Acknowledgments and Apendixes

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I apologize because I may have not cited works of other authors that may have some common ideas with the present work. I have not had time to read much of the high volume of specialized literature. Otherwise I could have not been able to do this work.

APPENDIX A : THE PARTICLE MODEL MECHANICAL WAVES

Model moving longitudinally

Let us call $n^{+}(b,x)$ and $n^{-}(b,x)$ to the NL frequencies of the forward and the backward components of a model with respect to the observer, respectively. Let us call the *NL frequency of the moving model, n(b, x),* to the sum of the frequencies of the model components. This one is equal to

$$n(b,x) = n^{+}(b,x) + n^{-}(b,x) \qquad \text{A1}$$

From Doppler shift, or wave continuity, the number of waves reflected forward and backward by the model mirrors have the values[1]:

$$n^{+}(b,x) = \frac{1}{2}n(b,x)[1+b] \quad ; \quad n^{-}(b,x) = \frac{1}{2}n(b,x)[1-b] \qquad \text{A2}$$

The *amplitudes* of these waves are normally written as the real terms of complex functions of exponential forms, like:

$$y^{+}(x,t) = A\exp\left\{iw^{+}(b,x)\left[t+\frac{x}{c}\right]+p\right\} \quad \text{and}$$

$$y^{-}(x,t) = A\exp\left\{iw^{-}(b,x)\left[t-\frac{x}{c}\right]\right\} \qquad \text{A3}$$

$$w^{+}(b,x) = 2pn^{+}(w,x) \qquad \textit{and} \qquad w^{-}(b,x) = 2pn^{-}(w,x) \qquad \text{A4}$$

From A3 and A4, the sum of the amplitudes of the model waves turns out to be equal to the product of two wave functions, according to:

$$\Psi(x,t) = y^{+}(x,t) + y^{-}(x,t) = 2Ai\cos(w_1 t - k_1 x)\sin(w_2 t - k_2 x) \qquad \text{A5}$$

Their angular frequencies are related to each other by:

$$w_1 = 2pn(b,x) \qquad \textit{and} \qquad w_2 = 2p\Delta n(b,x) = w_1 b \qquad \text{A6}$$

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1 These trivial values can be checked after substituting them in C1

and their corresponding wave numbers are:

$$k_1 = 2p\,\frac{\Delta n(b,x)}{c} = \frac{2p}{l(b,x)}b \quad ; \quad k_2 = 2p\,\frac{n(b,x)}{c} = \frac{2p}{l(b,x)} = \frac{k_1}{b} \qquad \text{A7}$$

Since the energy is proportional to the square of the amplitude, from A5, the average probability for finding the energy in a giving space-time interval:

$$\Psi\Psi^* \propto \sin^2(w_2 t - k_2 x)\cos^2(w_1 t - k_1 x) \qquad \text{A8}$$

The velocity of the first wave is, obviously, *the model velocity*.

$$V(x) = {w_2}/{k_2} = b\ c \qquad \text{A9}$$

The second wave is just *the De Brogue wave*, whose velocity is:

$$w(b,x) = \frac{w_1}{k_1} = \frac{c}{b} \quad ; \quad w(b,x)V(x) = c^2 \qquad \text{A10}$$

This *wave* has a wavelength

$$l^*(b,x) = \frac{w(b,x)}{n(b,x)} = \frac{c}{n(b,x)b} = \frac{l(b,x)}{b} = \frac{hc^2}{hn(b,x)V(x)} = \frac{h}{p(b,x)} \qquad \text{A11}$$

Then the strict correspondence with quantum mechanics is obvious.

APPENDIX B:

NONLOCAL MASS-ENERGY-FREQUENCY-CONSERVATION FROM GRAVITY EXPERIMENTS

Free atoms have well defined spectrums and natural oscillations. According to the EP, the ratios between their frequencies are related each other by well defined universal constants. Thus in principle any well defined natural oscillation can in principle be used as a basic clock for the definitions of the local units of all of them: *time, frequency, energy and mass units*.

Ordinarily, for example, exact time measurements are normally made with *atomic clocks* whose periods are controlled by some well defined atomic oscillations. Their periods and frequencies are related to each other and to those of their optical spectrums by universal constants.

According to the Explicit Equivalence Principle, the energy emitted by an atom (*DE*)is a well defined *fraction* of its total atomic rest mass-energy, $E = M_{r.}(0,r^*)$. Such fraction (*DE/E or DE/m*) is *non dimensional* and, therefore, it is *independent on the measuring units used*. This means that the same ratio holds for other NL observers that have different unit systems.

$$\frac{\Delta E(joule)}{E(joule)} = \frac{\Delta m(joule)}{m(joule)} = \frac{hn_{r*}(0,r^*)}{m_{r*}(0,r^*)} = \frac{1}{k} = \frac{hn_r(0,r^*)}{m_r(0,r^*)} = \frac{hn_{r*}(0,r)}{m_{r*}(0,r)} \qquad \text{(B1)}$$

For example, we can choose a particle model whose mass-energy is just equal to the energy emitted by some well defined photon of a standard atom.

