General Relativity and Universons

Claude Poher (Corresponding author)
Laboratoire Aurora, 33 Chemin de la Bourdette, F31400, Toulouse, France
Tel: 33-562-177-896 E-mail: claude.poher@wanadoo.fr

Patrick Marquet
Former Head of Research
Laboratory of Applied Astronomy Physics Observatoire de Paris, 75014 Paris, France
Private: 7, rue du 11Novembre, 94350 Villiers-Paris, France
Tel: 33-149-303-342 E-mail: patrick.marquet6@wanadoo.fr

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Abstract

Following numerous research studies, we have postulated a model of corpuscular gravitation implying massless particles, referred to as *Universons,* interacting with matter. These Universons seem to propagate in the Universe at the speed of light, as a dense isotropic flux of *quanta* each bearing at least a tinny linear momentum.

The existence of this flux has been successfully confirmed by repeated experiments carried out over the past 5 years.

In this paper, we show that these particles are actually part of a more general field formally defined with General Relativity's data, particles which are therefore fully compatible with our model.

Keywords: Universons, **U**-*Field*, Capture Time, Momentum four vector, Electric propulsion, Superconductors applications, Inertia, Gravitation, Dark Matter, Energy generation

Introduction

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.

(*four dimensional latin indices*: a = 0,1,2,3; *spatial indices*: μ = 1,2,3).

1. Short Overview on General Relativity (GR)

1.1 Field equations with a massive source

1.1.1 Covariant formulation

In a non Euclidean space-time (here pseudo *Riemannian*), the geodesic invariant is known to be

$$ds^2 = g_{ab} \, dx^a dx^b \tag{1.1}$$

Where the components of the metric tensor satisfy

$$g_{ab} \neq 1.$$

The adopted *signature* is here

$$diag \{1, -1, -1, -1\} .$$

The Einstein field equations with a source are known to be

$$G_{ab} = R_{ab} - (1/2) g_{ab} R = \chi T_{ab} \tag{1.2}$$

where the Ricci tensor is given by

$$R_{bc} = \partial_a \{^a{}_{bc}\} - \partial_c \{^a{}_{ba}\} + \{^d{}_{bc}\}\{^a{}_{da}\} - \{^d{}_{ba}\}\{^a{}_{dc}\} \tag{1.3}$$

and the curvature scalar R is the contraction of the Ricci tensor.

(the *cosmological constant* λ is here discarded)

The *Christoffel symbols of the second kind* are

$$\{^a{}_{bc}\} = 1/2\, g^{ad} (\partial_c g_{db} + \partial_b g_{dc} - \partial_d g_{bc}) \tag{1.4}$$

(emphasis is made on the fact these symbols do not constitute tensors).

χ: Einstein 's constant $= 8\pi \mathbf{G} / c^4$

G: Newton ' s constant

Since we will consider neutral homogeneous matter for the purpose of our derivation, we will choose the massive energy-momentum tensor under the simplest form

$$T_{ab} = \rho c^2 u_a \, u_b \tag{1.5}$$

where ρ is the neutral homogeneous matter proper density.

1.1.2 Weak gravitational fields

When the macroscopic velocities are low compared with c, and assuming weak gravitational fields, the fundamental equation (1.2) generalizes the *Poisson equation* which is here classically given by

$$\Delta V = 4\pi \mathbf{G} \rho \tag{1.6}$$

where the Newtonian potential is

$$V = -\mathbf{G}\, m_0 / r \tag{1.7}$$

(with the *Laplacian* $\Delta = \partial^2 / \partial x^\mu \partial x_\mu$)

The weak field theory is defined on a manifold on which the metric has components

$$g_{ab} = \eta_{ab} + h_{ab} \tag{1.8}$$

(η_{ab}: *Minkowskian* tensor) where

$$h_{ab} << 1$$

hence

$$g_{00} \approx 1 \quad ,$$

and the 4-velocity

$$u^a = u^0 = u_0 = 1$$

The energy-momentum tensor then reduces to its time component (energy density)

$$T^0{}_0 = \rho c^2 \tag{1.9}$$

and the field equations become

$$R^0{}_0 = (8\pi\, \mathbf{G} / c^4)\,(T^0{}_0 - (1/2)\,\delta^0{}_0 T)$$

that is

$$R^0{}_0 = (4\pi\, \mathbf{G} / c^2)\,\rho$$

Upon these assumptions, the derivatives ∂_0 are negligible with respect to the ∂_μ, and it is easy to see that the Ricci tensor (1.3) reduces to

$$R^0{}_0 = R_{00} = \partial_\mu \{^\mu{}_{00}\} = (1/c^2)\,\Delta V \tag{1.10}$$

