DEVELOPMENT OF GERLOVIN'S THEORY (1)

STRONG GRAVITATION

- The link between space-time and matter discovered by A. Einstein could be extended to other types of interactions, if only there would be a STRONG GRAVITATION, with a constant greater than G by several orders of magnitude.

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A perspective direction in theoretical physics, on the way to unite string theory, the Standard Model of particles and gravitation, is the holographic duality discovered by Juan Maldacena in 1998 [8].
In the concept of I. Arepeva [9], based on experimental data obtained in the LHC, it has been proved that the formation of a quark-gluon plasma corresponds, in terms of holographic duality, to the formation of a balck hole and its entropy. This approach supposes that our Universes forms a holographic screen, a projection of events of a N+1-dimension space on the frontier of a N-dimension space, and all the elementary particles should be considered as quantum dark holes.
I Gerlovin comes to similar conclusion in his monography about the Unified Theory of Fundamental Field (**TFF)** (published in 1990) [10], but through another interpretation.
The article will show, in an analytical manner, that our Universe, in the frame of the Standard Model, can be considered as a black hole from its "inside", in which all the elementary particles, now from the "outside", also can be considered as "quantum black holes".

INTRODUCTION

In this article, based on the equation of the Coulomb law, as modernized by I. Gerlovin : $\varphi = q\frac{e^{-\frac{R}{r}}}{r}$,

we make an attempt to modernize the Newtom law, as following : $\varphi = Gm\frac{e^{-\frac{R}{r}}}{r}$.

We will further prove that the gravitation becomes « strong » at nuclear scale, and that this force can fully be at the origin of the “strong nuclear interaction”. It is a development of Gerlovin’s theory, in the light of the contemporary state of physics, which allows us to make such a suggestion.

Let’s first take the following 6 fundamental equations, describing local and global properties of our world, and let’s compare them with one of Gerlovin’s conclusion ([13], p.6, item.8):

« … *The potential of the main interaction in vacuum appears to be equal to* $\boldsymbol{c^2}$ ».

$\frac{1}{\varepsilon_0 \mu_0} = c^2$ – dielectric and magnetic permittivity of vacuum

$\left(\frac{dr}{dt}\right)^2 = \frac{8}{3}\pi G\rho_{univ}(t)r^2(t) - kc^2 = c^2$ – cosmological equation of the Friedman energy

$E_0 = mc^2$ – rest energy of elementary particles

$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$ – metrics of space-time in the GTR

$\left(1 - \frac{\upsilon^2}{c^2}\right)^{1/2}$ - transformation of Lorentz

$c^2 = \frac{Gm}{r_{грав}}$ - condition of formation of a black hole.

All these equations present one constant – **the square of light speed ($\boldsymbol{c^2}$)**.

The QUESTION is: what is the interrelation between these independent equations and the *potential of Gerlovin's fundamental field* ?

We will try to answer this question, at the end of this article.

SHORT ANALYSIS OF GERLOVIN'S CONCEPT

Using a contemporary formulation, the TFF can be described as following:

1. In the TFF, the elementary particle of vacuum (**EPV**), a pair proton – antiproton and electron – positron, is, in contemporary physics – a virtual quark – gluon condensate and an electron – positron cloud (vacuum dipoles).

2. In the TFF, all the elementary particles are dark holes : and this is already one development in terms of holographic duality, in particular in the conception of I. Arepeva [9] and in the "entropic gravitation" or E. Verlinde [11], [12].

3. Gerlovin's Fundamenton, in a contemporary interpretation, can be regarded as a closed strong (loop) in the « string theory », and its harmonics give all the elementary particles, when projected into our real, 3D world.

4. The information (non-energetic) link between subspaces-layers in the TFF correspond to an holographic screen, as the projection of a N+1 world on a N world.
One can have the impression that I. Gerlovin was in advance on his time, and therefore it is more understandable why his idea have been considered as "insane ideas". But, on the other side, his mathematical description of the EVERYTHING without any physical foundation, does surprisingly fit well with reality.

