SUPPLEMENTARY MATERIAL

General Relativity and Universons

This document is the supplementary material [Poher C., 2007] proposed with our paper "General Relativity and Universons"

Reproduced introduction of that paper :
The motivation for the present work originated from the experimental testing of an electric space propelling system one of us invented and patented [C. Poher, 1992; C. Poher, 2006]. This device uses layers of Y123 superconducting material in which strong electric discharges are made to get propulsion.
In a recent publication [C. Poher, 2011], made in this same journal, we have detailed the experimental set up which led to show a real propulsive phenomenon likened to an adjustable gravitational like effect.
The experimental energetic behavior of the propelling device, and diverse distant physical effects it creates, implied an interaction of this system with an unknown external source of energy. In order to satisfy energy conservation, we had effectively to suspect an interaction of the accelerated electrons, inside the device, with a field of an unknown nature surrounding the experimental apparatus.
From these results, one of us proposed hypotheses in a scalar model of the inertia phenomenon, based on Special Relativity and Quantum physics [*C. Poher, 2007*, 2010, annex 1]. These hypotheses appeared to justify not only the successful functioning of the experimental propelling system, but also all the distant physical effects we observed in the laboratory. Effectively, the experimental results obtained with the patented device closely follow our scalar model in which Newtonian gravitation is actually described by an isotropic flux of massless particles referred to as Universons, interacting with matter through a specific process.
The Universons hypotheses thus led to two fundamental equations being in full agreement with Newton ' s inertia law. Moreover it appeared that the scalar hypotheses, needed to explain the experimentally confirmed propelling effect, predicted also several other gravitational effects at much larger scale, effects that have since long been observed by astronomers, and considered as enigmas, giving rise to the "dark matter" hypothesis.
So we thought appropriate to cooperate, and we called the theoretical competencies of the second half of our duo (P. Marquet) to try generalizing our scalar Newtonian equations in order to see whether this generalization is compatible with the known results of General Relativity.
The answer appeared clearly positive: in the Newtonian approach, each Universon is assumed to bear an elementary momentum $Pu = Eu/c$.
In what follows, we will show that Pu is in fact a part of a momentum four-vector $\mathcal{P}^a$ associated with a general field hereinafter denoted **U**-Field formally compatible with General Relativity.

SUPPLEMENTARY ANNEX I

THE UNIVERSONS MODEL

Claude POHER

We proposed in 2010, as [*supplementary material 2*], the following hypothetic model, based on special Relativity, in order to try explaining the experimental facts we reported in APR Volume3, N° 2 Page 51.

Several authors have proposed, since long, models where an isotropic flux of fast moving particles travel in the Universe and interact with matter. We will call these particles "***Universons***". The first to have built such a model were the Swiss physicists Nicolas Fatio de Duillier (1664-1753) and Georges-Louis Lesage (1724-1803). This was the epoch of Isaac Newton.

However their models were not acceptable mostly because the interaction of the moving particles with matter was supposed to be an elastic collision. Effectively, with such a collision, the Inertia principle of Newton would not exist.

Therefore, the interaction of our hypothetic Universons with elementary particles of matter cannot be a classical collision, such as in the Compton effect for example.

A different kind of interaction should be supposed.

This interaction must be closer to an absorption followed by a re-emission, like the behaviour of photons and atoms in an excitation interaction.

De Duillier and Lesage ignored, in 1750, that interactions of this type do exist in Nature.

The Universons interaction with matter ***MUST be temporary***, with no energy transfer on average.

The Universons may exchange their momentum P with matter, but ***it must be taken back a little later***.

There can be a non null interaction (or capture) time τ of the Universons by matter, but this capture time must be as small as permitted by the Heisenberg's uncertainty principle.

About the travel speed of the Universons, Le Sage has shown that it must be as high as possible. But the speed cannot be larger than the speed of light c. As gravitation propagates at the speed of light, according to Einstein's theory, let us choose speed c for the Universons while they do not interact with matter. The speed of the Universons must be c *in all reference frames*.

According to Special Relativity theory a Universon bears a certain linear momentum P, corresponding to a rest mass energy E such that :

$$P = E / c$$

The rest mass m would then be equal to :

$$m = E / c^2$$

If the Universon comes to a rest when interacting with a particle of matter.

Evidently, we will have to consider only the interaction of Universons with elementary particles of matter, bearing a mass, as such an interaction cannot be considered macroscopically. This imposes that *the rest mass* m *of each Universon must be much smaller than the rest mass of the less massive known particles of matter*.

We do not call «*Gravitons*» our Universons because there might be confusions with unproven past hypotheses.

Let us summarize the hypotheses in the concept of the Universons model we are going to study :

There is supposed to be an interaction of matter with a flux of Universons existing everywhere in the Universe.

These Universons travel at the speed of light when they do not interact with matter, and they come from all directions of space with the same average intensity.

This means that the natural (cosmological) flux of Universons is supposed isotropic.

Each free (moving) Universon bears a momentum, and this momentum is, on average, the same for all Universons of the natural flux.

Certain Universons interact momentarily with particles of matter bearing a mass.

During the interaction, the Universon comes to a rest, and transfers its momentum to the particle of matter.

But this is not a stable situation, and after a very short time, the particle of matter spits back out the Universon in accordance with the conservation principles.

QUANTUM PHYSICS ?

A priori, the study of the Universons hypotheses should use the classical methods of Quantum Physics where the treatment of electromagnetic and De Broglie waves is the rule.

This is indeed needed when these waves manifest interference, diffraction, and dispersion. These phenomena exist because the wavelength of the waves considered in classical Quanta Physics are always much smaller than the sizes of matter particles.

Here, with the Universons hypotheses, the situation is completely different, because the wavelength associated with a moving Universon is considerably larger than the size of matter particles. This because of the experimental proper energy we determined ($8.58 \cdot 10^{-21}$ Joule).

This will not be discussed into more detail in this annex, but the Nesvizhevsky experiments in Grenoble suggest that the energy associated with one Universon is of the order of 0.05 electronvolt, so the wavelength of the De Broglie wave associated with an Universon should be of the order of tens of micrometers.

This does not allow interferences, diffractions, or dispersions when Universons interact with particles of matter, characteristic dimension of which is about ten billion times smaller.

This fact justify a model limited to the momentum and energy exchanges of the captured Universons with matter, using classical Special Relativity relations.

However, a study of the quantum fluctuations associated with the natural flux of Universons, in the frame of the Heisenberg uncertainty principle has confirmed a study from Louis De Broglie that he published in the late 1960's. We have shown that the average rest energy E of a captured Universon, and its average capture time τ are narrowly dependent of the Planck's constant h :

$$E \ \tau = h \tag{0}$$

RELATIVISTIC NOTATIONS WE USE HERE :

