Final results from the Projective Unified Field Theory (PUFT): Motion of bodies, anomalous rotation curves, anomalous pioneer effect, heat production via cosmological expansion, Maxwell-Faraday equations, Dark matter, accelerated expansion of the universe model

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Abstract

The two preceding papers on the PUFT of the author published recently in viXra [1] and in [2] are geometrically grounded and physically based on the following forces: gravitation, electromagnetism and scalarism (new phenomenon of Nature, hypothetically introduced 1980) [3].

Paper 2 treats the cosmology of a closed symmetric isotropic world model, in 5-dimensional enlarging the Einstein theory based on fundamental new field equations and conservation laws (additional terms), being the result of the projection onto the 4-dimensional space-time. The physical basis of this world model is a two-component gas-mixture: mechanical dark-matter scalon-gas (particle: scalon) and electromagnetic photon-gas. The numerical procedure by resolving the appearing system of equations yields: Urstart of the expansion (named by the author) without singularity (no Big Bang) [4]. This way leads to the acceleration effect of the cosmological expansion (about 8 billion years after Urstart), according to the empirical detection some years ago. Correct rendering of the Hubble parameter. The age of finish of our world model yields 28 billion of years.

On such theoretical and (up to now) empirical basis we present here in Paper 3 following results as hypotheses:

1. Gravitational-scalaric field of a sphere.
2. Geodetic equation and general equation of motion of a moving body.

3. Anomalous pioneer effect of moving spacecrafts (departure from Newtonian behaviour).
4. Anomalous rotation curves of stars, moving around the centres of spiral galaxies (characteristic deviations from Newtonian mechanics).
5. Heat production in expanding moving bodies.
6. Reinterpretation of Maxwell-Faraday equations.
7. Status of Dark energy and accelerated cosmological expansion

1 Gravitational-scalaric field of a massive spherically symmetric static body

1.1 Exact solution

For the application of our theory PUFT to the motion of bodies (particles) in the neighbourhood of heavy masses (spheres) we need the gravitational-scalaric field in the surrounding. We were able, to find by calculation a suitable exact solution for treating our problem posed. By series expansion, it was possible to approximate the gravitational-scalaric field of a sphere. Our theory shows hypothetically a heat production effect for expanding bodies.

In order to simplify the physical situation, we formerly restricted to a sphere. In Schwarzschild coordinates our exact solution reads (inverse form) [2,5]:

$$e^{\alpha} = 1 + \frac{1}{\bar{\tau}}\left(\Lambda^2 - 1\right), \tag{1}$$

$$e^{\beta} = \left(\frac{\bar{\tau} A_1}{2r}\right)^2 \frac{1 + \frac{1}{\bar{\tau}}(\Lambda^2 - 1)}{(\Lambda - 1)^2}, \tag{2}$$

$$\sigma = \frac{A_0}{A_1}\beta + \bar{\sigma} \quad (\bar{\sigma} = \text{const}). \tag{3}$$

Here one should take into account the definition

$$\Lambda = \sqrt{1 + \bar{\tau}\left(e^{\alpha} - 1\right)}, \tag{4}$$

and the fact of constancy of the occurring integration parameters: $\bar{r}$, $\bar{\tau}$, A_0, A_1.

Let us in this context remind that A. Gorbatsievich, by leaving the Schwarzschild coordinates [6], could avoid this inversion problem within our solution.

1.2 Approximation of second order

First we exploit the structure of the Schwarzschild solution, being determined in detail by our general solution. This way we arrive next at the following choice of the parameters being received by integration:

$$\text{a)}\quad A_0 = 0 \quad \text{i.e.} \quad \text{b)} \quad \bar{\tau} = 0\,,\ A_1 \neq 0\,. \tag{5}$$

For astrophysical application we need the second order approximation. We reach this goal by following consideration: As mentioned above, by series expansion ($\bar{\beta}$ integration constant) we find:

$$\begin{aligned}(\mathrm{d}s)^2 = {} & \left[1 + \frac{r_g}{r} + \frac{r_g^2}{r^2}\left(1 + \frac{\bar{\tau}}{4}\right)\right] (\mathrm{d}r)^2 + r^2\left[(\mathrm{d}\theta)^2 + \sin^2\theta(\mathrm{d}\varphi)^2\right] \\ & - e^{\bar{\beta}}\left(1 - \frac{r_g}{r}\right)(\mathrm{d}x^4)^2\,,\end{aligned} \tag{6}$$

$$\sigma = \bar{\sigma} - \frac{r_g}{2r}\sqrt{\bar{\tau}}\left(1 + \frac{r_g}{2r}\right), \tag{7}$$

where the quantity

$$r_g = \frac{\varkappa_0 M_c c^2}{4\pi} = \frac{2\gamma_{\mathrm{N}} M_c}{c^2} \tag{8}$$

denotes the gravitational radius of the sphere considered (M_c mass of the sphere).

1.3 Further hints at the interior of the sphere

Applying these above results, we developed thoughts on the inner part of the sphere by restricting to the first approximation of our preceding calculations: radial in-homogeneity, pressure, temperature, rough equation of state, etc. As subjects with rather well known empirical parameters we took into account: sun, planets, moon etc. Our theoretical and numerical calculations became voluminous, but being not bad. Nevertheless, we got the personal impression, a new field of positive research seems to be found. We published our results in detail [2]. Perhaps interested scientists, particularly geophysicists and astrophysicists, may get inspirations.

2 Geodetic equation and general equation of motion of a moving body

The scientific contents of this chapter is taken from our calculations quoted in [2]. We remind at some useful results.

