3. A Model of the Unified Field and of the Neutrinos

Abstract: The accepted Standard Model in physics is founded on basic principles evolved with the advance of science over several centuries in order to describe observed phenomena in nature. The physical theories containing several ad hoc hypotheses appear consistent and complete to explain all measurements of physical objects and to provide satisfactory explanations of physical observations. Besides this, some discontinuities in physics exist and many fundamental problems remain unsolved. There is a profound discrepancy between the classical and the quantum theories. The accepted theory of gravity is incompatible with the other interactions and the problems of neutrinos are not well understood. Therefore, a New Model including new principles and centralizing the covariant Unified Field (UF) consisting of the electromagnetic and gravitational field has been formulated. The UF is generated by two kinds of invariant Maxwell charges which are two different attributes of the four elementary particles. Within the New Model, the source quantization is recognised as a theoretical process of open particle systems in a finite domain Ω and the neutrinos are explained.

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The non-equivalence of inertial mass m^i and gravitational mass m^g has been proved theoretically with the utilization of gravitational charges. Experimentally

$m^i = m^g(1-\Delta^{MD})$,

Δ^{MD} = mass defect of the body, is also verified with the free fall of different materials by the author in Ref. **[1]**. The New Model uses the source quantization of the fundamental field UF within a theory of open systems in finite space-time domains Ω together with seven new fundamental hypotheses, Ref. **[6]**. In many accepted physical theories however, the assumption of closed systems is fundamental and no restriction of physical description to finite space–time domains are usual. Analytical mechanics then allow a conversion from Lagrange to Hamilton formalism with all its advanced features and far-reaching consequences, Ref. **[2]**. In the quantum theory one is dealing with Hamilton operators in Hilbert spaces and the quantization is performed in this frame, Ref. **[3]**. Another characteristic of the quantum theories is the universality of Planck's constant h with Heisenberg's uncertainty principle. It is not our intention here to accept these basic assumptions unconditionally. We want see how they appear in physics or perhaps why it is not appropriate to use these terms. The New Model of the UF is constructed as a covariant theory of electromagnetism and gravity. The starting point is the Lagrange formalism in finite space-time domains in a mathematically well defined way, Ref. **[5]** and the covariant formulation of electromagnetism, Ref. **[4].** Beside the elementary electric charges, the elementary gravitational charges with both signs are consequently set up for the four stable particles electron (e), positron (p), proton (P) and the negative charges proton = elton (E) in complete analogy to the electric charges. This four particle are the sources = quanta of the UF. The physical imagination of repulsive gravitational forces, e.g. between e and p as well as between P and E, is unusual but it is compatible within a consistent formulation of a field theory and it allows to describe the properties of neutrinos as it is shown in this paper.

The investigation starts with the Lagrangian of the UF the New Model. On this basis, the general formulation is fixed, Ref. **[5],** by:

- The limitation of physical description on finite space-time domains with a unique Riemann's type of metric where the space and time is homogenous, the space is isotopic and all systems are open physical systems,
- The UF propagates with a unified velocity c,
- The canonical coordinates of particles are principally undeterminable and
- A separation principle for particle systems in very small and very large distances.

The unique Riemann's type of metric is given by the fundamental constant c of the UF and the invariant infinitesimal distance ds is defined with

$$(ds)^2 = dx_\alpha dx^\alpha = (dx_1^2 + dx_2^2 + dx_3^2) - (cdt)^2 . \qquad (1)$$

The space-time continuum is essentially Euclidian and it is represented by the Minkowski space. The manifest covariant Unified Field is consisting of the electromagnetic field and the gravitational field and propagates with c. The sources of the UF are the four stable, point-like, structure-less particles (e, p, P and E) with two elementary Maxwell charges. They are elementary particles (EP) and the quanta of the field. The UF is the only interaction between these particles.

