativistic mass of a NL body, with respect to an observer at rest in a well-defined potential, remains constant*" (mass-energy conservation law for NL bodies with respect to SI observers).

Either from (3) or from (5), it is clear that, to the contrary of GR, the *G field does not give up energy to the body*. The same holds for radiation because during its propagation in a conservative field, according to wave continuity, its frequency with respect to any SI observer is conserved.

The above results also admit a general check because it is clear that a static G field does not move altogether with the test bodies, i.e., that during the G work; the G forces remain strictly static. Then *they cannot do a real work because there is not a real displacement of their application points*.

The new gravitational theory based on a particle model

The NEP also provides a new justification and a global test for the new gravitational theory based on a particle model, proposed by Vera [2]. This is because any photon in stationary state between well-defined parts of the same system is also a well-defined part of it. According to the NP, it must obey the same inertial and gravitational laws as any other particle. In principle, any discrepancy could be detected, locally, thus violating the EEP.

Then uncharged bodies can be emulated by particle models made up of standing waves within perfect mirrors. In this way the inertial and gravitational properties of the bodies can be derived by using elemental properties of electromagnetic waves. Thus the new theory provides straightforward explanations for the inertial and G phenomena with *a complete agreement with the conventional G tests* [2].

Then, if $\nu_A(0,B)$ and $\lambda_A(0,B)$ are the frequency and the wavelength of a NL particle model at rest at *B* with respect to the observer at A, then the speed of NL light at *B* with respect to the observer at *A* is:

$$c_A(B) = \nu_A(0,B)\,\lambda_A(0,B) \tag{6}$$

Then, from (2) and (6),

$$\frac{\Delta\nu_A(0,B)}{\nu_A(0,A)} = \frac{\Delta m_A(0,B)}{m_A(0,A)} = \frac{\Delta\lambda_A(0,B)}{\lambda_A(0,A)} = \frac{1}{2}\frac{\Delta c_A(B)}{c_A(A)} = \Delta\varphi_A(B) = \frac{\Delta E_A(B)}{m_A(0,A)} \tag{7}$$

This equation is identical to that found from the new G theory [2].

From equation (7), it is clear that the G field has a gradient of the refraction index of the NL space with respect to observers in a fixed GP, i.e., *gravitation is caused by a refraction phenomenon*. According to wave continuity, the refraction phenomenon does not change the frequency of radiation, i.e., *there is not an energy exchange between photons and the dielectric*. Thus:

- The *gravitational refraction* accounts, directly for the lack of energy exchange between the G field and the radiation, found above either from wave continuity or from combining experiments on GTD and GRS.

- The same phenomenon accounts for (5), i.e., for the constant mass-energy of the NL bodies, with respect to any SI observer, occurring during a free fall or a free orbit [2], [3]. Refraction occurring during the round trips of the model waves, accounts for the momentum changes without a net frequency (color) change, i.e., without energy exchange with the G field.

The new universe fixed by the new principle and the new theory

The standard cosmology is also based on the CH because it is assumed that GR is right and that during universe expansion, the bodies don't expand themselves after the increase of GP produced by the general increase of distances. Such hypotheses are in contradiction with the phenomenon of "gravitational" expansion predicted from the NEP and equation (7).

It has been argued that the bodies would not expand due to the strong interaction forces within the structure of particles. But such argument is not valid for the G expansion fixed by Eq. (2) because it comes from the EEP and NL *experiments whose results are independent on the structure of the bodies*.

Assume, as a trial hypothesis, that the reference rod of some observer does not expand during universe expansion. If this were true, after a time interval Δt, the proportional increase of all of the distances would be the same and equal to $H\Delta t$. Then it is simple to find that the proportional increase of GP at the observer's place would be,

$$\Delta f = \frac{\Delta r}{r} = H\Delta t \qquad (8)$$

Then, from (2) and (8), it is found that the particle model would expand itself in the proportion:

$$\frac{\Delta l}{l} = \frac{\Delta r}{r} \qquad (9)$$

Then it is concluded that the trial hypothesis is wrong. *It is not possible to find a reference standard, or reference frame, that does not expands in the same proportion as any other distance of the universe*. Thus, paradoxically, a global universe expansion cannot increase any "measured" distance, velocity or "*cosmological red shift*" because the measuring rods must expand themselves in just the same proportion. *From the relative (measurable) viewpoint, the average universe must look like it is frozen, static, for ever, i.e., like its age is infinite.*

The same result comes out, more directly, after emulating every part of the universe by particle models. By using the Huygens's principle it found that the photons and particles must be the result of constructive interference of wavelets traveling rather indefinitely in the universe. From Doppler shift, a universe expansion would stretch every wavelet in just the same proportion without changing the net number of waves between the particles, i.e., without changing any local ratio or proportion anywhere in the universe. This puts on relief that the use of wavelets in different branches of physics can provide more simple and unified explanations for the physical phenomena.