Let us consider two parallel reference frames #1 and #2 (Fig.29). They are classical, with 3 perpendicular axes. Frame #1 is the one of a virtual observer at rest. He looks at the arrival of one incident Universon, from the natural flux. Frame #2 is tied to an elementary particle of matter, of mass *M,* and speed v in frame #1, along the Ox axis of frame #1. The speed of light c is the Universons speed in the two reference frames. We define the two classical relativistic quantities :

$$\beta = v / c \tag{1}$$

$$\gamma = (1 - v^2 / c^2)^{-1/2} \tag{2}$$

The momentum P of the Universon, or the one of the matter particle, will have subscript 1 or 2, according to the frame from where this momentum is observed. Moreover, this momentum, which is a vector, will be represented by its components along the 3 axes of each frame. So there will be one more subscript, x, y or z in order to show this.
The rest energy of the Universon will be represented by E in each frame, with the corresponding subscript.
The direction of the positive constant speed v of the particle of matter is supposed parallel to the Ox axis of each of the two frames. So, the transformation of the momentum observed in the two frames will use the following Lorentz relativistic physics relations :

$$P_{x2} = \gamma (P_{x1} - \beta E_1 / c) \tag{3}$$

$$P_{y2} = P_{y1} \tag{4}$$

$$P_{z2} = P_{z1} \tag{5}$$

$$E_2 = \gamma (E_1 - c \beta P_{x1}) \tag{6}$$

The interaction time τ_2 of the Universon, in frame #2, is not the same when observed in frame #1 :

$$\tau_1 = \gamma \tau_2 \tag{7}$$

Moreover, as free Universons travel at constant speed c in the two frames, one can say necessarily :

$$P_1 = E_1 / c \tag{8}$$

The 3 components of the momentum P_1 of the Universon in frame #1 are tied to the incident trajectory of the Universon. Let us suppose that the Universon trajectory is in the xOy plane of frame #1, as shown in Figure 29, with an angle ϕ between the Universon trajectory and the Ox axis, we can write :

$$P_{x1} = (E_1 / c) \cos \phi \tag{9}$$

$$P_{y1} = (E_1 / c) \sin \phi \tag{10}$$

$$P_{z1} = 0 \tag{11}$$

INTERACTION OF THE UNIVERSONS WITH MATTER IN UNIFORM MOVEMENT :

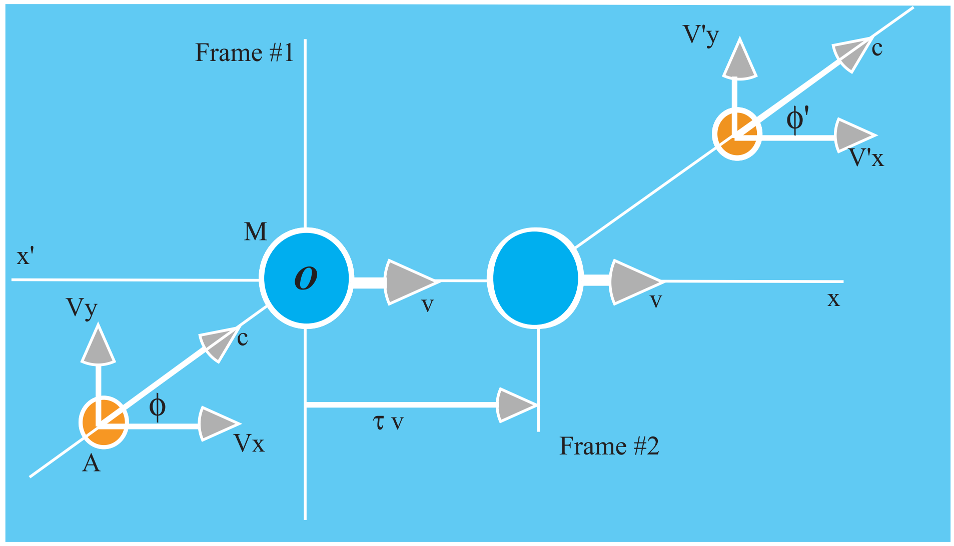
The first verification of our hypotheses we need to do is evidently the compatibility of the behaviour of Universons with the Inertia principle.

This means that a constant speed particle of matter should not be perturbed by the existence of an isotropic, natural flux of Universons, interacting with it.

Let us consider the interaction of a single Universon with an elementary particle of matter bearing a mass. As previously, this particle has a constant speed v along axis Ox in frame #1. The particle is at rest in frame #2.

Figure 29 illustrates the situation in an imaginary manner.

Fig 29



The momentum and rest energy of the incident Universon, defined by expressions (8) to (11) in reference frame #1 do not have the same values when observed from the particle, in reference frame #2.

So, the particle of matter interacts with an incoming Universon **A** having different characteristics than the (8) to (11) ones. We have to use transformations (3) to (6) to know the values of the momentum and energy exchanged while the interaction is taking place :

$$P_{x2} = \gamma \{ (E_1 / c) \cos \phi - \beta E_1 / c \} \quad (12)$$

$$P_{y2} = (E_1 / c) \sin \phi \quad (13)$$

$$P_{z2} = 0 \quad (14)$$

$$E_2 = \gamma \{ E_1 - c \beta (E_1 / c) \cos \phi \} \quad (15)$$

Expression (12) can be written :

$$P_{x2} = (\gamma E_1 / c) (\cos \phi - \beta) \quad (16)$$

Expression (15) becomes :

$$E_2 = \gamma E_1 (1 - \beta \cos \phi) \quad (17)$$

At the very moment of the Universon capture by the particle of matter, we can suppose that its energy E_2 is changed into a mass increase m of the particle, in such a way that the relativistic equivalence of mass and energy is satisfied :

$$m = E_2 / c^2 \quad (18)$$

Or :

$$m = (\gamma E_1 / c^2) (1 - \beta \cos \phi) \quad (19)$$

Moreover, the particle of matter receives an increase of its momentum, because the impulses defined by (13), (14) and (16) are transferred to it integrally.

It is interesting to consider what should happen to the particle of matter if it would capture simultaneously another Universon, coming from a direction exactly opposed to the direction of the previous one. In this case we should consider the previous relations, but with an incidence angle $\phi + \pi$ instead of ϕ that would reverse the signs of $sin\ \phi$ and of $cos\ \phi$, so that for this second Universon we would observe :

$$P_{x2} = (\gamma E_1 / c)(-cos\ \phi - \beta) \quad (20)$$

$$P_{y2} = -(E_1 / c)\ sin\ \phi \quad (21)$$

$$P_{z2} = 0 \quad (22)$$

$$E_2 = \gamma E_1 (1 + \beta\ cos\ \phi) \quad (23)$$

$$m = (\gamma E_1 / c^2)(1 + \beta\ cos\ \phi) \quad (24)$$

The momentum communicated to the particle of matter by the two interacting Universons, along axis Oy of reference frame #2, defined by (13) and (21) are opposed and they cancel each other when observed macroscopically. Effectively, the particle interacts with a large number of Universons from an isotropic flux, so there are numerous Universons interacting simultaneously from all the directions of space.

Expressions (17) and (23) tell us the value of the energy transferred to the particle of matter by two Universons with an opposed trajectory. These energies are not equal.

However, if we consider the effect of these two Universons on the mass increase of the particle while they interact simultaneously, we have to add expressions (19) and (24), and then we get :

$$m_{(19)} + m_{(24)} = 2\gamma E_1 / c^2 \quad (25)$$

We observe that the total mass increase of the particle of matter is exactly the same as if two Universons of the same energy E_1 (the rest energy observed in frame #1), were interacting with the same particle, at rest, in frame #1. This is an important result.

Let us stop for a moment our verification of the compatibility of our hypotheses with the inertia principle, in order to consider the consequences of the fact (25).

THE PROPER MASS OF A PARTICLE OF MATTER :

Expression (25) demonstrates that the simultaneous capture of two incident Universons, with opposed trajectories, induces a total mass increase of the matter particle, equal, if we ignore the γ factor, to the mass increase induced by any two Universons captured when the particle is at rest. So, for the particle, being at rest or in uniform movement, does not change its mass increase, except by the γ factor, which is precisely a known result of the relativity theory.

Moreover, the interaction of one Universon with a particle of matter has a finite duration, which is a constant time τ_2 in frame #2.

Let us call F_u the intensity of the natural flux of free Universons. This intensity is measured in particular units : Universons per second, per square meter, coming from the 4 π steradians.