The manifestly covariant UF is described with the four-vector potential A^α and the four-current j^α :

$\partial_{\beta}\partial^{\beta}A^{\alpha} = j^{\alpha}$, j^{α} in c units (2)

$\partial_{\alpha}j^{\alpha} = 0$, the charge conservation and (3)

$\partial_{\alpha}A^{\alpha} = 0$, the conservation of the field properties = Lorentz gauge. (4)

The wave equation in a particle free space with $j^{\alpha} \equiv 0$ is

$$\partial_{\beta}\partial^{\beta}A^{\alpha} = 0. \quad (5)$$

With the index convention (e) = 1, (p) = 2, (P) = 3 and (E) = 4, the distribution of the two elementary e-charges onto the four EP is on one hand

$$\oint_S \mathbf{E}_i^{(e)}.d\mathbf{s} = +q_i \text{ with } \{q_1 = -q;\, q_2 = +q;\, q_3 = +q;\, q_4 = -q\}. \quad (6)$$

On the other, the distribution of the four elementary g-charges is

$$\oint_S \mathbf{E}_i^{(g)}.d\mathbf{s} = -g_i \text{ with } \{g_1 = -gm_e;\, g_2 = +gm_e;\, g_3 = +gm_P;\, g = -gm_P\}, \quad (7)$$

whereby m_e is the electron mass, m_P the proton mass and $\boldsymbol{G} = g^2/4\pi$ is the Newtonian constant. The integrals are performed on a closed surface S containing one elementary particle i with the charges q_i and g_i and $\mathbf{E}_i^{(e)}$ and $\mathbf{E}_i^{(g)}$ are the corresponding static e-field and g-field. The value of Newton's constant $\boldsymbol{G}$ is

$$\boldsymbol{G} = g^2/4\pi = 6.576(6)\text{x}10^{-11}\,\text{m}^3\text{kg}^{-1}\text{s}^{-2}. \quad (8)$$

This value is ~1.5% less than the value given by literature of the gravitational constant G^{CODATA} which is an averaged value of G = $\boldsymbol{G}/(1-\Delta_A^{MD})(1-\Delta_B^{MD})$, Ref. **[1],**

$$G^{CODATA} = 6.673(10)\text{x}10^{-11}\,\text{m}^3\text{kg}^{-1}\text{s}^{-2}. \quad (9)$$

The basic implication of Eqs. (6) and (7) is that they fix not only the values of invariant quantities of the UF mathematically but determine also axiomatically the constants of nature. Mathematically the UF is connected to the invariants c, q_i and g_i. In physics we have the constant of nature c, q, $\boldsymbol{G}$, m_e and m_P; they are quantities which never change. For instance, if an electron meets a positron, they build indeed a bound state but they can not annihilate each other. The bound state (e,p) has to be identified with the "mass-less" electron-neutrino ν_e and the bound state (P,E) with the "mass-less" proton-neutrino ν_P. The bound states of (e,P), (p,E), (e,p) and (P,E) are connected to the so-called separation principle of the source = quanta of the Unified Field and build the neutrino theory.

Continuing the explanation of the field properties, A^{α} and j^{α} can be expressed in terms of the electromagnetic and the gravitational fields. The four-vector potential of the electromagnetic field and the electric four-current are

$$\mathrm{A}^{(e)\ \alpha} = (\phi^{(e)}/c, \mathbf{A}^{(e)}) \text{ and } \mathrm{j}^{(e)\ \alpha} = (\rho^{(e)}, \boldsymbol{j}^{(e)}/c). \tag{10}$$

The corresponding four-vector potential and four-current of the gravity is given by

$$\mathrm{A}^{(g)\ \alpha} = (\phi^{(g)}/c, \mathbf{A}^{(g)}) \text{ and } \mathrm{j}^{(g)\ \alpha} = (\rho^{(g)}, \boldsymbol{j}^{(g)}/c). \tag{11}$$

They produce the four-vector potential and the four-current j^{α} of the UF according to

$$\mathrm{A}^{\alpha} = \mathrm{A}^{(e)\ \alpha} + \mathrm{A}^{(g)\ \alpha}, \tag{12}$$

$$\mathrm{j}^{\alpha} = \mathrm{j}^{(e)\ \alpha} - \mathrm{j}^{(g)\ \alpha}. \tag{13}$$