2.1 Geodesic

Let us remember the 4-dimensional Einstein theory, in which in respect of the motion of bodies the geodetic motion played an outstanding role. It is provoking here to investigate the 5-dimensional geodesic. The 4-dimensional projection of the assigned equation reads (β is an integration constant in different context):

$$\frac{\mathrm{D}u^m}{\mathrm{D}\tau} = -\frac{ic\beta}{a_0\sqrt{1-\frac{\beta^2}{S^2}}}\,B^m{}_k u^k - \frac{\beta^2 c^2}{S^2\Big(1-\frac{\beta^2}{S^2}\Big)}\left(\sigma^{,m} + \frac{1}{c^2}\,\frac{\mathrm{d}\sigma}{\mathrm{d}\tau}\,u^m\right) \tag{9}$$

with

$$S = S_0\,\mathrm{e}^{\sigma} \tag{10}$$

($\alpha_0 = e_0$ electric elementary charge, S scalar field being world radius in cosmology, σ scalaric field being basic new field induced by the five-dimensionality, S_0 cosmological elementary length constant).

As usual, the occurring total acceleration in this subsequent equation is defined by

$$\frac{\mathrm{D}u^m}{\mathrm{D}\tau} = u^m{}_{;k}u^k = \frac{\mathrm{d}u^m}{\mathrm{d}\tau} + \begin{Bmatrix} m \\ ln \end{Bmatrix} u^l u^n\,. \tag{11}$$

With respect to the physical identification of beta, because of the same physical length dimension we came to the choice

$$\beta = iS_0\,. \tag{12}$$

Then from (9) follows the alternative shape of the geodesic:

$$m\frac{\mathrm{D}u^m}{\mathrm{D}\tau} = \frac{Q}{c}\,B^m{}_k u^k + \frac{mc^2}{1+\mathrm{e}^{2\sigma}}\left(\sigma^{,m} + \frac{1}{c^2}\,\frac{\mathrm{d}\sigma}{\mathrm{d}\tau}\,u^m\right). \tag{13}$$

Here our exceptional interest deserves the similar electromagnetic Lorentz term in this equation of motion.

2.2 Equation of motion of an electrically charged body (particle)

Our calculations on a moving charged body within our theory PUFT [2] yielded, by using our results via Lagrange-Hamilton formalism, following equation of motion (without pressure):

$$m\frac{\mathrm{D}u^m}{\mathrm{D}\tau} = \frac{Q}{c}\,B^m{}_k u^k - D\left(\sigma^{,m} + \frac{1}{c^2}\,\frac{\mathrm{d}\sigma}{\mathrm{d}\tau}\,u^m\right). \tag{14}$$

The quantities used are:

$$m = \int\limits_{x^4=\mathrm{const}} \bar{\mu}\mathrm{d}^{(3)}V \qquad \text{(mechanical mass)}\ , \tag{15a}$$

$$D = \int\limits_{x^4=\mathrm{const}} \bar{\vartheta}\mathrm{d}^{(3)}V \qquad \text{(scalaric substrate energy = scalerg)}\ , \tag{15b}$$

$$Q = \int\limits_{x^4=\mathrm{const}} \bar{\varrho}\mathrm{d}^{(3)}V = \mathrm{const} \qquad \text{(electric charge).} \tag{15c}$$

Attempted Interpetation:

Now our next step is devoted to the comparison of the equations of motion for the geodesic (13) and for a charged body (14): Using the scalaric mass of the body, derived earlier [2]:

$$m = m_0\sqrt{1+\mathrm{e}^{-2\sigma}} \quad (m_0 \ \text{restmass})\,, \tag{16}$$

and comparing both equations (13) and (14), we receive following two connecting relations:

$$\text{a)}\quad Q = -\frac{m_0 c^2 S_0}{e_0} \quad \text{and} \quad \text{b)}\quad D = -\frac{mc^2}{1+\mathrm{e}^{2\sigma}}\,. \tag{17}$$

It is obvious that both the above equations of motion (13) and (14), basing on different physical grounds (amplified geodesic and Lagrange-Hamilton formalism), can only be of common content, if the body (particle) considered carries the elementary electric charge e_0 and the same rest mass. Thus results the following formula

$$m_0 \ \rightarrow \ m_{el} = \frac{e_0^2}{S_0 c^2} \tag{18}$$

by identification of both approaches to the same motion treated.

Let us now specialize our considerations to a particle (instead general body): By means of the numerical value of the elementary scalaric length constant [2]:

$$S_0 = e_0\sqrt{\frac{\varkappa_0}{2\pi}} = \frac{2e_0}{c^2}\sqrt{\gamma_{\mathrm{N}}} = 2,763\cdot 10^{-34}\,\mathrm{cm}\,, \tag{19}$$

then the introduced elementary scalaric mass (on our hypothetic idea) reads:

$$m_{el} = 9.303\cdot 10^{-7}\,\mathrm{g}\,. \tag{20}$$

Since here our preceding reflections are based on the Urstart model of the cosmos, we could think on such a particle as an initial mechanical matter particle.