Let us call S the « *specific capture cross section* » of Universons by particles of matter. This is not a surface, but « *a surface per kilogram of matter particle mass* ». With these units, an elementary particle of matter of rest mass M_o interacts simultaneously with n Universons, during the capture time τ_2 of one of them :

$$n = \tau_2 S M_o F_u \quad (26)$$

Each interacting pair of these n Universons, with an opposed trajectory, induces a mass increase of the matter particle given by expression (25).

So, the total mass increase M_2 caused by all the n Universons captured during time τ_2 will be the product of (25) by $n / 2$:

$$M_2 = \tau_2 S M_o F_u \gamma E_1 / c^2 \quad (27)$$

Replacing τ_2 by its value (7), we get :

$$M_2 = \tau_1 S M_o F_u E_1 / c^2 \quad (28)$$

Now, when the capture time τ_1 has elapsed, the first captured Universons are re-emitted, and immediately replaced by new interacting ones. So <u>the total number of permanently captured Universons remains constant</u> and equal to n. Finally, the total mass increase M_2 of the matter particle in reference frame #2 remains constant on average, and, evidently it must be equal to the observed, permanent, and constant, rest mass M_o of the particle :

$$M_o = \tau_1 S M_o F_u E_1 / c^2 \quad (29)$$

So, evidently :

$$\boldsymbol{\tau_1 S F_u E_1 / c^2 = 1} \quad \textbf{(30)}$$

Expression (30) is a ***fundamental relation*** of the Universons model. It ties the parameters of the theory.

We might consider also that, with relation (0) in mind, we get another fundamental result :

$$\boldsymbol{S F_u = c^2 / h} \quad (30\ bis)$$

This expression tells us the total number of Universons permanently captured ***by a kilogram*** *of matter, and permanently replaced by new captured ones, as they are re-emitted. This number is gigantic : $1.36 . 10^{50}$.*

According to (18) & (26), relation (30) has an important signification : the rest mass of an Universon *captures only one Universon* during the capture time (itself).
More than that, from the previous relations, we see that, for matter at rest :

$$M_o = n E_1 / c^2 \quad (31)$$

This means that ***the rest mass of any particle of matter is made of the total energy of the simultaneously captured Universons***.

These captured Universons are continuously replaced after being captured for a *very short* time.

Effectively, if the capture time τ was quite long, we should have already observed the fluctuations of the mass caused by the non perfect coincidence of capture and re-emission of the pairs of Universons. This behaviour is only acceptable if the capture time is sufficiently small so as the uncertainty principle be macroscopically respected, concerning the conservation of the energy and momentum of matter and the Universons.

Nevertheless we should predict that any rest mass M_o of any particle of matter is subject to tinny and very rapid *random fluctuations*. These fluctuations follow the Laplace-Gauss statistics, as it is the case for all particles phenomena, with the corresponding properties. For example, about 99% of the time, the rest mass of a matter particle fluctuates between $M_o - 3\sigma$ and $M_o + 3\sigma$ with $\sigma = (M_o)^{1/2}$ and a frequency of these fluctuations proportional to n / τ .

Moreover, we have shown that the observed mass M_v of a particle of matter of rest mass M_o observed from reference frame #1, when the particle moves at constant speed v relative to this frame, is, according to relativity theory :

$$M_v = \gamma\, M_o \tag{32}$$

that is simply the result of the capture time transformation between the two frames (7) :

$$\tau_1 = \gamma\, \tau_2 \tag{7}$$

This shows that the model is correct from the relativistic point of view.

But let us now return to the main verification process of the compatibility of the model with the inertia principle.

RE-EMISSION OF CAPTURED UNIVERSONS BY THE PARTICLE IN UNIFORM MOVEMENT :

Now, we are considering a new reference frame #3, which is frame #2 moving at constant speed $-v$ along Ox axis. Evidently, frames #1 and #3 are identical, but this will avoid errors on the subscripts in our calculations.

Each captured Universon is re-emitted at the end of the capture time τ in such a way that the average particle mass remains constant. This means that, in frame #2, energy E_2 must be exchanged between the particle of matter and the re-emitted Universon. Consequently, the momentum defined by (13), (14) and (16) are transferred to the Universon, such that the average macroscopic movement of the particle of matter is not perturbed. Those are the necessary conditions imposed by the inertia principle.

These energy and momentum, transferred to the Universon will be observed from reference frame #3, so that we will be able to compare the characteristics of the incident and re-emitted Universon in the same frame #1. The transformation of these quantities from frame #2 to frame #3 uses expressions (3) to (6), with a reverted sign for β because speed v of frame #3 is negative :

$$P_{x3} = \gamma\,(P_{x2} + \beta E_2 / c\ ) \tag{33}$$

$$P_{y3} = P_{y2} \tag{34}$$

$$P_{z3} = P_{z2} \tag{35}$$

$$E_3 = \gamma\,(E_2 + c\,\beta\, P_{x2}\ ) \tag{36}$$

Replacing the terms defined by (13), (14) and (16) we obtain :

$$P_{x3} = \gamma\,\{\, (\gamma E_1 / c)\, (\cos\ \phi - \beta) + \beta\gamma E_1 (1 - \beta\ \cos\ \phi\,)\ /\ c\ \} \tag{37}$$

$$P_{y3} = (E_1 / c) \sin\ \phi \tag{38}$$

$$P_{z3} = 0 \tag{39}$$

$$E_3 = \gamma\,\{\,\gamma E_1 (1 - \beta\ \cos\ \phi\,) + c\,\beta\, (\gamma E_1 / c)(\cos\ \phi - \beta\,)\ \} \tag{40}$$

Simplifying (37), we get :

$$P_{x3} = (E_1 / c) \cos\ \phi \tag{41}$$

Simplifying (40) :

$$E_3 = E_1 \tag{42}$$

The trajectory of the re-emitted Universon is defined by a new angle ϕ' :

$$P_{x3} = (E_3 / c) \cos\ \phi' \tag{43}$$

$$P_{y\,3} = (E_3 / c) \sin \phi' \qquad (44)$$

Considering the meaning of relations (38), (39) and (42) to (44), it becomes evident that, on the one hand, *the re-emitted Universon has the same energy as the incident one* in frames #1 and #3 that are strictly identical.

On the other hand, *the incidence and re-emission angles* ϕ *et* ϕ' *are equal, which means that the Universon flux remains isotropic when interacting with matter moving at constant speed.*

We can affirm that the interaction of matter in uniform movement with the natural flux of Universons does not perturb the matter movement, and does not change the isotropy of the Universons flux.

So, we have verified that this Universons model is not in conflict with the inertia principle.

This is not sufficient to prove that this is a correct theory, because there must be a compatibility of the model with two more phenomena : on the one hand, the behaviour with accelerated matter (Newton's Inertia law), and on the other hand, we should also look at the behaviour when two bodies of matter are acting on each other (Newton's gravitational law).

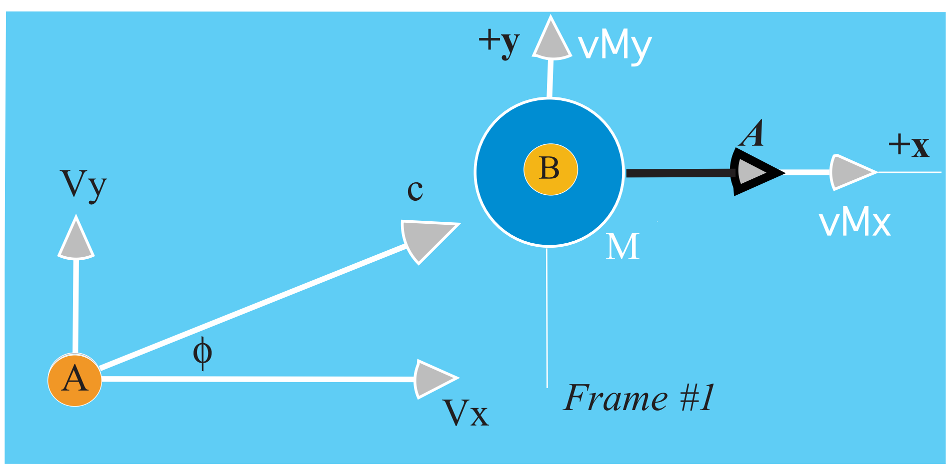
There is one important fact predicted by the Universons model that must be taken into account for future verifications : *particles of matter are submitted to random fluctuations of their rest mass, and momentum, caused by their permanent interaction with the natural flux of Universons.*

INTERACTION OF UNIVERSONS WITH ACCELERATED MATTER :

Let us consider now the interaction of a single Universon with a particle of matter accelerated along the Ox axis of frame #1. The particle acceleration A is supposed constant, and frame #2, where the matter particle remains at rest is supposed starting at frame #1 position at the instant of the Universon interaction.