The addition of the four-vector potential in Eq. (12) arises from the two different kinds of charges. In Eq. (13), a negative sing occurs for $\mathrm{j}^{(g)\ \alpha}$ because

$$\partial_\beta \partial^\beta A^{(g)\,\alpha} = -j^{(g)\,\alpha}$$

follows from the attractive force between two g-charges with the same sign. The following equivalences are stated for the four-currents expressed with the four-currents of the four kinds of elementary particles:

$$j^{(e)\,\alpha} \equiv \sum_{i=1,4} j_i^{(e)\,\alpha} \equiv \sum_{i=1,4} q_i j_i^{(n)\,\alpha} \equiv q\{(j_2^{(n)\,\alpha} + j_3^{(n)\,\alpha}) - (j_1^{(n)\,\alpha} + j_4^{(n)\,\alpha})\}, \qquad (14a)$$

and

$$j^{(g)\,\alpha} \equiv \sum_{i=1,4} j_i^{(g)\,\alpha} \equiv$$

$$\sum_{i=1,4} g_i j_i^{(n)\,\alpha} \equiv g\{(m_e j_2^{(n)\,\alpha} + m_P j_3^{(n)\,\alpha}) - (m_e j_1^{(n)\,\alpha} + m_P j_4^{(n)\,\alpha})\}. \quad (14b)$$

The four-current of particle number densities for each EP are denoted with

$$j_i^{(n)\,\alpha} = (\rho_i^{(n)}, \boldsymbol{j}_i^{(n)}/c).$$

The continuity equations yield for $j^{(e)\,\alpha}$, $j^{(g)\,\alpha}$ and $j_i^{(n)\,\alpha}$:

$$\partial_\alpha j^{(e)\,\alpha} = 0,\ \partial_\alpha j^{(e)\,\alpha} = 0 \text{ and for } j_i^{(n)\,\alpha},\ \partial_\alpha j_i^{(n)\,\alpha} = 0,\ \mathrm{i} = 1, 4, \qquad (15)$$

According to Gauss's law, which is valid for each vector field $\mathbf{E}$, we get a definition of a "charge density" ρ

$$\oint_S \mathbf{E}.d\mathbf{s} = \int_V \rho\, d^3\mathrm{x}. \qquad (16a)$$

But we will use an alternative definition of the charge density in case of the g-charges where Q_i is the net g-charge within a volume V

$$\int_V \rho^{(g)} d^3\mathrm{x} = Q_i, \qquad (16b)$$

and both definitions differ by the sign. Without confusion, the Eqs. (6) - (7) state

$$\oint_S \mathbf{E}_i^{(e)}.d\mathbf{s} = + \int_V \rho_i^{(e)} d^3\mathrm{x} = + q_i, \qquad (17a)$$

$$\oint_S \mathbf{E}_i^{(g)}.d\mathbf{s} = -\int_V \rho_i^{(g)} d^3x = -g_i, \tag{17b}$$

according to this convention. The static conditions for the elementary charges are in a finite space domain V,

$$\int_V \rho_i^{(e)} d^3x = q_i,\ \int_V \rho_i^{(g)} d^3x = g_i, \quad \text{for i = 1, 4.} \tag{18}$$

The continuity equation Eq. (15) allows transferring the static conditions in each finite space-time domain Ω according to Lorentz transformations.

The manifestly covariant Lagrange density of the UF, $L^{UF}(x)$, can be expressed by the usually constructed Faraday tensors $F^{(e)\ \alpha\beta}$ and $F^{(g)\ \alpha\beta}$, see Refs. **[2, 4],**

$$L^{UF}(x) = -\frac{1}{4}\{F^{(e)}{}_{\alpha\beta}F^{(e)\ \alpha\beta} + F^{(g)}{}_{\alpha\beta}F^{(g)\ \alpha\beta}\} + j^{(e)}{}_{\alpha}A^{(e)\ \alpha} - j^{(g)}{}_{\alpha}A^{(g)\ \alpha}. \tag{19}$$