Notation:

The value (20) of this elementary mass has been concluded from our 5-dimensional theory PUFT. The order of magnitude in (20) reminds at the treatment of the Planck scale of elementary quantities, where the Planck mass, considered on the basis of quantum theory, shows a smaller value of nearly one order of magnitude. The values of the Planck elementary units are:

$$\text{Planck length:} \qquad l_{\mathrm{Pl}} = \sqrt{\frac{\gamma_{\mathrm{N}} h}{c^3}} = 4 \cdot 10^{-33}\,\mathrm{cm}\,; \tag{21}$$

$$\text{Planck mass:} \qquad m_{\mathrm{Pl}} = \sqrt{\frac{ch}{\gamma_{\mathrm{N}}}} = 2.1767 \cdot 10^{-5}\,\mathrm{g}\,. \tag{22}$$

3 Anomalous pioneer effect of moving spacecrafts (departure from Newtonian behaviour)

Nearly two decades ago J. D. Anderson et al. discovered characteristic deviations of the spacecraft pioneer 10 on its course away from the solar planetary system with the additional acceleration:

$$g_{\mathrm{Pioneer|obs}} = -(8.74 \pm 1.33) \cdot 10^{-8}\,\mathrm{cm/s^2}\,, \tag{23a}$$

the spacecraft being

$$77,67\,\mathrm{AE} = 1.162 \cdot 10^{15}\,\mathrm{cm} \tag{23b}$$

remote from the sun, with the velocity (relative to the sun)

$$12,24\,\mathrm{km/s} = 1.224 \cdot 10^{6}\,\mathrm{cm/s}\,. \tag{23c}$$

Up till now this suggested departure from Newtonian physics seems to be unsolved.

Let us try to treat this problem based on our hypothesis of the existence of a gravitationally active accretion halo, additionally effective aside the gravitational field of the sun.

We developed our accretion theory of halos within the 5-dimensional theory PUFT towards the year 2003 [4].

The calculated results via series expansion read as follows: Gravitational accretion potential (M_c central mass):

$$\chi_{ac} = \frac{\gamma_{\mathrm{N}} M_c \varkappa^2 r}{2} \left[1 - \frac{1}{12}(\varkappa r)^2\right]; \tag{24a}$$

Gravitational accretion acceleration:

$$g_{ac} = -\frac{\gamma_{\mathrm{N}} M_c \varkappa^2}{2} \left[1 - \frac{1}{4}(\varkappa r)^2\right]. \tag{24b}$$

In these formulas appears the abbreviation ($\bar{n}$ averaged particle number density, m mass of accretion halo particle, T temperature of the accretion halo, k Boltzmann constant),

$$\varkappa^2 = \frac{4\pi\gamma_{\mathrm{N}}\bar{n}m^2}{\mathrm{k}T} = \frac{1}{\ell_{ac}^2}\,. \tag{25}$$

For our physical interpretation the accretion length ℓ_{ac} plays an important role.

By identifying both the acceleration (23a) (measured) and the accretion acceleration (24b):

$$g_{ac} = g_{Pioneer|obs}\,, \tag{26}$$

we come to the interesting equation

$$\frac{2\pi\gamma_{\mathrm{N}}^2 M_c\bar{n}m^2}{\mathrm{k}T} = 8,47\cdot 10^{-8}\,\mathrm{cm\,s^{-2}}\,. \tag{27}$$

Resolving leads to the result (one equation for three quantities)

$$\frac{\bar{n}m^2}{T} = 2,1\cdot 10^{-43}\,\mathrm{g^2cm^{-3}K^{-1}}\,. \tag{28}$$

From astrophysical knowledge the following rough estimated values:

$$\text{a)}\quad T\approx 3\cdot 10^{-3}\,\mathrm{K}\,,\qquad \text{b)}\quad \bar{n} = 6\,\mathrm{cm^{-3}}\,, \tag{29}$$

seem to be acceptable for the order of magnitude.

Hence from (27) results the value of the mass of an accretion particle of the halo around the sun:

$$\begin{aligned}&\text{a)}\quad m\approx 3\cdot 10^{-22}\,\mathrm{g} = 168,6\frac{\mathrm{GeV}}{c^2}\quad \text{with}\\ &\text{b)}\quad \frac{1\,\mathrm{GeV}}{c^2} = 1,78\cdot 10^{-24}\,\mathrm{g}\,.\end{aligned} \tag{30}$$

For later numerical application we hold onto following numerical values received for our assumed accretion halo of the sun:

$$\begin{aligned}&\text{a)}\quad \varkappa^2 = 1,275\cdot 10^{-35}\,\mathrm{cm^{-2}}\,,\\ &\text{b)}\quad \varkappa = 3,57\cdot 10^{-17}\,\mathrm{cm^{-1}}\,,\\ &\text{c)}\quad \ell_{ac} = 2,8\cdot 10^{16}\,\mathrm{cm}\,.\end{aligned} \tag{31}$$

Notation:

The above yielded value for mass of an accretion particle of the halo (30a) suggests to the hypothetical claim that the accretion particle calculated may be the wimp particle received by the deeply founded quantum elementary particle theory [7, 8]:

$$m_{wimp}\approx 2\cdot 10^{-22}\,\mathrm{g}\,. \tag{32}$$

4 Anomalous rotation curves of stars, moving around the centres of spiral galaxies (characteristic deviations from Newtonian mechanics).

4.1 Integration of the equation of motion

In the above research we tested, whether eventually the anomalous pioneer effect could be explained on the basis of our 5-dimensional field theory PUFT. Here we devote our treatment to the anomalous rotation curves of spiral galaxies, in order to investigate this not fully understood part of astrophysics on the same theoretical fundament as done. Since it is empirically well known, that in time, the motion of suns rotating around the centre of spiral galaxies (in large distance), do not fully follow Newtonian physics:

$$V_{rot|N} = \pm\sqrt{\frac{\gamma_{\mathrm{N}} M_c}{r_0}} = \pm c\sqrt{\frac{r_g}{2r_0}} \tag{33}$$

(for circular motion: r_0 distance between body and centre).

Let us now begin our new start based on our theory PUFT, having in the background the Newtonian approximation (33).