5. The main difference between the TFF and classical / quantum theories lies in the fact that the TFF does not consider single dark holes, but an entire subspace full of dark holes : the physical vacuum (**φV**), when interacting with Elementary Particles, can be considered as a continuum-discrete subspace, i.e. the principle of quantization (discrete values) is set forth from the very beginning as a property of the **φV**.
Hence, at the difference from the "classical" GTR, the TFF is a quantum theory.

Here are the facts from the TFF which remained unused.

1. This was a great idea to describe the quantum (discrete) motion of elementary particles via the Elementary Particles of Vacuum (see figure [10, p.166]). One can name it a "quantum leap", which, be the way, is observed in the quantum world. But here again, this sounds like a declaration, not based on physical foundations ; we will justify this later in the present article.

2. In the TFF, there is an intriguing description of the strong interactions, through a non-linear Coulomb law on nuclear scales :
$\left(\varphi = q\frac{e^{-\frac{R}{r}}}{r}\right)$, - this is, for sure, a fundamental discovery of I. Gerlovin, which will be justified in the present article, via a modernized law of Newton.

We will first prove, in a purely analytical manner, that **the constant c^2**, which is the potential of the fundamental field (according Gerlovin's TFF), and which is included in our world's description via the 6 equations mentioned above, **has a gravitational origin**.

Then, we will consider the formation of space-matter, according to the task we have set (modernization of Newton's law), in terms of gravitational field.

THE ENERGETIC ZERO-BALANCE OF UNIVERSE

In energetic terms, all our Universe can be divided into 2 independent energetic states (levels) : our real 3D world (space-time-matter) with real elementary particles (**EP**) with rest energy mc^2 , and the virtual world (the physical vacuum (**φV**) with an almost zero energetic state.
Let's consider how do these 2 independent energetic states form, at the stage of inflation. We turn to cosmology, for this.
One of the key moments of the theory of inflation is the zero energetic levels at the origin and during the development of the Universe, with a negative gravitational energy of the entire Universe which is exactly compensated by the positive energy of the entire matter.
R. Feynman (as well as A. Sakharov, Y. Zeldovich) emphasized that:
- the full energy of the Universe is equal to zero, and this is one a the « greatest secrets » ([3], p.68, line 17),
and L. Landau, E. Lifshits have rigorously proved that the full energy of a closed world is always equal to zero.

The energetic balance of the inflating Universe corresponds to the equality in module of: (i) the energy-mass of the visible and gravitationally-linked part of the Universe (increasing with the time), and (ii) the increasing potential energy of these same sources of gravitation.
As the Universe is basically homogeneous and isotropic, we can write this energy balance as following:

$$M_{univ}(t)c^2 = |-M_{univ}(t)\varphi_{univ}| \qquad (1)$$

Where :
$M_{univ}(t)$ – Energy - mass of the visible part of the Universe,
φ_{univ} – Gravitational potential of the Universe.

The equation (1) is respected only under one condition, when φ_{univ} is always and everywhere eaqual to $(-c^2)$.

Let's demonstrate that the energetic balance (equation (1)) corresponds to the dynamic of a flat model of Friedman Universe. We note that the universal law of gravitation lays at the foundation of the contemporary cosmology, and the **Newton gravitational potential (φ) can turn into the Friedman cosmological equation of energy via a Poisson transformation:**

$$\varphi = \frac{GM}{r} \rightarrow \frac{4}{3}\pi G\rho r^2 \rightarrow \frac{8}{3}\pi G\rho r^2 - kc^2$$

Let's write this equation in a dynamic form, which is more comfortable for us :

$$\varphi_{univ}(r) = \left(\frac{dr}{dt}\right)^2 = \frac{8}{3}\pi G\rho_{univ}(t)r^2(t) - kc^2 \qquad (2)$$

where:
$r(t)$ – radius of the part of the Universe which is linked by gravitation;
ρ_{univ} – density of the entire energy-mass of the Universe, including its « dark » components.