With

$$\{^\mu{}_{00}\} \approx -(1/2)\, g^{\mu\mu}\, \partial_\mu\, g_{00} \tag{1.11}$$

At this non relativistic approximation, the metric tensor is

$$g_{00} = 1 + 2V / c^2 \tag{1.12}$$

2. The Universons are Compatible with General Relativity

2.1 Fundamental relations of C. Poher.

Defining a *macroscopic interacting cross section* **s** (units: m^2 / Kg), it has been established in C. Poher (2007), that when the isotropic flux of *Universons* reaches a particle with rest mass m_0, the *Universons* are momentarily retained during an infinitesimal finite local time τ called *capture time,* before their release.

Using these assumptions, we arrive at the first fundamental equation from C. Poher giving the gravitational constant **G** included as expression (93) into Annex II of "supplementary material" to the present paper.

$$\mathbf{G} = \mathbf{s}\, c / 4\pi\, \tau \tag{2.1}$$

G is therefore Newton's constant as defined above.

For accelerated matter, the re-emission process of *Universons* obeys a different law and C. Poher has formally shown two important results.

Effectively, in C. Poher (2010) it was shown, about the anisotropy of the interaction of Universons with an accelerated particle of matter, that there are two particular, very small solid angles $\Omega = (2\pi\, \mathbf{a}\, \tau) / c$, 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 of the matter particle acceleration.

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

The incident angles θ of the *Universons* flux are not the same as the re-emitted flux angles θ', resulting in an *anisotropy* of the flux after capture by an accelerated particle.

The Universon momentum imparted to this particle is higher in the direction opposed to the acceleration which explains the inertial effect whereby a force is necessary to accelerate matter.

So let us consider the front solid angle: within a very small solid angle Ω about the accelerated direction, when $\theta = 0$ the particle never captures any Universon, according to the second Newtonian formula

$$\Omega = (2\pi\, \mathbf{a}\, \tau) / c \tag{2.2}$$

where **a** is the proper acceleration of the particle.

2.2.1 Compatibility of C. Poher 's first fundamental equation (2-1) with General Relativity

We know that the expanding Universe is strongly suggested by astronomical observations (synthesis in Lang, 1991). The basic cosmological model (Robertson-Walker, 1936) demands that the different parts of the homogeneous cosmic world, have the same histories, so that each co-moving observer *sees* the same view in all directions (isotropy).

For distant sources generating gravitational fields within any region of space, the classical theory always states that all those fields are represented by a *spherically symmetric* metric of Schwarzschild. If one accepts the notion of cosmological flux postulated by C. Poher, such a spherically symmetric model is straightforwardly applicable.

In this view, any solution of the field equations may thus be approximated to the following line element (Landau, 1962):

$$ds^2 = (ds_E)^2 — [2m_0\mathbf{G}/rc^2]\,(dr^2 + c^2\,dt^2) \quad (2.3)$$

where $(ds_E)^2$ is the flat metric, and the second term is a small correction related to the distant influence of remote masses.

The metric tensor components depending on x^0 are

$$g_{00} = (1 - 2\,m_0\mathbf{G}\,/\,r\,c^2) \qquad \text{and} \qquad g_{0\mu} = 0 \quad (2.4)$$

If $\boldsymbol{n}$ is the unit vector in the direction r, one switches to cartesian coordinates by replacing dr with

$$d\boldsymbol{n} = n_\mu\,dx^\mu$$

and the spatial components of the metric tensor become:

$$g_{\mu\beta} = -\,\delta_{\mu\beta} - [\,(2\,m_0\mathbf{G}\,/r\,c^2)\,(n_\mu\ n_\beta)\,] \quad (2.5)$$

$\delta_{\mu\beta}$ is the Kronecker symbol whose spatial indices need not be raised or lowered in the Newtonian approximation.

From the general definition of the Christoffel symbols $\{^a{}_{bc}\}$, one easily checks that the time component of the Ricci tensor in a static situation, is

$$R^0{}_0 = (-\,g)^{-1/2}\,\partial_\mu\ (-g)^{1/2}\ g^{a0}\{^\mu{}_{a0}\} \quad (2.6)$$

which is legitimized by the fact that all quantities are here independent of x^0.

$$(g = det\, g_{ab}).$$

Let us now set

$$R^{0\mu}{}_0\,(-g)^{1/2} = \mathcal{R}^{0\mu}{}_0 \quad (2.7)$$

with

$$R^{0\mu}{}_0 = g^{a0}\{^\mu{}_{a0}\}$$

Next, consider a mass m_0: applying Gauss' theorem to the integral of the divergence (2.6) over to the 3-volume $\boldsymbol{V}$ filled with matter, we find

$$\int R^0{}_0\ (-\,g)^{1/2}\,d\,\boldsymbol{V} = \int\ [\,\mathcal{R}^{0\mu}{}_0]\ ds_\mu \quad (2.8)$$

Note : intermediate steps are the well known demonstration of the Gauss theorem.