Self-consistency test for the gravitational tests

Let us put together the basic tests for gravity after using a strictly homogeneous physical language. For this purpose let us use the results of experiments for gravitational time dilation and gravitational fall, according to the Explicit Equivalence Principle.

In these experiments, most of the times the observer is in the ground and the objects are at some height H over the ground. Thus the observed effects in the first kind of experiments should be called, more properly, *G time contraction* (or *G blueshift*).

In the *G time contraction experiments*, the time intervals of NL clocks, at some height H over the observer are compared with those of the observer clock after using electromagnetic radiation. Since the observed time interval is so long compared with the fly time of the signals, *the results of such experiments are entirely independent on any eventual change or delay that the radiation can have during its trip throughout the field gradient*. These delays, anyway, are canceled out in the difference of time, called *time intervals*. Then we can be sure in that *the difference of time observed is not due to the time delay or any other kind of change occurring to the radiation during the trip.*

For homogeneity reason, the results of these experiments must be given in the unit system of the single observer in some well defined position r^*, based on the clock at r^*. Since no fly times come into play, therefore, the observed time interval corresponds to the real NL time intervals with respect to the observer at r^*. This is called $T_{r*}(0,r)$. Then the results of the measurements, written homogeneously, are given by:

$$\frac{\Delta T_{r*}}{T_{r*}} = \frac{T_{r*}(0,r) - T_{r*}(0,r^*)}{T_{r*}(0,r^*)} \approx -\frac{gH}{c^2} \qquad \text{(B2)}$$

in which g and H are the acceleration of gravity and the height of the fall, respectively.

From the results of these experiments it may be concluded, definitively, that

" The atoms and clocks oscillations at r + H have higher frequencies compared with the local ones at r*", i. e., the time units at r* + H are smaller than that of the observer at r*" . This is called "blue redshift"*

Since the frequencies are just equal to the inverse of the periods, then , the frequencies of the atoms at rest at r should be blueshifted with respect to those at r„*

$$\frac{\Delta n_{r*}(0)}{n_{r*}(0,r*)} = \frac{n_{r*}(0,r) - n_{r*}(0,r*)}{n_{r*}(0,r*)} \approx -\frac{\Delta T_{r*}}{T_{r*}} \approx \frac{gH}{c^2} \qquad \text{(B3)}$$

Since this is just the value obtained from the *gravitational redshift experiments*, then it may be concluded that "*all of the observed G blueshift is due to G time contraction occurring in the light sources". This rules out any appreciable shift of the NL frequency of light occurring during light trips*, within the experimental range of errors. Otherwise the observed blue shift should be different from that given by (B3). Then the experiments also prove that:

The NL frequency of free light remains constant during its trip through G fields.

(*Nonlocal frequency conservation law for free radiation's)*

But equation B3 is just equal to the energy per unit of mass-energy released, locally, during the stop, after a free fall of any body from *r* + H* and *r**. According to SR, locally, this one may be written as[2]

$$\frac{m^{mks} gH}{m^{mks} c^2} = \frac{\Delta E_{r*}(r*)}{E_{r*}(r*)} = \frac{m_{r*}(b,r*) - m_{r*}(0,r*)}{m_{r*}(0,r*)} \qquad \text{(B4)}$$

After using the EEP or E4.5b, B1 and B4 this relation can be written in the forms:.

$$\frac{n_{r*}(0,r) - n_{r*}(0,r*)}{n_{r*}(0,r*)} = \frac{m_{r*}(0,r) - m_{r*}(0,r*)}{m_{r*}(0,r*)} \approx \frac{m_{r*}(b,r*) - m_{r*}(0,r*)}{m_{r*}(0,r*)} \qquad \text{(B5)}$$

After comparing the two last members,

$m_{r*}(b,r) = m_{r*}(0,r*)$ NL mass-energy conservation during a free fall (B6)

2 Here $\Delta E_{r*}(r)$ is just the energy released during the stop and m^{mks} it the mass in the mks unit system, $E_{r*}(r*) = m^{mks} c^2 = m_{r*}(0,r*)$. This one is the relativistic energy equivalent of the current mass, called here mass-energy or just mass.

From B6 it may be inferred that

1.The NL mass-energy of the free falling body remains constant during a free fall. (NL mass-energy conservation law for free bodies in G fields)

2.The external field does not give up energy to the body. Otherwise, its NL (relativistic) mass should increase. This contradicts the current beliefs in that G fields give up the energy during the fall

3.Due to the mass-energy given away during the stop, the NL rest mass at $r*$ is smaller than that at $r* + H$. The NL rest-mass of a body depends on its position,.