According to the cosmological observations, our Universe is flat, and the curvature of space is equal to zero (k=0), - this being the consequence that the density of entire energy-mass is equal to the critical density : $\rho_{univ} = \rho_{crit}$.

If in the equation (2) we put the parameters of the Universe of any epoch, beginning from the time of Bing Bang until today, we will get a constant value, equal to $(-c^2)$ (I put aside the calculation here).

In fact, the equation (2) shows how the gravitational potential of the Universe (φ_{univ}) forms, for an observer on Earth, as well as for any other observer (all observers being equivalent) ; then $\varphi_{univ} = -c^2$ is valid for any point of space, at any time during the Universe's existence.

This means that the inflation has "generated" the entire Universe, with a total energy equal to zero, in the light of equality between the rest mass and the rest energy.

We can make the following postulate:

All the matter finds itself in the homogeneous potential field of the Universe, where $\varphi_{univ} = -c^2$ (external factor, negative energy) – the **gravitation**, and gets a rest energy $E_0 = mc^2$ (internal factor, positive energy) – the **inertia**, i.e. **gravitation and inertia always appear simultaneously**.

Let's remember the postulates of the GTR:

1. The gravitational mass is equivalent to the inertial mass.

2. An accelerated motion is equivalent to the field of gravitation.

Hence, we observe a zero energetic balance, locally as well as globally. This requirement is the consequence of the energy conservation law.

For instance, if we imagine that we bring a test body away to the infinity, then the entire rest energy of this body – the **inertia** $(+c^2 \to 0)$, turns into a potential energy – the **gravitation** $(-c^2 \to 0)$**,** with their sum equal to zero.

CONCLUSION (1)

The dynamics of the Friedman equation (2) showed us that $\varphi_{univ} = -c^2$ is a constant in all points of space and at any time, and that it has a **gravitational origin**.
It is also the main and sufficient condition of formation of a black hole.

The fact that our Universe could be a black hole is not new. This approach can be found in the articles of N. Poplavskiy [4] « *On the mass of Universe, arising from a black hole* » , and of R. Mass [5] « *A new model of the world : the Universe from a black hole* ».
M. Romashka comes to the same conclusions in his dissertation [6], *« In particular, it is shown that the fact that the visible horizon of Universe is the same than its gravitational radius, is a consequence of the principle of Mach ».*

Below, we will show that the gravitational "background" of the Universe ($\varphi_{univ} = -c^2$), is in interaction with the **φV**, which is the medium with the lowest energetic state of all quantum fields.

In contemporary views, the **φV** is a particular medium (a virtual world), which is the resulting product of the annihilation of almost all original matter, with the ratio (according to the relict background) of one elementary particle for 10^9 particles of original matter.

And indeed, during annihilation of pairs electron – positron, quark – antiquark, these pairs don't just "disappear", but they come into a strongly linked, dipole state, with a minimal, but non-zero energy (showing itself as the polarization of **φV**). At the same time, practically all of the pair's rest mass disappears.

On the other side, in the virtual world, individual parameters of particles, in particular their mass, are conserved. This can be interpreted (L.B. Okun [7]), in light of the equivalence mass – energy, as following: the mass of the particle doesn't disappear (it is a constant), but it is its rest energy $(c^2 \to 0)$ which disappears and is dissipated by electromagnetic quanta.

In quantum mechanics, **φV** is regarded as the medium with the lowest energetic state of all quantum fields. This is valid also for gravitation.

Then, in terms of field gravitation, we can postulate than **the gravitational potential of the φV** $(\boldsymbol{\varphi}_{\phi в})$ **tends to zero**, hence the rest energies of the annihilating particles also tend to zero.

CONCLUSION (2)

As all Elementary Particles, which find themselves in the homogeneous gravitational field of the Universe where $\varphi_{всел} = -c^2$, they get a rest energy equal to $E_0 = mc^2$, and the gravitational potential of the **φV** tends to zero when a difference of potential $\Delta\varphi = -c^2$ forms between each Elementary Particles and the **φV.**

This is a necessary and sufficient condition to consider that **all Elementary Particles, in relation to the φV, are QUANTUM BLACK HOLES.**

As a result, our Universe is « similar » to a black hole from the inside, and in which all the Elementary Particles, now considered from the outside, are also similar to « quantum black holes ».