For vanishing of electromagnetism around the central body, we succeeded in integrating the equation of motion (differential equation of second order in time) and arrived at the following first order equation [2]:

$$\left(\frac{\mathrm{d}r}{\mathrm{d}\tau}\right)^2 + \ell_0^2 \frac{\mathrm{e}^{-\alpha}}{r^2\left(1+\mathrm{e}^{-2\sigma}\right)} + \mathrm{e}^{-\alpha} c^2 \left(1 - \frac{\mathrm{e}^{2\bar{\beta}-\beta}}{1+\mathrm{e}^{-2\sigma}}\right) = 0\,, \tag{34}$$

showing two constant parameters: $\bar{\beta}$ and ℓ_0.

In the following we receive the area velocity

$$F = r^2\,\frac{\mathrm{d}\varphi}{\mathrm{d}\tau} = \frac{\ell_0}{\sqrt{1+\mathrm{e}^{-2\sigma}}} \tag{35}$$

and the time-propertime relation

$$\frac{\mathrm{d}t}{\mathrm{d}\tau} = \frac{\mathrm{e}^{\bar{\beta}-\beta}}{\sqrt{1+\mathrm{e}^{-2\sigma}}}\,. \tag{36}$$

Let us further remind the scalaric mass formula (16)

$$m_s = m = m_0\sqrt{1+\mathrm{e}^{-2\sigma}}\,. \tag{37}$$

The definition of the constant angular momentum reads:

$$\text{a)}\quad L_0 = mF = m_0\sqrt{1+\mathrm{e}^{-2\sigma}}\,F = m_0\ell_0 \quad \text{with} \quad \text{b)}\quad \ell_0 = \frac{L_0}{m_0}\,, \tag{38}$$

while the external Schwarzschild solution takes the form:

$$\mathrm{e}^{\alpha(r)} = \frac{1}{1-r_g/r}\,, \qquad \mathrm{e}^{\beta(r)} = 1 - r_g/r\,. \tag{39}$$

4.2 Further specialisation of the central body to spherical symmetry

Under this assumption we come to following formulas for the central body:

Newtonian gravitational potential:

$$\phi(r) = -\frac{r_g c^2}{2r}\,, \tag{40}$$

Gravitational-scalaric potential:

$$\phi_{gs} = \phi\left(1 - \frac{1}{\left(1 + \mathrm{e}^{2\bar{\sigma}}\right)^2}\right)\,. \tag{41}$$

During the subsequent calculations we use the dimensionless expansion parameter (R_0 radius of the sphere):

$$\gamma = \frac{r_g}{R_0}\,. \tag{42}$$

4.3 Time dependence of the scalaric field

This part of our paper is devoted to the scalaric field around the central body. We take the approximate equation

$$\sigma(r,t) = \bar{\sigma}(t) + s(r) \quad \text{with} \quad \frac{s}{\bar{\sigma}} \ll 1 \tag{43}$$

for our mathematical basis. This means additional space-time splitting. Since we are interested in final numerical statements, here our interest concentrates on the cosmological time dependence (index p refers to the present epoch). Referring to the numerical values, we very slightly corrected them compared with the some years ago values [2]:

$$\begin{aligned} &\bar{\sigma}_p = 1.8\,, && \left(\frac{\mathrm{d}\bar{\sigma}}{\mathrm{d}t}\right)_p = -1.435 \cdot 10^{-18}\,\mathrm{s}^{-1}\,, \\ &\mathrm{e}^{2\bar{\sigma}_p} = 36.6\,, && \mathrm{e}^{-2\bar{\sigma}_p} = 2.73 \cdot 10^{-2}\,. \end{aligned} \tag{44}$$

Here we stop our further treatment in detail, but we explain how to go on [2].

We substitute the quantities calculated above into equation (34) and arrive at the simplified radial equation of motion of the body moving around the central body:

$$\left(\frac{\mathrm{d}r}{\mathrm{d}t}\right)^2 = -\,\mathrm{e}^{-2\bar{\beta}}\left[\frac{\ell_0^2}{r^2} + c^2\left(1 + \mathrm{e}^{-2\sigma}\right)\right]\left(1 - \frac{r_g}{r}\right)^3 + c^2\left(1 - \frac{r_g}{r}\right)^2. \tag{45}$$

with both the constants: $\bar{\beta}$ being still free and ℓ_0 being related to the constant angular momentum of the rotating body:

$$L_0 = m_0 \ell_0\,. \tag{46}$$

4.4 Definition of the rotation curve of a moving body under the influence of the accretion halo

We consider the particular case of a circularly moving body (r_0 radius). Hence from (45) the equation of the rotation curve of the body results:

$$V_{rot}(r_0) = \frac{\ell_0}{r_0} = \pm c\sqrt{\frac{\mathrm{e}^{2\bar{\beta}}}{1-\frac{r_g}{r_0}} - \left(1+\mathrm{e}^{-2\bar{\sigma}}\right)}\,, \tag{47}$$

with both the constants: $\bar{\sigma}$ (see (44)) and $\bar{\beta}$ (as mentioned above free).

We tried to reach continuity with the result in Newtonian approximation (33), and received after rather lengthy calculation the following enlarged formula for the rotation velocity:

$$V_{rot} = \pm\sqrt{\frac{2\mathcal{E}_0}{m} + \frac{2\gamma_{\mathrm{N}} M_c}{r_0} - \gamma_{\mathrm{N}} M_c \varkappa^2 r_0}\,. \tag{48}$$

Here $\mathcal{E}_0$ is the constant energy of the moving body (T kinetic energy, U potential energy):

$$\mathcal{E}_0 = T + U + U_{Ac}\,. \tag{49}$$

In this equation appears the potential halo-accretion energy of the moving body.