(The ds_μ are here the components of the 3-vector *dual* to the tensor measuring the infinitesimal 2-surface area element of the mass m_0).

Inserting (2.5) into expression (2.7), and performing the integration, we eventually obtain

$$\int R^0{}_0\ (-\,g)^{1/2}\,d\,\boldsymbol{V} = -\,(4\,\pi\,\mathbf{G})\,m_0\ /c^2 = -\,[(4\,\pi\ \mathbf{G})\,/c^3\,]\,P^0 \quad (2.9)$$

Note : integration over the same volume as in (2.8).

with

$$P^0 = m_0\,c\,u^0$$

i.e.

$$P^0 = m_0\,c \quad (2.10)$$

(Time component of the 4-momentum vector P^a with $u^0 = 1$).

Let us then set the scalar quantity

$$\mathcal{P}^0 \quad (2.11)$$

which we relate to P^0 as

$$\mathcal{P}^0 = const.\,P^0 \quad (2.12)$$

with

$$const. = 4\pi \, \mathbf{G} / c^3 \tag{2.13}$$

$\mathcal{P}^0$ is obviously the time component of a four-vector $\mathcal{P}^a$ which we will determine later.

The form of the momentum vector component P^0 as a function of the massive tensor (1.5), is known to be (Tolman, 1934), (see § 3 of our text) :

$$P^0 = (1/c) \int [\, T^1{}_1 + T^2{}_2 + T^3{}_3 - T^0{}_0 \,] (-g)^{1/2} \, d\,V \tag{2.14}$$

Therefore, the equation (2.8) strongly suggests for $\mathcal{P}^0$ the following form

$$\mathcal{P}^0 = -\int \mathcal{R}^{0\mu}{}_0 \, ds_\mu \tag{2.15}$$

Now, let us define a *phase* element of a specific *wave* associated with a field hereinafter denoted the **U**-*Field* , such that

$$d\,\phi = \mathcal{P}_a dx^a \tag{2.16}$$

Since, we still assume here a *static* situation, we may admit dt as an infinitesimal time interval which is *finite* and *constant*, that is equal to the *capture time* τ .

The temporal part of the phase $d\,\phi$ is in this case, given by

$$d\,\phi_0 = \mathcal{P}_0 \, c\,\tau \tag{2.17}$$

Over this short interval, we consider the variation of this *phase* which is therefore written

$$d\,\phi_0 = c\,\tau \int \mathcal{R}^{0\mu}{}_0 \, ds_\mu \tag{2.18}$$

We now assume that the *temporal part* of the **U**-*Field phase* is equally likened to an *equi-potential 2-surface*, and we obviously have for its element

$$d\,\phi_0 = \mathbf{s}\, m_0 \tag{2.19}$$

so that

$$\mathcal{P}^0 = \mathbf{s}\, m_0 / c\,\tau \tag{2.20}$$

Therefore, with

$$\mathcal{P}^0 = const.\, P^0 \tag{2.21}$$

where

$$const. = 4\pi \, \mathbf{G} / c^3$$

we have

$$\mathbf{G} = (\mathbf{s}\, m_0 c^3) / (4\pi P^0 \, \tau\, c)$$

and we find back C. Poher 's formula

$$\mathbf{G} = \mathbf{s}\, c / 4\pi\,\tau \tag{2.22}$$

since the principle of equivalence stipulates that locally:

$$P^0 = m_0 c$$

see (2.10).

2.2.2 Compatibility of C. Poher ' second fundamental equation (2.2) with General Relativity

In order to generalize the (2.2) formula $\Omega = (2\pi\, \mathbf{a}\, \tau) / c$, we first simplify by setting

$$\mathcal{R}^{0\mu}{}_0 = \mathcal{R}^\mu$$

so

$$d\,\phi_0 = c\,\tau \int \mathcal{R}^\mu \, ds_\mu \tag{2.23}$$

Then, using here spherical coordinates r , θ, φ the point O being taken at the origin of the particle mass center, we assume without loss of generality:

$$\varphi = r = const.$$

For the newtonian approximation (where the body motions are slow) we have the limiting case:

$$\mathcal{R}^{\theta} = g^{00}\{^{\theta}{}_{00}\} \tag{2.24}$$

(here: $(-g)^{1/2} = 1$)