The new kind of "linear" black hole (LBH)

The strict linearity of the new field equations eliminates the odd singularity produced by the non linear equations of GR. Thus the new kind of *linear black hole* (LBH) is necessarily different and simpler than the traditional "black hole".

This one turns out to be just a huge macronucleus, made up of very low mass neutrons compared with neutrons at infinite, with a strong gradient of the refraction index of the NL space around it. Thus the phenomenon of "*critical reflection*" should prevent the escape of photons and nucleons [2].

On the other hand a LBH must be an efficient absorber of particles and radiation coming from the rest of the universe. Thus, after cleaning up the external space from gas and particles, the average mass-energy per nucleon of the LBH, with respect to an observer at infinite, must increase with the time until it becomes equal to the mass of a free neutron far away from it. During this period, the LBH should be a site in which the entropy decreases with the time. After that, neutrons can escape, collectively, because from (5) the mass-energy of neutrons traveling away from the LBH, with respect to an external observer, is constants. After that, its nucleons can escape "collectively", decaying into a cloud of H gas. Thus this macro nucleus can explode (decay), adiabatically with the generation of a rather cool cloud of new hydrogen gas. The new gas, mostly hydrogen (H) rather free from metals, can be captured by other cool bodies that would become new stars. This process can generate new clusters of stars, or galaxies, with high proportions of randomly oriented angular momentum generated from the LBH explosion. These characteristics are consistent with those of some *elliptical galaxies*.

The evolution cycles in the universe

From above it is inferred that there are no restrictions of time for the cyclic evolution of matter between the states of H gas and LBH, and vice versa.

Then, within a galaxy an appreciable fraction of matter can be evolve in a rather closed matter cycle. Consequently a galaxy can also be evolving, indefinitely, in a rather closed cycles with luminous and dark periods. The luminous periods must end when the whole galaxy has run out of available energies, i.e., when it becomes a set of LBHs surrounded by a dark galaxy. The dark periods would end when the LBHs have absorbed energy enough to explode.

The luminous periods of a galaxy should start after a chain of LBH explosions occurring in a dark galaxy. The new gas must convert its dark bodies into luminous ones, and so on. Then such period must start in the form of an "elliptical galaxy" with a high proportion of clean H with angular momentums of random orientations generated by the LBH explosions. After that, the number of dead stars and dark bodies would increase with the time. Thus the recently formed galaxies can also be recognized by the minimum percentages of metals and *dark bodies*.

With the time, statistically, the angular momentum of stars with random orientations, generated after the LBH explosions, should be cancelled out faster than the angular momentum of preferred orientations coming from more massive bodies of the earlier dark galaxy. Then the radius of the spherical halo of lower density stars should decrease at faster rates compared with the more massive ones coming from the dark period, closer to the galactic plane.

Then elliptical galaxies should take the forms of disk *and spiral galaxies in which the fraction of dark bodies resulting from stellar evolution must increase with the time.*

The last luminosity of a galaxy should come from a small volume near the central LBHs. Due to its low GP, it would emit light with a high GRS. It must be surrounded by the rest of the galaxy, which may be called "*dark galaxy*" or "host galaxy". Such luminosity should correspond with the genuine "quasi stellar radio sources" (quasars). They must be not confused with galaxies of high cosmological red shifts.

During the dark period of a galaxy, the last traces of gas or plasma must be captured by the more massive and dense bodies, thus producing high energy cosmic and gamma radiation. After that, there is no much G energy that can be transformed into electromagnetic radiation. Since a dark galaxy cannot emit gravitons, because G fields have no energy, then it cannot collapse. Thus, for a long period, the LBHs can recover the energy lost during the luminous period of a galaxy.