Finally the equation of the rotation curve (48) takes the form

$$V_{rot} = \pm\sqrt{\frac{\gamma_{\mathrm{N}} M_c}{r_0}}\sqrt{1+\frac{1}{2}(\varkappa r_0)^2}\,. \tag{50}$$

The first factor on the right hand side presents the Newtonian approximation.

4.5 Application at the Galaxy (Milky Way)

As first step calculation in our monograph [2] we chose our sun as the moving test body, for simplicity ignoring the other suns. A data bank of the needed values is contained in the book quoted.

First instead of r_0 by means of

$$r_0 = X \cdot 10^3\,\mathrm{ly} = 9{,}46X \cdot 10^{20}\,\mathrm{cm} \tag{51}$$

we introduce the dimensionless constant X as new abscissa for graphical purposes. Then the equation for the rotational curve reads:

$$V_{rot} = \pm\frac{1{,}19}{\sqrt{X}} \cdot 10^8\,\mathrm{cm\,s^{-1}}\sqrt{1+2{,}717X^2 \cdot 10^{51}\left(\frac{\bar{n}m^2}{T}\right)\mathrm{g^{-2}cm^3K}}\,. \tag{52}$$

From empirical experience we know the values:

$$\begin{aligned} &\text{a)} \quad R_\odot = 2.468 \cdot 10^{22}\,\text{cm} \qquad &&\text{(radius of the circle of the sun)}, \\ &\text{b)} \quad v_\odot = 233\,\text{km/s} \qquad &&\text{(velocity of the circulating sun)}. \end{aligned} \tag{53}$$

Thus we arrive at the unknown quotient

$$\frac{\bar{n}m^2}{T} = 1,5276 \cdot 10^{-56}\,\text{g}^2\text{cm}^{-3}\text{K}^{-1}\,. \tag{54}$$

If we here also accept the formerly suggested wimp as the particle of the halo, we may use the value (30a)

$$m \approx 3 \cdot 10^{-22}\,\text{g} = 168,6\frac{\text{GeV}}{c^2}\,, \tag{55}$$

being in the order of magnitude of (30a). Thus from (54) yields the new result

$$\frac{\bar{n}}{T} = 1,697 \cdot 10^{-13}\,\text{cm}^{-3}\text{K}^{-1}\,, \tag{56}$$

which may be satisfied by the values

$$\text{a)} \quad \bar{n} = 1,7 \cdot 10^{-7}\,\text{cm}^{-3} \quad \text{and} \quad \text{b)} \quad T = 10^6\,\text{K}\,, \tag{57}$$

which are rather near to the values of astrophysical estimate.

Under these numerical conditions the equation of the rotation curve (52) reads:

$$V_{rot}(X) = \pm 1,19 \cdot 10^3 \frac{1}{\sqrt{X}} \cdot \sqrt{1 + 4,3135 \cdot 10^{-5} X^2}\,\text{km}\,\text{s}^{-1}\,. \tag{58}$$

The following graphical presentation in figure 1 shows (for one circulating sun) the velocity enlarging influence through the gravitational field of the halo. Taking into account several circulating suns leads to a modulation of the curve.

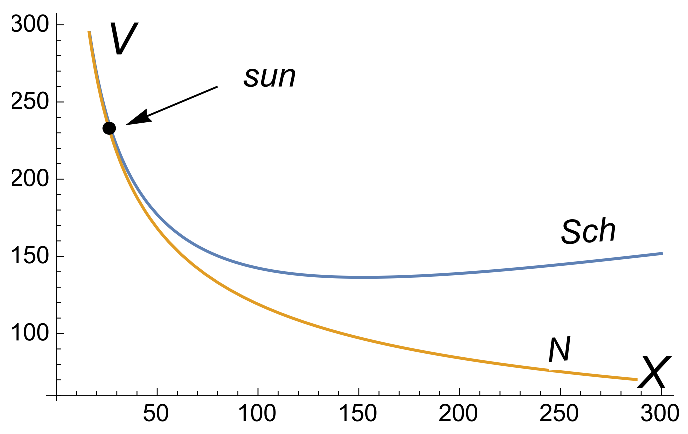

figure 1:
Rotation curve of a sun in the field of our Galaxy: N — Newton theory, Sch — PUFT theory

5 Heat production in moving bodies caused by the time-dependence of the cosmological scalaric field

5.1 General review on the (hypothetic) scalaric induction effect in geophysics and astrophysics

In treating the energy balance equation of a moving body, we received following balance equation for the temporal change of its energy content (grasping several distinguished) effects:

$$\begin{aligned}\frac{\mathrm{d}T_{\mathrm{kin}}}{\mathrm{d}t} &= -\frac{Mv^2}{\sqrt{1-(v/c)^2}}\,\frac{1}{K}\,\frac{\mathrm{d}K}{\mathrm{d}t}\\ &\quad + \frac{\mathrm{d}M}{\mathrm{d}t}\,c^2\big(\sqrt{1-(v/c)^2}-1\big)+Q(\boldsymbol{E}\cdot\boldsymbol{v})\,.\end{aligned} \tag{59}$$

The definition of the kinetic energy reads:

$$T_{\mathrm{kin}} = \mathcal{E}_d - Mc^2 \tag{60}$$

($\mathcal{E}_d$ dynamic energy, Mc^2 rest energy), whereas the last term of the right hand side of (59) represents the well known Ohm term in thermodynamics which now will be ignored.