I. Gerlovin's declaration ([13], p.28), that ***Elementary Particles are black holes, as manifestation of the fundamental field*** receives a justification.

An **Elementary Particles** is a "gravitational pit", around which a strong deformation of the **φV** is formed.

I. Gerlovin put emphasize on an interesting idea of A. Salam ([10], p.30): *The link between space-time and matter discovered by A. Einstein could be extended to other types of interactions, if only there would be a STRONG GRAVITATION, with a constant greater than G by several orders of magnitude.*

Developing the idea of A. Salam, I. Gerlovin introduces an exponential into the law of Coulomb at nuclear scales, justifying this by the principle of conformity of the TFF to Einstein's GTR ([13], p.61):

it is known that a conformal mapping from one subspace on another looks following :

$$g^s_{\mu\nu} = e^{f(s)} g_{\mu\nu} \qquad (3)$$

([13], p.28): *if we write the potential of the fundamental field with mass and charge, then according to mapping (3), we can get the main equations of the TFF, which are identical to the ones in Einstein's GTR, for subspaces* $(s = 1,2,3)$:

$$\varphi = q\frac{e^{-\frac{R}{r}}}{r}; \qquad \varphi = Gm\frac{e^{-\frac{R}{r}}}{r}; \qquad (4)$$

where: R – radius of Schwarzschild in terms of electromagnetic interactions

$$R^s_{\mu\nu} - \frac{R^s}{2} g^s_{\mu\nu} = 8\pi G \frac{T_{\mu\nu}}{c^4} \qquad (5)$$

We get the following picture: If we expose the equations of Einstein's GTR (5) to a reverse mapping (3), then we get exponential equations of Coulomb and Newton (4). In other words, the non-linear equations found by Gerlovin (4) are a consequence of solving the equation (5) for black holes, as mapping of one subspace on another.

This is a fundamental finding of I. Gerlovin, by the way, and A. Einstein didn't "note" this idea, which shall now be rethought. Why?

Let's take the 2nd postulate of the TFF: **the fundamental field is of electromagnetic nature, and is the source of all types of interactions**, and in no way this does reduce to gravitation.

The masses of Elementary Particles and the collapse (black hole) are both of electromagnetic nature, and can be described by the formula ([13], p.35):

$$m = \frac{q^2}{Rc^2}$$

The gravitational constant in the TFF, according to the equation ([10], p.174, (11.15)), in which we have the square of the electrical charge, also has an electromagnetic origin.

And we have to note that **all the 4 constants of the fundamental interactions**, according to the calculations of Gerlovin ([10], p.153-157), as well as the **potential of the fundamental field** (equal to $\boldsymbol{c^2}$), also have an **electromagnetic origin**.

What comes out of this? On nuclear scales, essentially positive charges are present, which can form only repulsive forces, and this doesn't eliminate the contradiction with non-linear Coulomb. How can we get out of this "pat" situation?

The concept of I. Gerlovin is based on the non-linearity of Coulomb's law, which forms a potential of the fundamental field equal to $\mathbf{c^2}$, having an electromagnetic origin. All this can be linked only to electroweak interaction, where the non-linear Coulomb law on nuclear scales describes weak interactions, in the form of **–Z, +Z** и $\mathbf{Z^0}$ vector bosons. Here, the concept of I. Gerlovin showed an incredible coincidence with experimental data ([10], p.157, (7.33)).

Above, it has been demonstrated that **the constant $\mathbf{c^2}$ has a gravitational origin**. And this is a sufficient condition in order to build, based now on the **modified Newton law**, and on the method of I. Gerlovin, a **STRONG GRAVITATION**, which is responsible for the **strong nuclear interactions**.