The construction of the Faraday tensor for the gravitational field $F^{(g)\ \alpha\beta}$ with $A^{(g)\ \alpha}$ is the same as in case of the electromagnetic field. The Euler-Lagrange equations for the field quantities $A^{(e)\ \alpha}$ and $A^{(g)\ \alpha}$ of the action integral,

$$I = \int_\Omega (dx^4) L^{UF}(A^{(e)\ \alpha}(x), A^{(g)\ \alpha}(x), j^{(e)\ \alpha}(x), j^{(g)\ \alpha}(x)), \tag{20}$$

are the field equations in a finite Ω applying the Hamilton principle, where in δI the four-currents $j^{(e)\ \alpha}(x)$ and $j^{(g)\ \alpha}(x)$ are not objects of the variation,

$$\partial_\beta \partial^\beta A^{(e)\ \alpha} = j^{(e)\ \alpha} \text{ and } \partial_\beta \partial^\beta A^{(g)\ \alpha} = -j^{(g)\ \alpha}. \tag{21}$$

However, the four-vector potentials must fulfil the Lorentz conditions

$$\partial_\alpha A^{(e)\ \alpha}(x) = 0,\ \partial_\alpha A^{(g)\ \alpha}(x) = 0. \tag{22}$$

The covariant field equations of the e-field are also known in a non-covariant form as the Maxwell equations. The corresponding equations for the gravitational field differ solely by a minus sign of ρ^g and $\mathbf{j}^g$

$$\nabla.\mathbf{E}^e = +\rho^e, \qquad \nabla.\mathbf{E}^g = -\rho^g, \qquad \text{Maxwell Eq. I,} \quad (23a)$$

$$\nabla.\mathbf{B}^e = 0, \qquad \nabla.\mathbf{B}^g = 0, \qquad \text{Maxwell Eq. II,} \quad (23b)$$

$$\nabla x\mathbf{E}^e + \frac{1}{c}\frac{\partial}{\partial t}\mathbf{B}^e = 0, \qquad \nabla x\mathbf{E}^g + \frac{1}{c}\frac{\partial}{\partial t}\mathbf{B}^g = 0, \qquad \text{Maxwell-Eq. III,} \quad (23c)$$

$$\nabla x\mathbf{B}^e - \frac{1}{c}\frac{\partial}{\partial t}\mathbf{E}^e = +\frac{1}{c}\mathbf{j}^e, \nabla x\mathbf{B}^g - \frac{1}{c}\frac{\partial}{\partial t}\mathbf{E}^g = -\frac{1}{c}\mathbf{j}^g, \qquad \text{Maxwell Eq. IV.} \quad (23d)$$

where $\varepsilon_0 = 1$, $\mu_0 = 1$ is used, and $\mathbf{B}^g$ is the gravitomagnetic field. The static forces are given by the Coulomb's and Newton's law

$$\mathrm{F}^{Coulomb} = +\frac{1}{4\pi}\frac{q_1 q_2}{r^2}, \qquad \mathrm{F}^{Newton} = -\frac{1}{4\pi}\frac{g_1 g_2}{r^2} = \mp \boldsymbol{G}\frac{m_1^g m_2^g}{r^2}. \qquad (24)$$

corresponding to Eqs. (16), (17). The two kinds of Lorentz forces are

$$\mathbf{F}^e = q_i\,(\mathbf{E}^e + \frac{1}{c}\mathbf{v}x\mathbf{B}^e) \qquad \mathbf{F}^g = -g_i(\mathbf{E}^g + \frac{1}{c}\mathbf{v}x\mathbf{B}^g). \qquad (25)$$

All quantities are defined in finite space-time domains Ω. The static equations (24) and (17) are valid in a finite space volume V.

In case of the electromagnetism, the experimental verification of Maxwell equations are done with Coulomb's, Ampère's, Biot&Savart's and Faraday's laws. For the gravity, only Newton's law in Eq. (24) is verified and therefore $\nabla.\mathbf{E}^g = -\rho^g$ too. The other field equations of gravity are derived from the postulated covariant properties of the UF and are consequences within the New Model. An experimental proof of the field equation has yet to be done. In any case, they are different from A.

Einstein's equation of gravity, based on the Equivalence Principle with m^{i} $\equiv$ m^{g} which is not realized in nature.