It is advisable to change the shape of the equation (59):

$$P = -\frac{\mathrm{d}Q}{\mathrm{d}t} = P_K + P_\sigma \quad (T_{\mathrm{kin}} \;\to\; -Q) \tag{61}$$

using the abbreviations:

$$P_K = -\frac{\mathrm{d}Q_K}{\mathrm{d}t} = \frac{Mv^2}{\sqrt{1-\left(\frac{v}{c}\right)^2}}\,\frac{1}{K}\,\frac{\mathrm{d}K}{\mathrm{d}t} \tag{62}$$

(cosmological heat production) and

$$P_\sigma = -\frac{\mathrm{d}Q_\sigma}{\mathrm{d}t} = -\frac{\mathrm{d}M}{\mathrm{d}t}\,c^2\left(\sqrt{1-\left(\frac{v}{c}\right)^2}-1\right) \tag{63}$$

(scalaric heat production). Let us remind: According to the heat production equation (61) we have to distinguish between two different classes:

1. Heat production by the cosmological expansion (time-dependence of the radius of the cosmological model): This prognostic effect, received by applying our hypothetical theory PUFT on geophysics, astrophysics and cosmology, could be an interesting addition to the conventional result. The many-sided fields mentioned are numerically treated in our monograph [2].
2. Heat production by the immediate time-dependence of the scalaric field: In future vision, perhaps empirical progress can open the sight. Of course, we are thinking at hypothetical consequences of our theory.

5.2 List of rough numerically applications (present era, order of magnitude)

Heat production:

Earth

$$\text{a)} \quad P_E = 2 \cdot 10^{16}\,\mathrm{W}\,, \quad \text{b)} \quad P_{E,emp} = 4 \cdot 10^{13}\,\mathrm{W}\,. \tag{64}$$

Idea for the surplus: volcanicity, seismicity.

Moon of earth

$$\text{a)} \quad P_{ME} = 1.6 \cdot 10^{11}\,\mathrm{W}\,, \quad \text{b)} \quad P_{ME,emp} = 4 \cdot 10^{11}\,\mathrm{W}\,. \tag{65}$$

Extension velocity by heat production:

Earth

$$\begin{aligned} &\text{a)} \quad V_E = 0.6\,\mathrm{cm/centure}\,, \\ &\text{b)} \quad V_{E,emp} = 1\,\mathrm{cm/centure} \quad \text{(differing estimates in literature).} \end{aligned} \tag{66}$$

6 Reinterpretation of Maxwell-Faraday equations

6.1 Influence of the phenomenon scalarism/scalarity on the Maxwell-Faraday electromagnetism

In the preceding representation of our new theory PUFT (Part 1, Part 2 and partially in Part 3), which we understand as a hypothetic trial on the way to a basic new physics, we concentrated on the eventual enlargement of the sight on gravitation and cosmology. This section of our article is devoted to the question: Influence of scalarism on electromagnetism; existence of a proper additional scalaric electromagnetism?

Using understandable traditional notations, the theoretical fundament of electromagnetism in the Gauss system reads:

Inhomogeneous Maxwell field equation:

$$H^{ij}{}_{;j} = \frac{4\pi}{c}\, j^i \tag{67}$$

(H^{ij} electromagnetic induction tensor, j^i electric current density).

Electric continuity equation (conservation law):

$$j^i{}_{;i} = 0\,. \tag{68}$$

Cyclic field equation:

$$B_{<ij,k>} = 0 \tag{69}$$

(B_{ij} electromagnetic field strength tensor).

The relation between field strength tensor and induction tensor reads:

$$H_{ij} = \varepsilon B_{ij}\,, \tag{70}$$

with the scalaric vacuum dielectricity defined by

$$\varepsilon = \mathrm{e}^{2\sigma} \tag{71}$$

(naming was introduced by the author).

Closing this section, we remind that at presence of substrate (matter) the electric current density reads:

$$\text{a)} \quad j^i = c\,\mathrm{e}^{\sigma}\sqrt{\frac{\varkappa_0}{2\pi}}\,\overset{5}{\Theta}{}^{i\nu} s_\nu \quad \text{with} \quad \text{b)} \quad s_\nu = \frac{X_\nu}{S}\,. \tag{72}$$

6.2 Alternative sight on electromagnetism

We remember the fact that in the Lorentz force (equation of motion of electrical matter moving in an electromagnetic field) the induction tensor plays the dominant role. It seems to be legitimate to cast the inhomogeneous field equation (65) into an other inhomogeneous form:

$$B^{ij}{}_{;j} = \frac{4\pi}{c}\, J^i\,. \tag{73}$$

Thus we arrive at the alternative electrical current density

$$J^i = \mathrm{e}^{-2\sigma} j^i - \frac{c}{2\pi}\, B^{ij}\sigma_{,j} = J^i_S + J^i_\sigma\,, \tag{74}$$

satisfying the continuity equation (conservation law). The occurring splitting terms are:

$$J^i_S = c\,\mathrm{e}^{-\sigma}\sqrt{\frac{\varkappa_0}{2\pi}}\,\overset{5}{\Theta}{}^{i\nu} s_\nu \quad \text{(mechanical-scalaric part)} \tag{75}$$

and

$$J_\sigma^i = \frac{c}{2\pi}\, B^{ij}\sigma_{,j} \qquad \text{(scalaric-fieldtheoretical part)}\,. \tag{76}$$

The obvious physical interpretation means: Scalaric in-homogeneity (space and time) in an electromagnetic field may influence electromagnetism.