Moreover, the considered approximation leads to

$$g^{00} = c^2 / (c^2 + 2V) \approx 1$$

so by referring to (1.10), we have

$$\mathcal{R}^{\theta} \equiv \{^{\theta}{}_{00}\} = (1/c^2)\, \partial V/\partial_{\theta} \tag{2.25}$$

(∂_{θ} is the derivative with respect to θ).

which is just the Newtonian potential gradient, accounting for an *acceleration* **a** according to the general definition:

$$\mathbf{a} = grad\, V \tag{2.25bis}$$

The formula (2.23) can be then written

$$d\phi_0 = (1/c)\, \tau\, \mathbf{a}_{\theta}\, ds^{\theta} \tag{2.26}$$

where $\mathbf{a}_{\theta}$ is the particle's acceleration with respect to the angle θ which deviates from incidence chosen here to be 0.

On the other hand, we know that the solid angle is the *oriented surface*, viewed from O, (in our case ϕ), and represents the flux

$$\iint s\, n\, d\phi \;/ (Om)^2 \tag{2.27}$$

of the phase field across this surface.

$$\mathbf{Om} = \boldsymbol{r},$$

and

$\boldsymbol{n}$ is the unit normal at **m** of the compact surface ϕ .

Furthermore, to this point **m** one can associate the point **p** intersection of the sphere centered at O (particle) of radius 1, with the half distance O**m**, and a surface element belonging to this sphere, that is:

$$ds^{\theta} = 2\pi\ \sin\theta\ d\theta \tag{2.28}$$

or (with some mathematical approximation) :

$$ds^{\theta} \approx 2\pi\ d\theta \tag{2.28bis}$$

For O**m** = 1, formula (2.26) finally becomes :

$$d\phi / d\theta = (1/c)\, 2\pi\, \tau\, \mathbf{a}_{\theta} \tag{2.29}$$

where

$$1/ d\theta = \partial^{\theta}$$

constitutes the sole component of the normal $\boldsymbol{n}$.

Therefore C. Poher's conclusions are here entirely re-instated, and the angle θ is indeed tigthly related to the accelerated mass interacting with the **U-***Field* (*Universons*).

2.3. Explicit form of the four-vector P^a

The vector defined above

$$\mathcal{P}^{0} = (4\pi\ \mathbf{G}/c^3)\, P^0$$

applies to local situation where all quantities in

$$R^0{}_0 = (-g)^{-1/2}\, \partial_{\mu}\ (-g)^{1/2} g^{a0} \{^{\mu}{}_{a0}\} \tag{2.30}$$

do not depend of x^0, which means that we are in a *static* situation.

When ruling out this restriction, we can naturally generalize

$$\mathcal{P}^{0} = -\int R^0{}_0 (-g)^{1/2}\, d\,\boldsymbol{V}$$

to the 4-vector

$$\mathcal{P}^{a} = -\int R^a{}_b\, (-g)^{1/2}\, dS^b \tag{2.31}$$

which is regarded as the 4-momentum vector of the **U**-*Field* , through the hypersurface dS^b.

This in perfect accordance with the field equations with a massive source, if we write them as

$$R^a{}_b = (8\pi \mathbf{G}/c^4)(T^a{}_b - 1/2\,\delta^a{}_b T) \tag{2.32}$$

In the static case,

$$R^0{}_0 = (8\pi \mathbf{G}/c^4)(T^0{}_0 - 1/2\,T) \tag{2.33}$$

$$R^0{}_0 = (4\pi \mathbf{G}/c^4)(T^0{}_0 - T^1{}_1 - T^2{}_2 - T^3{}_3)$$

Hence the U-Field momentum vector in contact with matter can be written

$$\mathcal{P}^0 = (1/c)\int (4\pi \mathbf{G}/c^3)(T^1{}_1 + T^2{}_2 + T^3{}_3 - T^0{}_0)(-g)^{1/2}\,d\boldsymbol{V} \tag{2.34}$$

which agrees with the standard expression for the usual massive momentum time component

$$P^0 = m_0\,c = (1/c)\int (T^1{}_1 + T^2{}_2 + T^3{}_3 - T^0{}_0)(-g)^{1/2}\,d\boldsymbol{V}$$

taking account of (2.12) and (2.13), as per (2.14) .

Therefore, $\mathcal{P}^0$ is that part of the 4-momentum vector $\mathcal{P}^a$ representing the **U**-*Field* which is interacting with the mass (and its constant gravity field), that is uniquely expressed by the diagonal components of its energy momentum tensor and within a constant.