The electrostatic field and the static gravitational field are conservative fields. But, $\mathbf{B}^{e}$ and $\mathbf{B}^{g}$ are non-conservative fields unless there are no currents $\mathbf{j}^{e}$ and $\mathbf{j}^{g}$. When the fields and the currents are steady, we have

$$\nabla \mathrm{x}\mathbf{B}^{e} = \frac{1}{c}\mathbf{j}^{e}, \text{ (Ampère's law) and } \nabla \mathrm{x}\mathbf{B}^{g} = -\frac{1}{c}\mathbf{j}^{g}. \tag{26}$$

The continuity equations, Eq. (15), are simultaneously conservation equations for the net electric and the net gravitational charges and for the particle numbers.

According to Eq. (18), we are now able to formulate the static conditions for the sources quantum of the UF in a finite space domain V,

$$\int_{V} \rho_{i}^{(n)} d^{3}\mathrm{x} = 1 \text{ for i= 1, 4.} \tag{27}$$

The continuity equations

$$\partial_{\alpha} \mathrm{j}_{i}^{(n)\,\alpha} = 0,$$

allow then to move the static conditions to any finite space-time domain Ω in the Minkowski space. The Eq. (27) formulates the isoperimetric subsidiary conditions of the variation problems within the New Model if the field quantities of the four EP are subject to variation, see Ref. **[12].** The continuity equations determine corresponding natural boundary conditions for these field quantities. The Eq. (27) is an integral representation of the source quantization and corresponds to the principle uncertain canonical coordinates of the four elementary particles.

It is worth noticing the essential difference between the New Model and the Quantum Mechanics. E. Schrödinger has used an infinite integral with

$\rho = \psi^* \psi$

for an electron in the field of a proton in case of the H atom,

$$\int \psi^* \psi \; d^3 x = 1, \tag{28}$$

and the quantization of the eigenvalues of the Hamilton operator H

$$\int \psi^* H \psi \; d^3 x = E. \tag{29}$$

as quantum condition for different ψ_i and discrete energies E_i. Corresponding to the energy quantization of particle systems, the electromagnetic field has also to be quantized by photons with energy

$h\nu_{ij} = E_i - E_j$.

The New Model uses a finite integral, Eq. (27), for an open system and the eigenvalues λ_i do not correspond in general to energies of a particle system. Furthermore, only the sources of the UF are quantized and not the field itself. Therefore, the discrete frequencies of the emitted radiation ν_{ij} will be proportional to eigenvalue differences $\lambda_i - \lambda_j$ and the emission and absorption of light will be interpreted as a resonance process, see Ref. **[7]** and previous publications in Ref. **[11]**.

After this short excursion to the difference of the principles of the Quantum Mechanics and the New Model, we continue the explanation of formalism.

In the Lagrange density $L^{UF}(x)$, Eq. (20), the four-currents $j^{(e)\,\alpha}(x)$ and $j^{(g)\,\alpha}(x)$ can be expressed with $j_i^{(n)\,\alpha}(x)$ according to Eqs. (14), (15). The Lagrangian for the total system with the particles is usually written with the Lagrange density as two additive terms

$$L(x) = L^{T}(x) + L^{UF}(x), \tag{30}$$

in which L^T(x) represents the density of the kinetic energy of the particles. But the calculus of variation requires expression for the particle number densities $\rho_i^{(n)}$(x) and for the currents $\boldsymbol{j}_i^{(n)}$(x) with functions η_i(x) for the four EP, if the variation problem will be extended to the four elementary particles. The functions η_i(x) have to be appropriately defined in a finite domain Ω of the Minkowski space. Obviously we can choose

$$\rho_i^{(n)}(x) = \eta_i(x)^* \eta_i(x), \ \ i = 1, 4, \tag{31a}$$

where η_i(x)* are the complex conjugate of η_i(x). We must also express the currents

$$\boldsymbol{j}_i^{(n)}(x) = f(\eta_i(x)^*, \eta_i(x), \eta_{i\nu}(x)^*, \eta_{i\nu}(x)), \ i =1, 4, \tag{31b}$$

whereby f is an appropriate function, and $\eta_{i\nu}$(x) are the derivative of η_i(x). The conditions on η_i(x) are such that $\rho_i^{(n)}$(x) and $\boldsymbol{j}_i^{(n)}$(x) must be real and Eq. (27) and $\partial_\alpha j_i^{(n)\alpha} = 0$ has to be fulfilled additionally in a finite space-time domain.