The imaginary figure 30 helps understanding this situation, with the two frames superposed.

Fig. 30



The incident Universon A is captured in B at the start of the frame #2 acceleration with the particle M.

The incident Universon A has the following momentum components in reference frame #1 :

$$P_1 = E_1 / c \qquad (45)$$

$$P_{x\,1} = (E_1 / c) \cos \phi \qquad (46)$$

$$P_{y\,1} = (E_1 / c) \sin \phi \qquad (47)$$

$$P_{z\,1} = 0 \qquad (48)$$

When the Universon is captured in position B, its energy E_1 is changed into a mass increase m of the matter particle. In this capture process the relativistic equivalence of mass and energy is satisfied :

$$m = E_1 / c^2 \qquad (49)$$

So the particle of matter recoils because the momentum defined by (46), (47) and (48) are integrally transferred to it.

It is interesting to consider what would happen with another incident Universon, coming from a direction directly opposed to the direction of the previous one. In this case we should consider an incidence angle equal to $\phi + \pi$ instead of ϕ and this would reverse the signs of $sin\ \phi$ and $cos\ \phi$, in this case we would get :

$$P_{x\,1} = -(E_1 / c) \cos\ \phi \qquad (50)$$

$$P_{y\,1} = -(E_1 / c) \sin\ \phi \qquad (51)$$

$$P_{z\,1} = 0 \qquad (52)$$

$$m = E_1 / c^2 \qquad (53)$$

One observe that the momenta of the two Universons with opposed trajectories would compensate exactly so that the particle of matter would not move. This is true for any pair of Universons with opposed trajectories.

It is also interesting to consider what would happen with another incident Universon, coming from a symmetrical direction to the direction of the previous one, in relation to the direction of the acceleration +x. In this case we should consider an incidence angle equal to $-\phi$ instead of ϕ and this would reverse only the sign of $sin\ \phi$ and not the one of $cos\ \phi$, in this case we would get :

$$P_{x\,1} = (E_1 / c) \cos\ \phi \qquad (54)$$

$$P_{y\,1} = -(E_1 / c) \sin\ \phi \qquad (55)$$

One observe that the momenta transferred to matter by the two Universons with symmetrical trajectories would compensate exactly in the y direction, but would add in the x direction of the acceleration.

Exactly at the beginning of the capture time τ we suppose that an external cause creates the acceleration A of the particle of matter which begins to move along axis x.

The observer remains in frame #1. Effectively, the Lorentz equations that we used previously are not adapted to accelerated frames.

So we are going to suppose that the capture time τ of the Universon by the matter particle is observed from this #1 frame.

The whole elementary particle of matter is supposed accelerated by an external cause, from the beginning of time count (time zero). And this is also supposed to be exactly the beginning of the Universon capture.

As soon as it is captured, the Universon disappears, and is changed into a part m of the matter particle mass. And we are going to consider that this mass element m is now the bearer of the energy and of the momentum of the captured Universon.

This is of course a purely pedagogical method for studying the interaction, because nothing distinguishes this mass element from others, and in strict rigor it would be more correct to use another method. But this simple method gives correct results and is easy to understand.

Thus, the elementary matter particle mass element m has the following momentum and energy at instant t = 0, when the Universon has just been captured :

$$P_{x1} = (E_1 / c) \cos \phi$$
$$P_{y1} = (E_1 / c) \sin \phi \qquad \text{(previous relations 46 to 49)}$$
$$P_{z1} = 0$$
$$m = E_1 / c^2$$

The total energy E_{m0} of the mass element m is expressed by the following relation at instant zero :

$$E_{m0} = m \, c^2 \tag{56}$$

Then, during the capture time τ the matter particle and its mass element m are accelerated by an external cause along the x axis of frame #1.

Consequently, their speed increases versus time. And their momentum and kinetic energy increase accordingly.

Now let us consider instant $t = \tau$ in frame # 1, just before the Universon re-emission.

We are now going to look at the previous quantities at the end of capture time τ just ***before*** the Universon is re-emitted. The variables indices 1 become 1τ for clarity.

The matter particle is moving now at speed

$$v = A \, \tau \tag{57}$$

in frame #1, along the x axis.

In relativistic physics, the momentum P acquired by a matter particle of mass m moving at speed v is given by the expression :

$$P = m \, \gamma \, v \tag{57-1}$$

Where the parameter γ has the value defined by expression (2). Moreover, according to (2), and (49) and (57) we can write :

$$P = (\beta \, \gamma) \; E_1 / c \tag{57-2}$$

The total energy E of this same matter particle is given by the following expression :

$$E = \gamma \, m \, c^2 \tag{57-3}$$

And the kinetic energy E_c of this particle is expressed by :

$$E_c = m \, c^2 \; (\gamma - 1) \tag{57-4}$$

In these expressions, let us recall that the mass m is the one caused by the Universon capture and defined by expression (49) :

$$m = E_1 / c^2 \tag{49}$$

So, the mass element m of the elementary particle of matter has the following components of its momentum, and the following total energy at the instant $t = \tau$ in frame # 1, just before the

Universon re emission :

$$P_{x1\tau} = (E_1 / c)\,(\cos\phi + \beta\gamma)$$
$$P_{y1\tau} = (E_1 / c)\sin\phi \qquad (58-1 \text{ to } 58-4)$$
$$P_{z1\tau} = 0$$
$$E_{m1\tau} = \gamma\, E_1$$

And exactly after this instant, the universon is re emitted and the mass increase m disappears.

But we must not forget that the matter particle captures and re-emits Universons permanently. And this is the reason why the matter particle mass remains constant on average. So the mass element m does not simply disappear, it is replaced by another one, created by the capture of another Universon, other mass element which is identical, and which is taking care of the momentum and kinetic energy.