The constants of gravitation and of strong nuclear interaction will have the following form:

Modified Newton law	$\varphi = Ge^{-R/r}\frac{m}{r}$; $\quad G_{сил} = Ge^{-R/r}$
Constant of gravitation	$G \approx 10^{-11}\frac{m^3}{kg \cdot c}$
Constant of gravitation, normalized (no units)	$G\frac{m_p^2}{hc} \approx 10^{-39}$
Gravitational constant of the strong gravitation	$G_{strong} = \frac{hc}{m_p^2} \approx 10^{28}\frac{m^3}{kg \cdot c}$
Constant of strong interaction, normalized (no units)	$G_{\boldsymbol{strong}} m_p^2/\boldsymbol{hc} \approx 1$

Now we can answer the above mentioned question. The constant $\mathbf{c^2}$ appears in all 6 equations, because all the physical processes take place in the **homogeneous gravitational field of the Universe**, where $\varphi_{\boldsymbol{univ}} = -c^2$, and **the space "receives" electromagnetic parameters** (apart from gravitation and inertia), **thanks to the equation:**

$\frac{\mathbf{1}}{\boldsymbol{\varepsilon_0\mu_0}} = c^2$.

AFTERWORD

Why has the electromagnetic nature of Gerlovin's fundamental field some "flaws"? Here is my opinion.

At Gerlovin's time, the scientific circles bet on an electromagnetic origin of mass (hence the trend in Gerlovin's ideas). All in physics, all type of constants, even space, have been given an electromagnetic origin at this time, via the equation:
$\frac{1}{\varepsilon_0\mu_0} = c^2$.

And what is really stunning is that all the calculations of Gerlovin, all the constants and numbers without dimensions, the hierarchy of masses of Elementary Particles, did coincide to reality with a great level of exactitude.

Even I. Gerlovin said : *almost all constants are usually either postulated, either obtained from experiments, and I can calculate them directly from the theory…* And indeed, he managed to do it !

There are no such coincidences in science, and Gerlovin did rather uncover a new fundamental physical law, which remains to be correctly assessed.

Gerlovin saw that **the fundamental field is not a force, it inducts a curvature of the space** (just like in GTR: gravitation is not a force, it is a result of a curvature of space). This is specific to Gerlovin's child, the fundamental field, having a potential equal to $\mathbf{-c^2}$, and this field simply modifies the metrics of space according to equations (3), (4), (5).

So why do I seem to be critical to the model of strong interactions in terms of electromagnetic field? Here is the point. In the TFF, the physical vacuum is an extremely compact medium, full of Elementary Particles of Vacuum (EPV : proton – antiproton pairs), with a density equal to $\mathbf{10^{39}}$ **per** $\mathbf{см^3}$, and which are also black holes themselves (in the TFF, all the elementary particles are black holes).

By definition, a black hole is an object which forms a gradient of potential around itself, equal to $\mathbf{-c^2}$**.**
In classical terms, it is the gravitational potential.
In the TFF, it is an electromagnetic potential: i.e. in order for the black hole to form itself, the conjugated subspace should be characterized by a zero potential.

Here comes the following question: with respect to what are all the Elementary Particles black holes, it the **φV** itself is a medium full of black holes?
Moreover, in the TFF, there are no subspaces with a zero field.

We remind that **φV**, in quantum mechanics, is regarded as the medium with the minimal energetic state of all fields, i.e. the potentials of all fields tend to zero. And it is exactly in these conditions that any Elementary Particle, with respect to the "zero" **φV**, become a black hole.

But Gerlovin stated that any EPV is a black hole, which seems to be false.
At the same time, the real interesting thing is that the mathematical apparatus, in particular the equations (3), (4), (5), is really working. And this means that the subspace conjugated with our real world (the **φV**) should be characterized by "zero" fields.
The fundamenton, in the **φV** medium, should bear zero potentials, and not $\mathbf{-c^2}$, but at the limit (stitching) of the subspace **φV** → **Elementary Particles**, according to equations (3), (4), (5), the potential of the fundamenton rises to $\mathbf{c^2}$.
In the TFF, this is really the case : the assertion of Gerlovin ("**φV** is a medium of black holes") is excluded by the TFF itself !...

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