4.In general, all of them, the NL frequencies, the NL masses and the NL energies of nonlocal bodies at a height H over the observer turn out to be blue shifted, with respect to the observer at $r*$, by the common factor $1+gH/c^2$. This factor accounts for the higher relativistic mass of the atoms observed at the end of the fall, just before the stop.

APPENDIX C:

NONLOCAL FORCES IN GRAVITY

According to quantum vector conservation, in order that the model may be at rest with respect to the observer, the sum of its quantum vectors with respect to the observer must be permanently null. The same holds for a model body made up of many particle models. If the system is made up of two bodies, for example[3],

$$\mathbf{Q}_{r*}(0,r) = \mathbf{Q}^1_{r*}(b^1,r^1) + \mathbf{Q}^2_{r*}(b^2,r^2) = 0 \qquad \mathbf{Q}^1_{r*}(b^1,r^1) = -\mathbf{Q}^2_{r*}(b^2,r^2) \qquad \text{C1}$$

Since *the NL quantum vectors of the two bodies must have the same absolute values and opposite signs*, then, from E3.9 and C1, the NL momentums, their NL velocities and their NL masses are related to each other and with the average NL speed of light, by::

$$\mathbf{p}^1_{r*}(b^1,r^1)c^1_{1r*} = -\mathbf{p}^2_{r*}(b^2,r^2)c^2_{r*} \qquad m^1_{r*}(b^1,r^1)\boldsymbol{b}^1 = -m^2_{r*}(b^2,r^2)\boldsymbol{b}^2 \qquad \text{C2}$$

$$\frac{b^1}{b^2} = -\frac{m^2_{r*}(b^2,r^2)}{m^1_{r*}(b^1,r^1)} \quad ; \quad \frac{V^1}{V^2} = -\frac{m^2_{r*}(b^2,r^2)c_{r*}(r^1)}{m^1_{r*}(b^1,r^1)c_{r*}(r^2)} \qquad \text{C3}$$

Notice that in G fields, to the contrary of other kind of fields, *the NL momentum's of the two bodies are not necessarily equal to each other*. This may be important, for example, in binary stars that have large differences of masses so that the differences of the NL speed of light produced en each body in the space of the other one may be large. In such cases they would be traveling in fields of different G potentials. i. e., in regions of different average NL speed of light[4].

From C1, any change *the rate of change of the NL quantum vectors* of one body should be associated with the corresponding rate in the one of the other body, in same proportions and in opposite sense:

$$\frac{d\mathbf{Q}^1_{r*}(\boldsymbol{b}^1,r^1)}{dt_{r*}} = -\frac{d\mathbf{Q}^2_{r*}(\boldsymbol{b}^2,r^2)}{dt_{r*}} \qquad \text{C4}$$

This is similar to the *action-reaction law.* For simplicity I call it by the same name:

$$\mathbf{A}_{r*}(\boldsymbol{b},r) = \frac{d\mathbf{Q}_{r*}(\boldsymbol{b},r)}{dt_{r*}} = \frac{d\left[\mathbf{p}_{r*}(\boldsymbol{b},r)c_{r*}(r)\right]}{dt_{r*}} \qquad \text{C5}$$

In a free fall, for example, where NL mass with respect to a fixed observer is constant,

$$A_{r*}(\boldsymbol{b},r) = m_{r*}(\boldsymbol{b},r)\frac{d\boldsymbol{b}}{dt} \approx \mathbf{F}(\boldsymbol{b},r)c_{r*}(r)\ ; \qquad \text{C6}$$

From C4 , the NL action-reaction law can be written in the form

$$\mathbf{A}^1_{r*}(\boldsymbol{b}^1,r^1) = -\mathbf{A}^2_{r*}(\boldsymbol{b}^2,r^2) \quad ; \quad \frac{d\left[\mathbf{p}^1_{r*}(\boldsymbol{b}^1,r^1)c^1_{r*}(r)\right]}{dt_{r*}} = -\frac{d\left[\mathbf{p}^2_{r*}(\boldsymbol{b}^2,r^2)c^2_{r*}(r)\right]}{dt_{r*}} \qquad \text{C7}$$

In NL cases in G fields, the NL speeds of light in the locations r^1 and r^2 are not exactly the same with respect to each other. Then, from C7, the NL action and reaction "*forces*", *defined as dp/dt*, are not exactly the same. However the differences are rather negligible.

In the local and nonlocal cases, in static central fields, the gradient of the NL mass-energy of the model *at rest* with respect to the observer corresponds with the *NL gravity force*. From E5.1,

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3 The superscripts 1 and 2 is just a label to make clear which of the two bodies is involved.