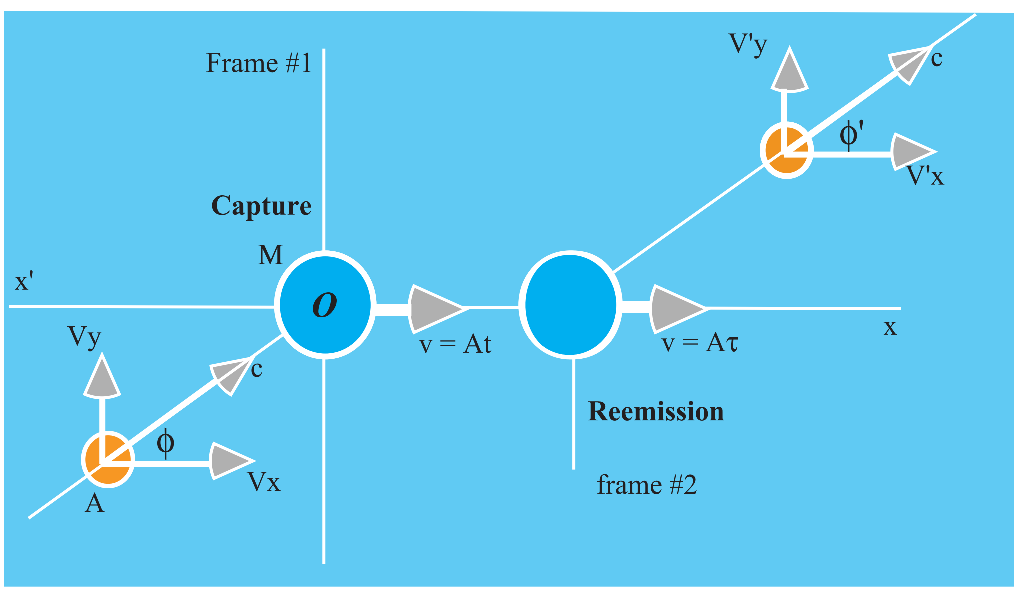
RE-EMISSION OF THE UNIVERSON BY THE ACCELERATED MATTER PARTICLE :

At the end of the capture time, the previously captured Universon recovers its freedom.

We know, by experiments, that the total average mass of the matter particle does not change, and that its average kinetic energy is the one predicted in the absence of interaction with Universons.

The Universon re emission is represented on Figure 31 below. The observer remains in frame #1 as previously.

Fig. 31



As the Universon interaction with the matter particle does not change the average mass of matter, and does not change its final kinetic energy, it is essential that the re emitted Universon energy E_τ be equal to :

$$E_\tau = E_{m1\tau} = \gamma\, E_1 \qquad (59-1)$$

The corresponding momentum P_τ is equal to :

$$P_\tau = E_\tau / c = \gamma \; E_1 / c \qquad (59 - 2)$$

Precisely, the Universons re emission must not be the cause of a supplementary modification of the matter particle speed. This implies necessarily :

$$P_\tau = P_{x\,1\,\tau} = (E_1 / c)\,(\cos \phi + \beta\gamma) \qquad (59 - 3)$$

If we call ϕ ‘ the re emission angle of the Universon in frame #1, according to figure 31, we know that, by definition :

$$P_\tau = (E_\tau / c) \cos \phi\,' \qquad (59 - 4)$$

So, with (59 - 1) and (59 - 2) :

$$P_\tau = \gamma\,(E_1 / c)\,\cos \phi\,' = (E_1 / c)\,(\cos \phi + \beta\gamma) \qquad (59 - 5)$$

Which simplifies the following way :

$$\cos \phi\,' = (1 / \gamma) \cos \phi + \beta \qquad (59 - 6)$$

However, we know that $\beta = v / c$ with a speed $v = A\,\tau$ (57) which is always extremely small, whatever the value of the acceleration A because the capture time τ is extremely brief. In these conditions, the value of the parameter :

$$\gamma = (1 - v^2 / c^2)^{-1/2} \qquad (2)$$

Is always equal to one with an error inferior to 10^{-39} and equation (59 - 6) can be simplified :

$$\cos \phi\,' = \cos \phi + A\,\tau / c \qquad (59 - 7)$$

The expressions system defining the Universon re emission conditions becomes :

$$P_{x\,1\,\tau} = (E_1 / c) \cos \phi\,'$$

$$P_{y\,1\,\tau} = (E_1 / c) \sin \phi\,' \qquad (\text{60 - 1 à 60 - 4})$$

$$P_{z\,1\,\tau} = 0$$

$$E_{m\,1\,\tau} = E_1$$

In frame #2, tied to the accelerated matter particle, the momentum and the kinetic energy of the particle are null.

Consequently, relations (60) represent the characteristics of the re emitted Universon as seen by the observer situated in frame #1.

Let us examine the direction of the Universon re emission by comparing the angles ϕ of capture and ϕ‘ of re emission, both measured from the axis x in frame #1.

According to definition (59 - 7) let us recall that these angles are tied by expression :

$$\cos \phi\,' = \cos \phi + A\,\tau / c \qquad (59 - 7)$$

INTERPRETATION OF THESE RESULTS :

Interpretation of relations (59 - 7) and (60) reveals several facts :

1 — The angles of incidence ϕ and of re-emission ϕ' of the Universons are not equal. There exists an ***anisotropy of the re-emitted flux of captured Universons***.

2 — The momentum communicated to the accelerated particle of matter by the Universon interaction ***is different, in the direction opposed to the acceleration***, than in the acceleration direction.

It suffices effectively to compare expressions (46) and (60 -1) to draw this conclusion.

This explains the inertia effect, and the need to exert a force on matter in order to be able to accelerate it. More about that later.

3 — This difference in capture and re-emission momentum manifests itself the same way in all space around the particle.

The anisotropy of the re-emitted flux of captured Universons, by accelerated matter, concerns all space around the particle of matter. This anisotropy has a revolution symmetry around the acceleration direction.

4 — The compensation of the momentum transferred to matter, perpendicularly to the acceleration direction, by the interaction with the Universon flux does not appear Universon by Universon, but from pairs of captured Universons with opposed or symmetric incident trajectories according to the acceleration direction.

The conservation of energy, and of momentum is only true at macroscopic scale, on average. The uncertainty principle authorizes this behaviour if the capture time of the Universons' pairs is sufficiently small, which is the case.

5 — Taking into account the fact that, for all practical acceleration values, $A\tau/c <<< 1$ which means that $\gamma = 1$, expression (62) becomes :

$$\cos\phi' = \cos\phi + A\tau/c \qquad (61)$$

Now, let us consider the solid angle Ω' defined by a cone with the half summit angle ϕ' because the interaction is symmetric around the direction of the acceleration. The axis of this cone is the acceleration direction.

When $\phi = \pi$ then, expression (63) can be written :

$$\cos\phi' = -1 + A\tau/c \qquad (62)$$

From definition of solid angle :

$$\Omega' = 2\pi(1 - \cos\phi') \qquad (63)$$

With (62) we obtain :

$$\Omega' = 4\pi - 2\pi A\tau / c \qquad (64)$$

This is the full sphere plus the solid angle :

$$\Omega' = -2\pi A\tau / c \qquad (65)$$

In this very small solid angle Ω', *situated in the opposite direction of the acceleration, the accelerated particle of matter does not re emit any captured Universon*.

This explains how the re-emitted flux can be anisotropic.

6 — In expression (61), if $\phi = 0$ then :

$$\cos \phi' = 1 + A\tau/c \tag{66}$$

But, as $A\tau/c$ is positive, this expression is impossible, because the cosine of the re-emission angle cannot be larger than one. Interpretation of this fact is evidently that, *in a very small solid angle :*

$$\Omega = 2\pi A\tau / c \tag{67}$$

Situated in the direction of the acceleration, around $\phi = 0$, ***the accelerated particle of matter does not capture any Universon coming from this solid angle***.

These un-captured Universons continue their trajectory, as if matter was not there. So, in the direction of the acceleration, entirely inside the solid angle Ω, the incident, natural flux of Universons, is not perturbed.

7 — We can write expression (63) the following way :

$$2\pi(1 - \cos \phi') = 2\pi(1 - \cos \phi) - 2\pi A\tau / c \tag{68}$$

Or, according to (63) :

$$\Omega' = \Omega - 2\pi A\tau / c \tag{69}$$

This expression shows that for an incident solid angle $\Omega = 4\pi A\tau / c$ the re-emission solid angle is only $\Omega' = 2\pi A\tau / c$ or two times less.

But we already know that, for all Universons coming in the solid angle $\Omega = 2\pi A\tau / c$ there is no capture. This means that they simply continue their trajectory and emerge in the solid angle $\Omega'=2\pi A\tau/c$;

However in this same emergence solid angle, there are also the Universons re-emitted after capture in the periphery of the incident solid angle $\Omega=4\pi A\tau/c$.