6.3 Hypothetically enlarged electromagnetism in 3-dimensional shape

Approximately the inhomogeneous Maxwell field equation (67) splits into the three equations:

$$\begin{aligned} &\text{a)}\quad \operatorname{rot}\boldsymbol{H} = \frac{1}{c}\Big(\frac{\partial \boldsymbol{B}}{\partial t} + 4\pi\boldsymbol{j}\Big)\,, \quad \text{b)}\quad \operatorname{div}\boldsymbol{D} = 4\pi\varrho\,,\\ &\text{c)}\quad \boldsymbol{D} = \varepsilon\boldsymbol{E}\,,\quad \boldsymbol{H} = \varepsilon\boldsymbol{B} \qquad\qquad (\varepsilon = \mathrm{e}^{2\sigma} \approx \mathrm{e}^{2\bar\sigma})\,, \end{aligned} \tag{77}$$

whereas the cyclic Maxwell system (69) yields following equations:

$$\text{a)}\quad \operatorname{rot}\boldsymbol{E} = -\frac{1}{c}\,\frac{\partial \boldsymbol{B}}{\partial t}\,, \quad \text{b)}\quad \operatorname{div}\boldsymbol{B} = 0\,. \tag{78}$$

Now it is advisable to reshape the equations (77a) and (77b):

$$\begin{aligned} &\text{a)}\quad \operatorname{rot}\boldsymbol{B} = \frac{1}{c}\Big(\frac{\partial \boldsymbol{E}}{\partial t} + 2\,\frac{\mathrm{d}\bar\sigma}{\mathrm{d}t}\,\boldsymbol{E}\Big) + \frac{4\pi}{c}\,\mathrm{e}^{2\bar\sigma}\boldsymbol{J}\,,\\ &\text{b)}\quad \operatorname{div}\boldsymbol{E} = 4\pi\,\mathrm{e}^{-2\bar\sigma}\varrho\,. \end{aligned} \tag{79}$$

By rot-calculation at the first equation we find the enlarged wave equation

$$\triangle\boldsymbol{B} - \frac{2}{c^2}\,\frac{\mathrm{d}\bar\sigma}{\mathrm{d}t}\,\frac{\partial \boldsymbol{B}}{\partial t} - \frac{1}{c^2}\,\frac{\partial^2 \boldsymbol{B}}{\partial t^2} = -\frac{4\pi}{c}\,\mathrm{e}^{-2\bar\sigma}\operatorname{rot}\boldsymbol{J}\,, \tag{80}$$

which by further calculation leads to the simplified wave equation for the magnetic field strength:

$$\triangle\boldsymbol{B} - \frac{1}{c^2}\,\frac{\partial^2 \boldsymbol{B}}{\partial t^2} + 2\,\mathrm{e}^{-2\bar\sigma}\boldsymbol{B}\triangle s = 0\,. \tag{81}$$

During these calculations following intermediate results were used:

$$\boldsymbol{J} = \frac{c}{2\pi}\,\boldsymbol{B}\times\operatorname{grad}\sigma - \frac{1}{2\pi}\,\boldsymbol{E}\,\frac{\mathrm{d}\bar\sigma}{\mathrm{d}t}\,, \tag{82}$$

$$\varrho = \frac{1}{c}\,J^4 = \frac{1}{2\pi}\,(\boldsymbol{E}\cdot\operatorname{grad}\sigma)\,, \tag{83}$$

$$\operatorname{rot}\boldsymbol{J} = \frac{c}{2\pi}\big(\boldsymbol{B}\triangle s\big) + \frac{1}{2\pi c}\,\frac{\partial \boldsymbol{B}}{\partial t}\,\frac{\mathrm{d}\bar\sigma}{\mathrm{d}t}\,. \tag{84}$$

These three hypothetical basic equations, being formulated in 3-dimensional language, show obviously an interaction between the electromagnetic field and the time-dependent scalaric field. Required that scalarity/scalarism exists in Nature at all.

The physical vision on this eventual perspective gets even more impressive, when we look at the corrected equation of motion of a particle [2–4]:

$$m\left(\frac{\mathrm{d}\boldsymbol{v}}{\mathrm{d}t}+\operatorname{grad}\phi_{gs}-\frac{1}{1+\mathrm{e}^{2\bar{\sigma}}}\frac{\mathrm{d}\bar{\sigma}}{\mathrm{d}t}\boldsymbol{v}\right)=Q\left(\boldsymbol{E}+\frac{1}{c}\boldsymbol{v}\times\boldsymbol{B}\right), \tag{85}$$

whereas the quantities occurring are:

$\bar{\sigma}$: approximated scalaric field,

ϕ_{gs}: gravitational-scalaric potential,

m (scalaric mass) $= m_0\sqrt{1+\mathrm{e}^{-2\bar{\sigma}}}$.

7 Status of Dark energy and accelerated cosmological expansion

7.1 Introduction

The idea of postulating the existence of Dark matter in our universe is fully justified by the need to explain several very important empirical discoveries. Our preceding theoretical treatment was primarily devoted to: anomalous pioneer effect of moving spacecrafts and anomalous rotation curves within spiral galaxies.

The postulated existence of Dark energy introduced by P. J. Steinhardt [9] is mainly basing on the argument: explaining Einstein's cosmological constant via accepting the existence of Dark energy in Nature. An important argument: Grasping the obviously existing quantum theoretical vacuum energy density (critics on the order of magnitude followed later).

Statement of negative pressure to be welcome to account for the observed accelerated cosmological expansion. Here some researchers suggest that the observed acceleration of the cosmological expansion can be understood by Dark energy. In time various ideas were investigated and even claimed as correct. Checking this new headword "Dark energy" in topical specialized literature, one is not able to find an unambiguous definition, often one even meets refusal [10].