4 Here, most of the times the observer is at rest with respect of some system made up of a large central mass and a small test model. Thus the changes of velocity of the central mass and the changes of NL speed of light induced by the test model into the central one are negligible. The observer is at rest relative to the system, i. e., with respect to its mass-center.

$$F_{r*}(0,r) = -\frac{dm_{r*}(0,r)}{dr} = -m_{r*}(0,r)\frac{df(r)}{dr} = -\frac{GM_{r*}(0,r^{o})m_{r*}(0,r)}{r^{2}} \qquad \text{C8}$$

After using Newtonian masses, in the *mks* system, and C5.32

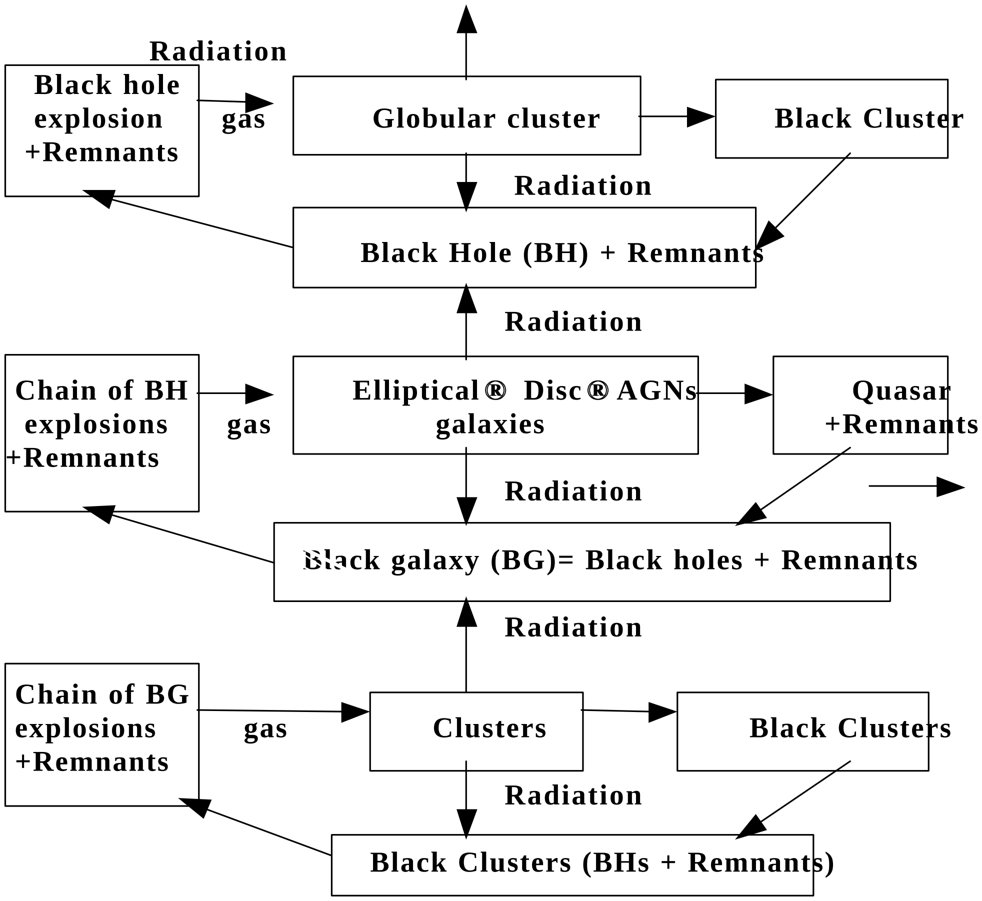
$$F_{r*}(0,r) = -\frac{G^{new}M^{new}{}_{r*}(0,r^{o})m_{r*}^{new}(0,r)}{r^{2}} \qquad \text{G}^{\text{new}} = Gc^{4}\,; \quad m^{new} = \frac{m}{c^{2}} \qquad \text{C9}$$

$$F_{r*}(0,r) = -m_{r*}(0,r)\frac{df(r)}{dr} = \frac{m_{r*}(0,r)}{c_{r*}^{2}(r)}g_{r*}(0,r) = m_{r*}^{new}(0,r)g_{r*}(0,r) \qquad \text{C10}$$

This corresponds with the Newton gravitational law for bodies at rest with respect to the observer.

Diagram

The Main Macro-Cycles in the Universe



Most of the matter in the universe must be in the state of black hole that absorbs net energy from the space. This should account for <u>the low temperature radiation background</u>.

All of the evolution stages of a matter cycle have been detected, directly or indirectly in astronomy. No one is missing, within the actual detection possibilities. This seems to be a fair test for the EEP.