So the **OUTPUT flux** of Universons, from the accelerated particle of matter, ***in the direction of the acceleration***, and only in the solid angle $\Omega'=2\pi A\tau/c$ ***is always LARGER, than in the opposite direction***, where the captured Universons are not re-emitted.

So, considering facts #5 and #7 about the anisotropy of the interaction with an accelerated particle of matter, *there are two particular, very small solid angles* $\Omega=2\pi A\tau/c$, of the same value, to consider. Both solid angles have the same axis, which is the acceleration direction, but *they are opposed by their summit*. One of these two solid angles is opened towards the front, the other one towards the rear.

In the front solid angle, the output flux of Universons is increased. In the rear solid angle, incident Universons are not captured.

CALCULATION OF THE INERTIA FORCE :

According to (59 - 7) expression (60 - 1) can be written :

$$P_{x1\tau} = (E_1 / c)\,(\cos\phi + A\tau / c) \qquad (70)$$

We know that this is the momentum transferred to the particle of matter by the re emitted Universon, with a negative sign (in the direction —x).

Let us compare this momentum with the one transferred to the particle of matter, in the + x direction, by the captured Universon. It was given by expression (46) :

$$P_{x10} = (E_1 / c)\cos\phi \qquad (46)$$

So now, by subtracting directly (46) from (70) we get the total momentum transferred to the matter particle, along the minus direction of the x axis, by the interaction of a single Universon :

$$\Delta P_x = (E_1 / c)\,(A\tau/c) \qquad (71)$$

The residual momentum (71) impedes the acceleration of the matter particle. This fact justifies the inertia effect, and the need to exert an external force in order to accelerate the matter particle.

The elementary force δf that must be applied to the element of mass m of the matter particle, in order to compensate the back momentum delivered by the interaction of a single Universon during time τ must be, in principle, such that :

$$\delta f = \Delta P_x / \tau = E_1 A / c^2 \qquad (72)$$

We are going to verify if this is correct.

In reality, *we want to verify that this model is compatible with the Newton's law of inertia*.

So, we have to determine the value of the force, acting on the accelerated particle of matter by the difference in linear momenta induced by the Universons interaction. The particle of matter has a total rest mass M_0.

Let us call F_u the intensity of the natural Universons flux, as previously. This flux is again expressed in Universons per second, in the 4 π steradians.

This incident flux F_u is isotropic, so the partial, flux $\delta F(\phi, \psi)$ per steradian, in a direction defined by angles ϕ and ψ is equal to :

$$\delta F(\phi, \psi) = F_u / 4\pi \qquad (73)$$

We will consider incident Universons, coming from direction ϕ, ψ where the angle ϕ is, as previously, measured in the xOy plane, and angle ψ in the yOz plane.

Again, let us call S the specific capture cross section of matter for the Universons interaction. So the flux $\delta F_c(\phi, \psi)$ of the captured Universons, coming in the direction ϕ,ψ is given by :

$$\delta F_c(\phi, \psi) = S M_0 F_u / 4\pi \qquad (74)$$

This flux is expressed in captured Universons per second and per steradian, in the (ϕ, ψ) direction.

The number of Universons $\delta N(\phi, \psi)$ simultaneously captured, from this direction, during the capture time τ of one of them is equal to :

$$\delta N(\phi, \psi) = \tau\, \delta F_c(\phi, \psi) = \tau\, S\, M\, F_u / 4\pi \tag{75}$$

Each one of these captured Universons transfers, to the particle of matter, when re-emitted, a supplementary momentum, in the direction opposed to the acceleration, which value is given by (71) copied here :

$$\Delta P_x = (E_1 / c)\, (A\tau/c) \tag{76}$$

For each re-emitted Universon, the elementary force δf exerted on the particle of matter, at the end of time τ is simply equal to $\Delta P_x / \tau$:

$$\delta f = \Delta P_x / \tau = A\, E_1 / c^2 \tag{77}$$

So, the $\delta N(\phi, \psi)$ captured Universons during this time τ, coming from the direction (ϕ,ψ) are exerting a total force, which is given by the product : $\delta f \;\; \delta N(\phi, \psi)$.

The total force acting on the particle of matter for all the Universons coming from all the directions of space is obtained by integrating the value of this product in all space. This means by varying angle ϕ from 0 to π, and angle ψ from 0 to 2π. We get :

$$\text{Force} = (2/\pi) \int_{\phi=0}^{\phi=\pi} \int_{\psi=0}^{\psi=2\pi} \tau\, S\, M_0\, A\, E_1 F_u \;/ (4\pi c^2)\;\; \delta\phi\;\; \delta\psi \tag{78}$$

Finally :

$$\text{Force} = \tau\, S\, M_0\, A\, E_1 F_u \;/ c^2 \tag{79}$$

But, from (30) we already know that :

$$\tau\, S\, F_u\;\; E_1 / c^2 = 1 \tag{30}$$

So, expression (85) becomes :

$$\textbf{Force} = \mathbf{M_0\, A} \tag{80}$$

That is simply the well known Newton's inertia law.

So, ***the Universons model is compatible with the Galileo's Inertia principle AND with the Newton's inertia law***.

A SIMPLER METHOD FOR THE FORCE DETERMINATION :

We have shown (76) that no Universon is re-emitted in a solid angle $\Omega' = — 2\pi A\tau/c$, opposed to the direction of the acceleration. Macroscopically speaking, this means that incident Universons, coming from the direction opposite to the acceleration direction, into this solid angle, transfer to the particle of matter, a momentum, opposed to the direction of the acceleration, which is not compensated.

Moreover, incident Universons coming in the direction of the acceleration, in a solid angle $\Omega = 2\pi A\tau/c$, which axis is the direction of the acceleration, are not captured. Macroscopically speaking, this means that the re-emitted Universons in the direction of the acceleration direction, into the same solid angle, transfer to the particle of matter, a momentum, opposed to the direction of the acceleration, which is not compensated.

So the solid angle value $\Omega=2\pi A\tau/c$ *acts two times* on the momentum transferred macroscopically to matter, in the opposite direction of the acceleration.

Expression (75) gives the average number of Universons captured, per steradian, during time τ in the (ϕ, ψ) direction. So the product of expression (82) by **two times** the value of the solid angle $\Omega = 2\pi A\tau / c$, should be the average number N_Ω of Universons exchanging a momentum in these solid angles :

$$N_\Omega = 2\, \Omega\, \delta N(\phi, \psi) \quad (81)$$

$$N_\Omega = A\tau^2\, S\, M_0\, F_u / c \quad (82)$$

Each one of these Universons transfers to the particle of matter a momentum E_1 / c and the force is equal to the momentum divided by time duration τ so :

$$\text{Force} = N_\Omega E_1 / c\, \tau = A\, \tau\, S E_1 M_0 F_u / c^2 \quad (83)$$

But, from (30) we know that :

$$\tau\, S\, F_u\, E_1 / c^2 = 1 \quad (30)$$

So :

$$\text{Force} = A\, M_0 \quad (84)$$

Which is as correct as (80).

This means that, in order to obtain the force acting on an accelerated particle of matter, it suffices, macroscopically, to determine the number of Universons captured in the solid angle $\Omega = 2\pi A\tau / c$, and then to multiply this number by $2\, E_1 / \tau\, c$. And finally, take into account fundamental expression (30).

SUPPLEMENTARY ANNEX II

IS THE UNIVERSONS MODEL ABLE TO EXPLAIN GRAVITATION ?

