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6. CORRESPONDENCES WITH PHYSICS AND EXPERIMENTS

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In spite of the high simplicity of this theory, compared with General Relativity, it fits with a wide range of experimental facts in different branches of physics. The main correspondences are:

6.1 Correspondence with Fundamental Physics

It is simple to verify that the basic conservation laws derived from general properties of the radiation are in strict agreement with those of fundamental physics.

On the other hand, it is proven that the current conservation laws are not well defined in gravitational fields unless that a well-defined and fixed unit system, based on a strictly invariable standard, is used.

The agreement with the special theory of relativity, observed above, is complete. This is an obvious consequence of the fact that the present theory is also based on the equivalence principle.

6.2 Quantum Mechanical Tests

The model properties, derived in *Section **3***, account for the basic equations of *Quantum Mechanics*.

The model also provides a simple and fair explanation of the dual properties of particles.

On the other hand, the use of wavelets also provides a unified explanation of properties of photons and particles. They can eventually used to understand Quantum Electrodynamics.

6.3 Gravitational Tests

6.3.1 Correspondence with Conventional Gravity Theories

It is simple to verify that, in weak fields, the first order approximations of all of the equations derived in *Section 4 and Section 5* are in strict correspondence with the conventional gravity theory.

On the other hand, the differences with General Relativity can only be detected in stronger fields. Unfortunately, the current tests have been done in too weak fields.

In a central G field, the G potential used here (in the *meter-joule*-second) can be transformed to the *mks* system after E5.3,

$$f(r) = -\frac{GM}{r} + \text{constant} = -\frac{G^{new} M^{new}}{rc^2} + \text{constant} \quad . \qquad \text{E6.1}$$

In which $G = G^{newt}/c^4$. In a central G field, according to E5.27, the theoretical changes of the NL periods and NL frequencies of light sources located at a $r^* + H$, with respect to the observer at r^* are given, in a first approximation, by:

$$\frac{\Delta n_{r^*}(0,r)}{n_{r^*}(0,r^*)} = -\frac{\Delta t_{r^*}}{t_{r^*}(0,r^*)} = \frac{1}{2}\frac{\Delta c_{r^*(r)}}{c_{f^*}(r)} \cong \left[\frac{GM}{r^2}\right] H \cong \frac{G^{new} M^{new}}{r^2 c^2} H \cong \frac{gH}{c^2} \qquad \text{E6.2}$$

6.3.2 Gravitational Time Dilation (GTD)

The famous gravitational time dilation experiments of Maryland, in 1976, were made up with atomic clocks in airplanes flying at great height. They clearly showed that clocks located in different G potentials run, permanently, with different speeds with respect to each other. After subtracting the well proved relativistic effect, the differences of time of the clocks were in good agreement with E6.2. Actually, the lectures of the clocks orbiting around the earth are systematically corrected for GTD.

In all of these experiments, the time of fly of the radiation used for comparing the time intervals is obviously canceled out in the differences of time. Anyway, such fly time are negligible compared with the time intervals.

Then, from the Gravitational Time Dilation experiments is inferred that

This phenomenon has nothing to do with anything occurring during the trip of the radiation's throughout the G field gradients.

The Gravitational Time Dilation is due, exclusively, to differences of the happening rates occurring in different G potentials.

6.3.3 Gravitational redshift occurring in nonlocal light sources

Pound and Rebka, in 1960, and Pound and Snider[13] in 1965 have verified the *gravitational redshift* equation given by first and the last member of E6.2.

They used the Mossbauer effect with gamma radiation. This one makes possible to measure very small differences of frequencies.

For the height of *22.5 m* used in these experiments, the value predicted by E6.2 is $2.45 \times 10^{-15} + 9 \times 10^{-30}$ and the one predicted by GR is $2.45 \times 10^{-15} + 3 \times 10^{-30}$. The differences between these predictions, of 6×10^{-30}, cannot possibly be detected in this kind of experiments.

6.3.4 Gravitational refraction

In Fig. (6.1), *AB* is the trajectory of a photon in the field of a massive body M.