In the following, we restrict the description to two particles in a finite space-time domain. Because of the property of the electric force, two particles with the same sign of electric charges can not stay in a finite domain Ω. Only the systems (e,P), (p,E), (e,p) and (P,E) can being resident in a volume V enclosed by the surface S. These four systems in V have zero net electric charges. The net gravitational charges are

$$g_{(e,P)} = +g(m_P - m_e),\ g_{(p,E)} = -g(m_P - m_e),\ g_{(e,p)} = 0,\ g_{(P,E)} = 0, \tag{32}$$

corresponding to the following gravitational masses

$$m^g_{(e,P)} = m^g_{(p,E)} = (m_P - m_e) = \boldsymbol{m}, \tag{33a}$$

$$m^{g}_{(e,p)} = m^{g}_{(P,E)} = 0. \tag{33b}$$

They are the most important fundamental systems corresponding to H-Atom and neutron (e,P) as well as to the two kinds of neutrino, (e,p) and (P,E) etc. The mutual interaction between the two particles depends on the relative four-coordinate $x^{\alpha} = x_i^{\alpha} - x_j^{\alpha}$ of the particles on one hand. On the other hand, if we let p^{α} define the relative four-impulse in the "center-of-momentum system" in the C-O-M system, the product $p_{\alpha} x^{\alpha}$ is an invariant quantity. Therefore, the two particle number densities and currents, $\rho_i^{(n)}(x_i), \boldsymbol{j}_i^{(n)}(x_i)$, and $\rho_j^{(n)}(x_j), \boldsymbol{j}_j^{(n)}(x_j)$ must be expressible as a function of $p_{\alpha} x^{\alpha}$ and $P_{\alpha} X^{\alpha}$, $\eta(p_{\alpha} x^{\alpha}, P_{\alpha} X^{\alpha})$, where the $P_{\alpha} X^{\alpha}$ describes the motion of C-O-M system. The $p_{\alpha} x^{\alpha}$ describes the relative motion of both particles and leads to the interesting part of the problem. We do not want to consider the motion of C-O-M system with $P_{\alpha} X^{\alpha}$ and therefore, we loosely consider η as a function of $p_{\alpha} x^{\alpha}$ alone; and we want consider a function $\eta(p_{\alpha} x^{\alpha})$ now.

Physical intuition allows the assumption that an (e,P) system, the H atom, as well as the (e,p) respectively the (P,E) systems, the neutrinos, have a time independent, steady ground state. The observed ionisation energies, $E_{ionisation}$, of these ground states are 13.5 eV in case of the H atom, $2m_e c^2$ for (e,p) and $2m_P c^2$ for (P,E). Since the steady ground states have a time independent electric charge distribution

$$\rho^{(e)}(p_{\alpha} x^{\alpha}) = q\,\eta^{*}(p_{\alpha} x^{\alpha})\,\eta(p_{\alpha} x^{\alpha}),$$

the function $\eta(p_\alpha x^\alpha)$ must be for $x_\alpha x^\alpha < s^2$ with a finite s^2 in each three case proportional to

$$\eta \sim \exp(-i\, h\, p_\alpha x^\alpha), \tag{34}$$

with some constants h. In case of the H-atom we know the connection between Planck's constant h, $E_{ionisation}$: and the reduced mass

$m' = m_e m_P/(m_e + m_P)$.

$$h = (q^4/8 \text{ x } m'/E_{ionisation})^{1/2}. \tag{35}$$

We take this formula with the reduced masses

$m' = m_e/2$ for (e,p)

and

$m' = m_P/2$ for (P,E)

and we have in analogy to Eq. (35)

$$h^0 = (q^4/32c^2)^{1/2} = 1/4\sqrt{2} \text{ x } q^2/c, \text{ and } h^0 = h/387. \tag{36}$$

It should be mentioned that Eq. (34) does not correspond to the quantization of energy in the New Model**.** The appearance of a second basic constant h^0 in case of neutrinos beside Planck's constant h provides that the Planck's constant cannot be universal in all microscopic processes. This statement is a very fundamental recognition within the Unified Field Theory. The meaning of h and h^0 will be clear within the variation treatment of the quantum condition Eq. (27) as an isoperimetric subsidiary condition in Ref. **[12]**.