Claude POHER

The Universons model presented in Annex I is not at all a « shadow » model of gravity, like the model proposed by Lesage for example, because Universons are not absorbed by particles of matter, they are only temporarily captured, then released after about $7.8 \;.\; 10^{-14}$ second.

Two macroscopic masses of matter separated by a distance are bathing in the general flux of Universons. This flux is isotropic and constant on average only. In fact the flux has **random fluctuations of its intensity and directions**. This is the fundamental point.

However, because the Universons travel at the finite speed of light, an increase of the incident flux intensity from a direction of space is almost always acting on one of the two masses of matter *before* it arrives at the other one.

This situation is equivalent to the one of matter irradiated by an anisotropic flux of Universons, because the fluctuations are equivalent to a constant isotropic average flux to which is added a random fully anisotropic component.

Therefore the mass of matter being the first to receive the flux intensity increase is pushed the first towards the direction of the other mass.

Finally, ***the random fluctuations of the natural flux push the two matter bodies one towards the other one***.

The only stable situation occurring is therefore a balance between the acceleration pushing the two masses of matter from the outside, and the acceleration caused by the emission of an anisotropic flux of Universons by each mass towards the other one.

This stable situation corresponds evidently to a Keplerian orbit of the two masses.

Effectively, if each mass is pushed in the direction of the centre of the other mass, it is submitted to an accelerated movement (its trajectory is not a straight line).

This phenomenon exists really at the level of the elementary particles of matter of the two bodies in circular orbit.

And we know that each accelerated particle re emits the Universons it captures anisotropically.

A more intense flux of Universons is re-emitted by each particle in the direction of the acceleration, which is the direction of the other mass centre of mass.

This anisotropic flux of Universons creates immediately a force (the inertia force) in the opposed direction of the flux.

There is an automatic equilibrium between the spatial anisotropy of the captures impulses caused by the perturbation introduced by the other mass, and the spatial anisotropy of the impulses transferred to matter by the re emission of the Universons.

In other terms, the two anisotropies of the local flux of Universons : the one of the incident flux and the one of the re-emitted flux, compensate exactly at any instant, for any elementary particle of the matter of the two bodies.

But this equilibrium exists only if the two masses of matter are macroscopically and permanently accelerated, each towards the other one.

This is the *only possible stable situation* for the two masses immersed inside the natural isotropic flux of Universons **with permanent random fluctuations**.

Effectively, if we attempt to imagine that any one of the two masses can be the object of an acceleration oriented in any other direction of space, we get an unstable situation that converges always towards the equilibrium situation we have described previously.

In fact, the real phenomena are not at all so simple, because it is necessary to consider the ***instantaneous*** *acceleration of each elementary particle of matter, and also, it is necessary to consider the* ***fluctuations*** *of the Universons captures and re-emissions. But the macroscopic result appears to be the one we have described.*

GRAVITATION FORCE :

Let us try to calculate the gravitation force exerted on two matter bodies of rest masses M_1 and M_2 situated at a distance D. In the gravitation process, only the Universons captured successively by the two masses of matter are of interest to us, because all others are isotropically distributed.

The intensity of the natural flux of Universons being F_u and using the previous notations, the number of Universons n captured by the first body of mass M_1, each second, from the 4π steradians, is equal to :

$$n = F_u \, S \, M_1 \tag{85}$$

All these Universons are re-emitted. At a distance D from the mass M_1, these re-emitted Universons propagate and are distributed along the surface of a sphere of radius D, so, at the surface of the sphere, the flux F' of these Universons is given by :

$$F' = n / 4 \pi D^2 = F_u \, S \, M_1 / 4 \pi D^2 \tag{86}$$

So F' is the flux of Universons, first captured by M_1 and arriving in the solid angle Ω on mass M_2. These Universons are partially captured by the particles of the second body of mass M_2 and the number n' that are captured, during capture time τ, is :

$$n' = F' \, S \, M_2 \tau \tag{87}$$

$$n' = F_u \, S^2 \, M_1 M_2 \, \tau / 4\pi D^2 \tag{88}$$

These n' two times captured Universons transfer to matter, when re-emitted, a momentum which is not compensated in the other direction.

So, they create a resultant force (gravitation force) which is oriented towards the incoming flux, or the direction of the mass M_1. The force exerted by each Universon being $E_1 / c \, \tau$ the value of this resultant force is :

$$Force = n' E_1 / c \, \tau \tag{89}$$

$$Force = F_u \, S^2 \, M_1 M_2 \, E_1 / 4 \pi \, c \, D^2 \tag{90}$$

This can be written :

$$Force = G\ MM' / D^2 \qquad (91)$$

With :

$$\boldsymbol{G = F_u S^2 E_1 / 4 \pi c} \qquad \textit{(92)}$$

Expression (91) is the well known Newton's law of gravitation, and expression (92) ties the gravitational constant G to the parameters of the theory, mainly the parameters of the natural flux of Universons.
From (30), we know that :

$$\tau\ S\ F_u\ \ E_1 / c^2 = 1 \qquad (30)$$

So expression (92) can be written also :

$$\boldsymbol{G = S\, c / 4 \pi \tau} \qquad \textit{(93)}$$

Expression (93) ties the gravitational constant G to the parameters of the Universons capture by matter. Both expressions (92) and (93) are equivalent.

POSSIBLE VALUES OF THE MODEL PARAMETERS :

The momentum carried by an Universon is deduced from our laboratory experiments.

We have determined the experimental value of the energy of an Universon Eu by comparing the acceleration communicated to the known mass of an accelerometer, by an anisotropic flux of Universons emitted by a layered ceramic (emitter), to the displaced charge (number of electrons) inside a dielectric, simultaneously by the same flux.
The result of this determination is the following :

$$\boldsymbol{Eu = 8{,}0 \,.\, 10^{-21}\ joule \pm 10\ \%}$$

This determination is confirmed by a previous one, obtained five years earlier, thanks to the experimental results from Valery V. Nesvizhevsky & al. of the Institut Laue-Langevin in Grenoble.

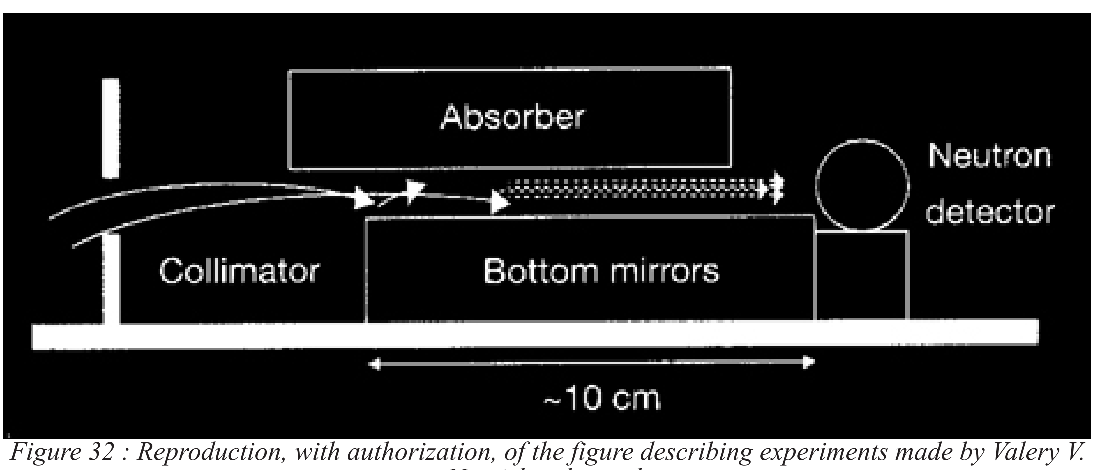


Figure 32 : Reproduction, with authorization, of the figure describing experiments made by Valery V. Nesvizhevsky et al.