Statistically, after the rather infinite age of the universe, the different evolution phases of the galaxies and clusters should be rather uniformly distributed in the universe in a proportion fixed by their corresponding periods. Due to the small capture cross sections of the LBHs, the dark period, necessary for recovering the energy lost during the luminous period of a galaxy, must be of a higher order of magnitude than the luminous one. Then, statistically, the number of dark galaxies must also be of a higher order of magnitude compared with the number of luminous ones, i.e., *most of the galaxies of the universe should be in their cool and dark periods*.

Clusters can also evolve in rather closed cycles because the higher energy released by a new luminous galaxy should accelerate the regeneration of other nearby galaxies. Thus the regeneration of galaxies can occur in chains that are consistent with clusters of luminous galaxies and cluster of dark ones (apparent voids).

Then dark galaxies and dark clusters should account for most of them: the low temperature black body radiation background, the high energy radiation background, the iron content of gamma background, and the anomalous velocities of luminous galaxies observed in the intergalactic space.

Thus galaxies in radically different phases of different cycles can be "relatively close with respect to each other", in the space, now and in any time. This is solves a fundamental problem of astrophysics, which is that bodies with large difference of estimated "ages" are relatively close with respect to each other, everywhere in the universe.

In the new predicted scenario, the different evolution stages of the luminous period of the galaxies should be consistent with the different types of galaxies, according to the current classification.

The apparent problem is that the dark galaxies are not present in the current classification of galaxies just because they are not visible in ordinary telescopes.

However they should be present in the sky. They should account for the missing mass of the universe and for the different kinds of radiations coming from the intergalactic space.

Conclusions

To understand the nature and the origin of the dark matter in the universe, it is necessary to eliminate, first of all, some traditional errors that are causing most of the problems in astrophysics and cosmology.

Such errors come from the classical hypothesis on the absolute invariability of the bodies, after a change of GP, which also comes from a wrong interpretation of the EEP. Such hypothesis is not consistent either with the wave properties of radiation or with NL experiments in which bodies and observers are in different GP.

Then it is indispensable to start all over from a new formalism and a new principle that is simultaneously consistent with the EEP and the NL experiments. The same results come up from the theoretical properties of a particle model. They new relationships fixed by the EEP are strictly linear. Obviously, they are not consistent with the G field energy hypothesis of GR.

Then the new kind of black hole has fundamental differences compared with the traditional one. It has no singular regions so that the ordinary physical laws are not violated anywhere. For a long period they can absorb radiation coming from the rest of the universe until the explosion conditions are reached. This last process makes possible the generation of the new gas that can transform a dark galaxy into a luminous one.

On the other hand, the universe expansion is radically different from an ordinary explosion because, the increase of GP produced by the general increase of distances must produce a G expansion in just the same proportion. Thus it is not possible to find a standard rod that does not expand in the same proportion as any other distance of the universe. Then, in a first approximation, the universe age must be infinite.

In the new scenario of the universe, the galaxies should have been evolving, from long ago, in rather closed cycles with luminous and dark periods.

After such long time, statistically, the different phases of the evolution cycles of the galaxies should be present in the universe, in the proportion given by their corresponding periods. Each phase, also, should be rather uniformly distributed in the universe.

The LBHs formed mostly during the luminous periods would also play a fundamental role for absorbing energy from the host dark galaxy and from the rest of the universe, i.e., for entropy conservation in the universe. Such dark periods must be the longest ones. Thus, statistically, most of the universe must be in the state of dark galaxy, which should account the missing mass of the universe and for the higher velocities of galaxies in clusters.

The low temperature CMB should come from the blackbody radiation of the largest fraction of the universe that must be in the form of cool galaxies that are absorbing energy from the rest of it.

The high energy cosmic radiation background should come from the last atoms and particles falling into the neutron stars of the dark galaxies. They are consistent with the mechanism of neutron stripping with rejection of charged particles [2], [3].

The metal lines in the gamma radiation coming from the intergalactic space are consistent with the higher proportion of metals in the dark galaxies.

References

1. R.A. Vera. *Proceedings of the Einstein Centennial Symposium on Fundamental Physics*. Eds. S. M. Moore et al, Universidad de Los Andes. Bogotá, G. Violíni, Universitá di Roma, p. 597-625 (1981)
2. R. A. Vera. *International Journal of Theoretical Physics*. **20** p. 19-50 (1981)
3. R. A. Vera. "*The New Universe Fixed by the Equivalence Principle and Properties of Light*:" (Ed. R. Vera. Universidad de Concepción Concepción. Chile. <rvera@ udec.cl> (1997)