This result confirms that $\mathcal{P}^a$ can also be regarded as the sum of all elementary momenta defined by C. Poher i.e. the *Universons* :

$$Pu = Eu/c \tag{2.35}$$

3. Conclusion

In the aforementioned text, we did not go through the specific kinematics of C. Poher's model of *Universons*, but we merely showed that its two fundamental equations appear as particular cases of more general covariant equations.

These equations are formally compatible with the General Relativity as they are currently established, and thus it validates C. Poher's hypotheses and results.

A natural question then arises :

If we remain within the standard theory, why have the propelling phenomenon put into evidence by C. Poher's experiments, never been detected so far?

The answer certainly lies in the deep and accurate description of the intimate *Universons* kinematics (see enclosed supplementary material, or (Poher C., 2007)), which has enabled C. Poher to work out the principle of its multilayer superconductive propelling emitters.

The fact that the improved emitter shows increased effects leads to the true evidence of a control of the flux of these *Universons* throughout vacuum that is suggested by C. Poher.

According to the results presented here, the momentum carried by each *Universon* is a part of a momentum four-vector associated with the Ricci tensor.

This is equivalent to saying that C. Poher's emitters are capable to modify locally the curvature of space-time in some particular way.

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Appendix

The derivation of the equation (2.2) still relies on the classical definition of a solid angle Ω, but strictly speaking, within the general relativity, this angle has a different form due to the use of curvilinear coordinates.

Hence, we may generalize further the formula $d\,\phi_0 = c\,\tau \int \mathrm{R}^{\mu}\, ds_{\mu}$ by switching cartesian coordinates to spherical coordinates.

For a basis (e_{α}) these are written

$$e_r = (\partial x/\partial r)\, e_x + (\partial y/\partial r)\, e_y$$

and

$$e_{\theta} = (\partial x/\partial\theta)\, e_x + (\partial y/\partial\theta)\, e_y = -r\sin\theta\, e_x + r\cos\theta\, e_y$$

thus

$$(e_{\theta})^2 = r^2\sin^2\theta + r^2\cos^2\theta = r^2$$

Accordingly

$$e_{\theta}\,.\,e_{\theta} = g_{\theta\theta} = r^2$$
$$g^{\theta\theta} = 1/r^2$$

knowing that

(a) $$g^{r\theta} = 0 \qquad g^{rr} = g_{rr} = 1$$

In polar coordinates the *Christoffel symbols of the second kind*, are related to the metric tensor by

$$\{^{\theta}{}_{r\theta}\} = (1/2)\, g^{\mu\theta}\,(\partial_{\theta} g_{\mu r} + \partial_r g_{\mu\theta} - \partial_{\mu} g_{r\theta})$$

that is

$$\{^{\theta}{}_{r\theta}\} = [1/(2r^2)]\,\partial_r g_{\theta\theta} = [1/(2r^2)]\,\partial_r\,(r^2)$$

with

(b) $$\{^{a}{}_{rr}\} = 0 \qquad \text{for all } a$$

(c) $$\{^{a}{}_{\theta\theta}\} = 0$$

(d) $$\{^{r}{}_{\theta\theta}\} = -r$$

Within a very small solid angle Ω situated in the accelerative direction about the incidence $\theta = 0$ the considered particle does not capture any Universon according to the formula

(e) $$\Omega = (2\,\pi\,\mathbf{a}\,\tau)/c$$

where **a** is the proper acceleration of the particle.

When in contact with matter

$$d\,\phi_0 = c\,\tau \int \mathrm{R}^{\mu}\, ds_{\mu}$$

we will have

$$\mathrm{R}^{\mu}\ \cdot\ \rightarrow\ g^{\theta\theta}\{^{r}{}_{\theta\theta}\} + g^{r\theta}\{^{\theta}{}_{r\theta}\} + g^{00}\{^{\theta}{}_{00}\} + g^{00}\{^{r}{}_{00}\}$$

(f) $$= g^{\theta\theta}\{^{r}{}_{\theta\theta}\} + g^{00}\{^{\theta}{}_{00}\} + g^{00}\{^{r}{}_{00}\}$$

in virtue of *(a)*.

If

$$r = 1 = const.,$$

which is the case of the *classical solid angle* , the term *(d)* and the last term of *(f)* vanish since they no longer represent a connection symbol and only survives

$$\mathrm{R}^{\mu} \rightarrow \mathrm{R}^{\theta} = g^{00}\{^{\theta}{}_{00}\}$$

which is just the formula (2.6), for the newtonian case where the mass velocities are slow compared with c , and thus corresponds to the first formula *(e)* written down by C. Poher, when using a *classical* solid angle Ω .