In this experiment, ultra cold neutrons are moving horizontally at low speed (of the order of 10 meters per second) in a narrow space between two horizontal and parallel planes along a 10 centimeters distance.
The inferior plane is a mirror for the neutrons, and the superior plane is an absorber for

neutrons. The neutrons moving slowly between the two plates are submitted to the gravitational field of the Earth. They have parabolic trajectories in this narrow space, before going out where they are detected and counted.

The experiment shows that no neutron goes out when the distance between the two planes is smaller than 15 microns. Over this distance, the number of neutrons increases rapidly with the distance : 8 times more at 20 microns than at 15 microns, 100 times more at 40 microns etc..

One can try to interpret this experiment in the frame of the Universons' model, considering that each neutron is submitted to a non isotropic exchange of energy with the captured Universons, this gives the gravitational acceleration of the neutrons and their parabolic trajectory. The energy that is needed to raise a neutron by 15 microns in the Earth gravitational field is 1.5 pico electron volt.

Effectively, this energy is given by the following classical physics equation :

$$E = m\,g\,h = 1{,}67\ .\ 10^{-27}\ .\ 9{,}81\ .\ 15.\ 10^{-6} = 2{,}4\ .\ 10 — 31\ Joules = 1{,}5.10^{-12}\ eV$$

As no neutron goes out of the experiment when the distance between the two planes is less than 15 microns, one can estimate that this is due to the fact that they are all absorbed. This tells us that they receive, during their travel along the 10 centimeters of the parallel plates, a larger kinetic energy than the one needed for a neutron to be reflected by the inferior plate and absorbed by the superior one.

Then we can deduce that the minimum kinetic energy transferred to a neutron, in the vertical direction, by the capture of Universons (corresponding to only one Universon) is 1.5 pico electron volt.

Let us call Eu the energy transferred by an Universon to a neutron during capture. We know that the impulse communicated by the capture is equal to Eu / c, where c is the speed of light.

A neutron of mass Mn gets, during capture a speed v such as :

$$Mn\ v = Eu / c$$

Its kinetic energy is :

$$Ec = Mn\,v^2 / 2$$

Then finally :

$$Ec = Eu^2 / (2\ Mn\ c^2)$$

We know that :

$$Ec = 1{,}5\ .\ 10^{-12}\ eV$$

Or :

$$Ec = 2{,}4\ .\ 10^{-31}\ joule$$

With $c = 3\ .\ 10^8\ m/s$ and $Mn = 1{,}67\ .\ 10^{-27}\ kg$, we get finally :

$$\mathbf{Eu = 8{,}5\ .\ 10^{-21}\ joule}$$

If the Universons energy was electromagnetic, this would correspond to a wavelength of :

$$\lambda = h\,c / Eu$$

Where c is the speed of light and h the Planck's constant.

With $h = 6{,}62\ .\ 10^{-34}\ J\ .\ s$ we would get :

$$\lambda = 2{,}34\ .\ 10^{-5}\ metre\ or\ 23{,}4\ microns$$

This would be a very powerful infrared radiation easy to detect.

As this radiation does not exist, we conclude that Universons don't bear an electromagnetic energy, but only a kinetic energy.

Consequently, Universons don't make any difference between neutral (neutrons) and charged (protons, electrons) particles of matter, only their mass counts in their interaction.

The fundamental relations used to deduce the other parameters values are the following :

Notations :

A = Acceleration of matter. ($m . s^{-2}$).
τ = Capture time of an Universon in a particle of matter. (Seconds, s).
Ω = Solid angle where there is no emission of the captured Universons. (Steradians, sr).
F = Cosmological, isotropic flux of free Universons. (Universons . $m^{-2} . s^{-1}$. in 4π sr)
S = Capture cross section of the Universons by matter. ($m^2 . kg^{-1}$).
Eu = Proper energy of a captured Universon. (Joules).
c = Speed of light. ($m . s^{-1}$). We use here $c = 3 . 10^8$ instead of $2.99792458 . 10^8$.
G = Universal Gravitation Constant. (Newton . $m^2 . kg^{-2}$). We use here $G = 6.67 . 10^{-11}$
H = Hubble's constant (We use here H = 75 km/s per mega parsec).
h = Planck's constant. $h = 6,626 . 10^{-34}$ joule . second.

$$\Omega = 2 \pi A \tau / c \qquad (A)$$

$$\tau = c^2 / (F\ S\ Eu) \qquad (B)$$

$$G = Eu\ F\ S^2 / (4 \pi c) = S c / 4 \pi \tau \qquad (C)$$

$$\tau / S = 3.58 . 10^{17} \qquad (D)$$

$$Eu\, \tau = h \qquad (E)$$

$$F \tau^2 = 3.8 . 10^{54} \qquad (F)$$

REST ENERGY OF AN UNIVERSON

$Eu = 8,5 . 10^{-21}$ Joule

ISOTROPIC COSMOLOGICAL FLUX OF UNIVERSONS

$F = 6,3 . 10^{80}$ Universons . m^{-2} . Sec^{-1} . in 4π steradians

POWER OF THE COSMOLOGICAL FLUX OF UNIVERSONS

$P = 5,37 . 10^{60}$ watts . m^{-2} . sr^{-1}

CAPTURE CROSS SECTION OF THE UNIVERSONS BY MATTER

$$S = 2{,}18 \cdot 10^{-31} \ m^2 \cdot kg^{-1}$$

CAPTURE TIME OF AN UNIVERSON

$$\tau = 7{,}8 \cdot 10^{-14} \ \text{second}$$

SOLID ANGLE OF NO RE EMISSION OF THE UNIVERSONS

$$\Omega = 1{,}6 \cdot 10^{-21} \ \text{steradians} \cdot m^{-1} \cdot s^2$$

AGITATION TEMPERATURE OF MATTER DURING THE INTERACTION

$$T° = 1{,}16 \cdot 10^{-8} \ \text{Kelvin}$$

IS THE UNIVERSONS THEORY A MODEL OF DARK ENERGY ?

The existence of the isotropic flux of Universons is confirmed by our laboratory experiments using electric discharges in layered superconducting ceramics, where electrons are strongly accelerated and emit an isotropic flux bearing a momentum, extracted from the isotropic one.

We have also shown that the Universons model explains several observations enigmas about gravitation. this is not detailed here but published on our website *http://www.universons.org*

— It justifies the constant orbital speeds of stars in galaxies.

— It justifies the very high speed of galaxies in clusters of galaxies

— It justifies the double gravity peaks observed with gravimeters during Solar eclipses.

— It justifies the apparently anomalous trajectory of the free falling interplanetary spacecrafts Pioneer 10 & 11.

The isotropic flux of Universons is composed of quanta travelling at the speed of light, therefore much faster than matter particles of the Universe.

We can therefore suppose that this cosmological flux of energy was also created during the Big Bang and that it fills all the Universe space. This is precisely the definition of the Dark Energy concept.

Moreover, we can suppose that the total amount of energy carried by this cosmological flux is constant, without creation of new Universons along time.

Therefore, there should be a flux gradient at very large scale if the Universe has a finite energy content, and this gradient is pushing matter outwards, like any anisotropic flux in the laboratory.

A consequence of this fact should be an increase of the Universe expansion speed, a fact that seems to be confirmed by the redshift / luminosity relation of very distant supernova.

CONCLUSION OF ANNEX II :

Finally, we have demonstrated :

A — That ***Universons model is compatible with the Galileo's Inertia principle AND with the Newton's inertia law***.

B — The ***Universons model is also compatible with Newton's gravitation law***.

So we can hope that this model constitutes another possibility to understand these two fundamental natural phenomena.

Particularly because the predictions of this model are corroborated by a large amount of observations, including during our laboratory experiments.