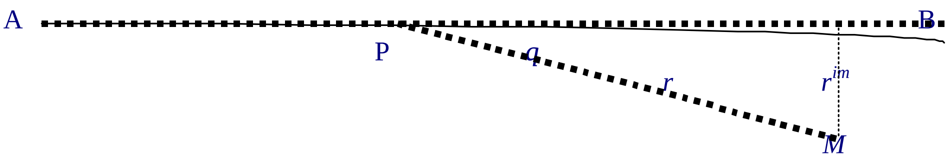

Fig. 6.1. *Deviation of light by the central G field of a mass M.*

According to E5.46, E5.27 and E6.1, the photon deviation between *r* and *r + dr* is:

$$d\alpha = \frac{d\lambda}{\lambda}\tan\theta = \frac{2GMdr}{r^2}\tan\theta \qquad \text{E6.3}$$

Since $d\alpha$ is very small, the value of *r* can be approximated to $r = r^{im}/\sin\theta$, in which r^{im} is the *impact parameter, i. e,* the minimum distance to M for a straight trajectory. After changing the variable *r* by θ, the net deviation obtained from integration of E6.3, is:

$$\alpha \cong \frac{2GM}{r^{im}}\int_{-\pi/2}^{\pi/2}\sin\theta\, d\theta \cong \frac{4GM}{r^{im}} \qquad \text{E6.4}$$

This is just the value obtained from the experiments on light deviation by the Sun field[14].

6.3.5 Time delay of radar echoes from planets or space probes

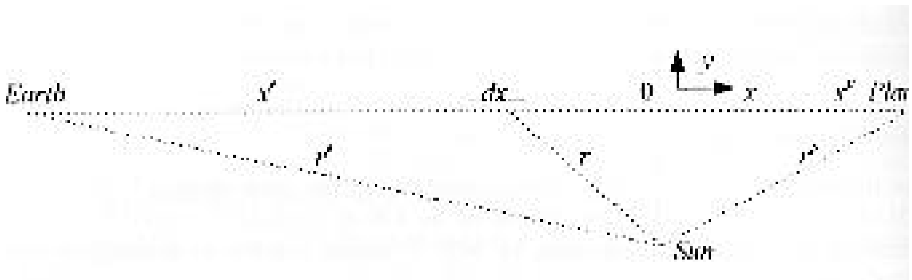

Fig. (6.2). *Experiment on time delay of radar echo due to the Sun G field.*

In these experiments, radar waves have been sent to a planet or a space probe traveling near occultation by the Sun. In this way the radiation in its back and forward trip travels, in the average, closer to the Sun.

In principle, the time delay of the reflected echo, due to the lower NL speed of light traveling back and forth, can be measured in the earth. The theoretical *NL time* can be derived according to E2.1, E5.6 and E6.1, after integration

$$\Delta t_{re} = 2\int_{x^e}^{x^p} \frac{dx}{c_{r*}(r)} \cong 2\int_{x^e}^{x^p} \frac{dx}{c\exp[\frac{GM}{r^e} - \frac{GM}{r}]} \cong \frac{2}{c}\int_{x^e}^{x^p} [1+\frac{2GM}{r}]dx$$ E6.5

$$\Delta t_{r*} = \frac{2(x^e + x^p)}{c} + \frac{4GM}{c} Ln \frac{r^p + x^p}{r^e - x^e}$$ E6.6

in which x^e and x^p are the NL distances along the line of flight from the earth to the planet, respectively, to the point of the closest approach to the sun. This relation fits with the results of the experiments of Shapiro[15] and Anderson[16].