The detection of the accelerated expansion of our universe since about eight/nine billion years was primarily revealed by S. Perlmutter and B. Schmidt [11] as well A. G. Riess [12] (Nobel prize for all in 2011), who primarily evaluated the observed properties of special supernovae of category 1a.

Let us mention some often used arguments for the reality of the existence of Dark energy, but also reflect at open questions:

- The obvious cosmological acceleration is only understandable by the necessarily negative pressure which prevents the forming of astrophysical structures. Otherwise the cosmological expansion would be basically changed.
- The Dark energy conception yields a better explanation of the explosions of special types of supernovae, thinking at observed facts, mainly by exploiting the gravitational lens effect.
- Problems with the application of the Planck radiation theory on the observed cosmic background results.
- Constancy of the cosmological Dark energy since nine billion of years?

7.2 Cosmological term in gravitational field equations and the cosmological acceleration

In 1980 at the GR9 Congress in Jena [3] the author presented his 5-dimensional Projective Unified Field Theory (PUFT) with his new projecting axiomatics onto the 4-dimensional space-time and further onto 3-dimensionality. Via Lagrange-Hamilton formalism he arrived at his set of 5-dimensional field equations, leading to the 4-dimensional gravitational field equation

$$R^{mn} - \tfrac{1}{2}\, g^{mn} R - \frac{\lambda_{\mathrm{S}}}{S_0^2}\, e^{-2\sigma} g^{mn} = \varkappa_0 \Big[E^{mn} + S^{mn} + \Theta^{mn} \Big] \,. \tag{86}$$

On the left hand side we recognize a term similar to Einstein's cosmological term. Treating our Urstart cosmological model (without Big Bang) [2] , we met the value of our cosmological constant (both variants)

$$\text{a)} \quad \Lambda_{\mathrm{S}} = 5,7639 \cdot 10^{-55}\, \mathrm{cm}^{-2} \quad \text{with} \quad \text{b)} \quad \lambda_{\mathrm{S}} = 4,4 \cdot 10^{-122} \,. \tag{87}$$

The graphic figures 2 and 3 show the qualitative temporal course of the expansion velocity $\dot{L}$ and the expansion acceleration $\ddot{L}$ (point means derivative with respect to η):

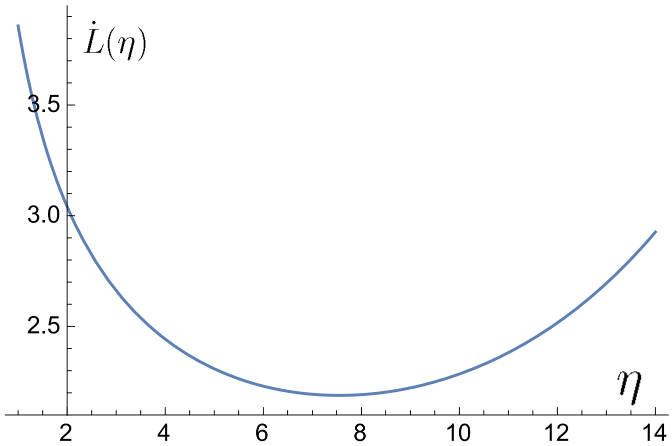

figure 2:
Temporal course of the qualitative expansion velocity $\dot{L}$ between Urstart and presence

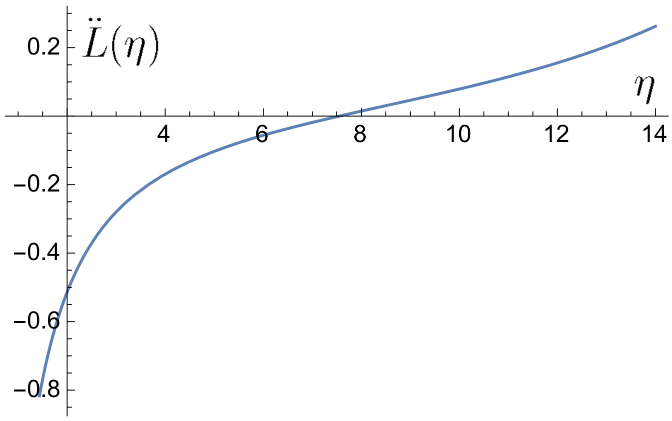

figure 3:
Temporal course of the qualitative expansion acceleration $\ddot{L}$ between Urstart and presence

We remind at the relation

$$\text{a)} \quad t = A_0\,\eta/c\,, \quad \text{with} \quad \text{b)} \quad A_0 = 10^{27}\,\text{cm}\,, \tag{88}$$

connecting time t and the temporal coordinate η used in the figures. I was impressed by figure 3 with the zero-value of the acceleration, reflecting the inversion of the velocity from a diminishing to an increasing phase at the numerical value:

$$\text{a)} \quad \eta = 7.75 \quad \text{i.e.} \quad t = 2,6 \cdot 10^{17}\,\text{s} = 8.2 \text{ billion years} \tag{89}$$

$(1\,\text{s} = 3.17 \cdot 10^{-8}\,\text{y})$.

From empirical astrophysics we know that in the era of about 8 billion years existence time of our universe the phase of the accelerated expansion started. Perhaps our result could be a hint for empirical astrophysics.

Researching the cosmological expansion velocity after the Urstart, the graphic presentation shows an inverse from the increasing velocity to a scaling down velocity at:

$$\text{a)} \quad \eta = 2 \cdot 10^{-9}\,, \quad \text{i.e} \quad t = 2 \cdot 10^{8}\,\mathrm{s} = 2.11 \text{ years}\,. \tag{90}$$

Perhaps this result immediately after the Urstart of our universe could be interesting, too.

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