6.3.6 Orbits of planets and their perihelion shifts

The form of the differential equation for the planets orbits can be derived from the triangle AA'C of Fig.(5.1)

$$AA'^2 = CA'^2 + AC^2 = ds^2 = (rdf)^2 + dr^2$$ E6.7

After dividing by the angle df and rearranging the variables in terms of linear velocities, *V(r)*, and angular velocities, *w(r)*

$$r^2 + \left[\frac{dr}{df}\right]^2 = \left[\frac{ds}{df}\right]^2 = \left[\frac{V(r)}{w(r)}\right]^2$$ E6.8

The values of *V(r)* and *w(r)* can be derived from NL mass-energy conservation and angular momentum conservation, respectively. From the first one, according to E5.6,

$$b^2 \cong 1 - K^2 \exp[-2z] \quad ; \quad K = \frac{m_{r*}(0, r*)}{m_{r*}(b, r)} = Constant$$ E6.9

Notice that for bodies, $m_{r*}(b,r)$ is a constant for each orbit. *For photons, b = 1 and K = 0*

After substituting in E6.8, the values of *V(r)* and *w(r)* given by E6.9 and E5.46,

$$r_{r*}^2 + \left(\frac{dr_{r*}}{df}\right)^2 = \left\{\frac{r_{r*}^2}{j_{r*}c}\right\}^2 [1 - K^2\exp(-2z)]\exp(4z) \quad ; \quad z = \frac{GM}{r}$$ E6.10

After changing the variable r by z ,

$$z^2 + \left(\frac{dz}{df}\right)^2 = (z^j)^2[1 - K^2\exp(-2z)]\exp(4z) \quad ; \quad z^j = \frac{GM_{r*}}{j_{r*}c_{r*}}$$
E6.11

After using *a second order approximation* for the exponential terms,

$$z^2 + \left(\frac{dz}{df}\right)^2 \cong (z^j)^2[(1-K^2) + 2(2-K^2)z + 2(4-K^2)z^2]$$
E6.12

The solution of this equation has the form:

$$z = a + b \cos gf \qquad g \cong 1 - (z^{j})^{2}(4 - K^{2}) \cong 1 - 3(z^{j})^{2} \qquad \text{E6.13}$$

This would be an ellipse only if *g=1*. Since K is close to one, then the perihelion shift after each turn is

$$\Delta f = 2p - 2pg \cong 6p(z^{j})^{2} \equiv 6p\left(\frac{GM}{jc}\right)^{2} \cong \frac{6p\, GM}{a(1-e^{2})} \qquad \text{E6.14}$$

In the case of the perihelion of Mercury, the shift is of about 43 seconds per century. This one is consistent with equation 6.14 within measurement errors[16] of about 1%.

This turns out to be the most sensible test for G theories just because it depends on E6.12, which is *a second order approximation.*

6.4 Some important differences with respect to general relativity

From above, the main difference with general relativity is that the G field has no energy and, therefore, the NL mass of the bodies in free orbits remain constant.

For example,

6.4.1 The origin of the perihelion shift of planets

according to the NL angular momentum law, E5.44, *the perihelion shift is due to the change of the NL refraction index of the space but not due to changes of the NL mass of the orbiting bodies*. According to the NL mass-energy conservation, the NL (relativistic) mass of the orbiting object, with respect to a strictly invariable observer, remains strictly constant. This is the origin of the differences between the present theory and general relativity.

6.4.2 The non delectability of gravity waves

According to the nature of matter fixed by the EP, the G field would have not real energy and, therefore, no gravity quanta would exist. Gravity interactions would come out from gradients of the NL perturbation rate of the space. However, a temporal change of the perturbation rate of the space cannot be detected locally. This is because all of the objects and stationary radiations have the same nature and, therefore, they must change in the same proportions after any temporal change of the relative perturbation rate of the space. Therefore, every ratio between them, in the instrument, must remain invariable.

Paradoxically, the Michelson-Morley experiments were carried out at the end of the last century and similar experiments for detecting gravity waves are planed for the end of this century.

According to the explicit form of the Equivalence Principle, the experiments for detecting gravity way should give the same negative results, for reasons similar to those of the Michelson-Morley experiments.

6.4.3 The new cosmic context

The Explicit Equivalence Principle fixes new properties of the black holes and of the universe that are described below. Thus, they also fix a new and well-defined context for the evolution of the celestial bodies that can be verified with the astronomical observations.

Because of the linearity of the new relations, the new cosmic context derived below has some fundamental differences with the conventional one based on General Relativity. Then a better fit with the observed facts will provide, below, large number new indirect and discriminative tests for the new approach based on the more explicit form of the EP.

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