Furthermore, using the known relation between the radius of the H atom and Planck's constant,

$$r_{(e,P)} = h^2/(4\pi^2 m' q^2) = 0.529 \text{ x } 10^{-8} \text{ cm}, \tag{37}$$

we can also estimate the radii of the (e,p) and (P,E) systems:

$$r_{(e,p)} = h^{0\,2}/(2\pi^2 m_e\, q^2) = 0.703 \text{ x } 10^{-13} \text{ cm,} \tag{38a}$$

$$r_{(P,E)} = h^{0\,2}/(2\pi^2 m_P\, q^2) = 0.383 \text{ x } 10^{-16} \text{ cm,} \tag{38b}$$

We can state that $r_{(e,p)}$ is in the range of the nuclei size and $r_{(P,E)}$ is much smaller.

As the four EP can be neither created nor annihilated in the UF Theory, the mass-energy-equivalence

$$\Delta E = \Delta m^i c^2,$$

is only valid for inertial masses m^i of many particle systems. The

$$E_{ionisation} = 13.59 \text{ eV},$$

lowers the energy of the H atom and we have

$$m_H^i = m_H^g \,(1\text{-}13.59 \text{ eV}/(m_P\text{-}m_e)c^2).$$

The two-particle systems give reason to two basic neutrinos within the UF theory

$$\upsilon_e = (e,p) \text{ and } \upsilon_p = (P,E). \tag{39}$$

The electron-neutrino υ_e and the proton-neutrino υ_p are the bound state of the composing particles. Because of the zero net gravitational charge, the neutrinos are “mass-less”. The magnetic momentums of the neutrinos also equals zero, because the two particles move with opposite charges on “circle orbits with the same velocities and radii”. The vanishing of both net charges in case of neutrinos indicates that the interaction radii of the neutrinos are comparable with their size. Since

$$r_{(e,p)} = 0.703 \text{ x } 10^{-13} \text{ cm,}$$

we can assume that the electron-neutrino υ_e is used to build the nuclei. The υ_p can not be integrated in the nuclei because its interaction sphere is very small compared to the size of the nuclei. The interaction radius of υ_p is two thousand times smaller than the size of the nuclei. Since the electron-neutrino and h^0 must be responsible for the nuclear forces, qualitatively some observed properties of the nuclei and the nuclear forces are immediately clear:

- The size of the nuclei,
- The distribution of charge density within the nuclei,
- The saturation of nuclear forces,
- The gravitational mass of a nucleus with A nucleons is $m^g_A = A(m_P - m_e)$,
- The the binding energy pro one nucleon (pro proton) is

$\Delta E/A = m^g_A c^2 \Delta^{MD}_A/A = (m_P - m_e)c^2 \Delta^{MD}_A$, with $\Delta^{MD}_A = (m^g_A - m^i_A)/m^g_A$.(40)

The neutron is a two particle state n^0 = (e,P) and can be calculated with h^0.

The other two-particle neutron, $\underline{n}^0$ = (p,E) is usually called as "antineutron".

With (36), the binding energy of n^0 and $\underline{n}^0$ has the same value

$$E_{n^0} = (h/h^0)^2 \times 13.59 \text{ eV} = 2.04 \text{ MeV}. \quad (41a)$$

The size of n^0 is with $d_{n^0} = 2\, r_{n^0}$ almost the radius of υ_e.

$$d_{n^0} = 0.702\text{x}10^{-13} \text{cm}. \quad (41b)$$

The calculated magnetic moment for n^0

$$\mu_{n^0} = -4.74\ \mu_{nucl}, \quad (42)$$

is compared with the known value

μ_n = -1.91 μ_{nucl}, (43)

which is connected to the instable four-particle neutron n=(e,υ_e,P). In general, the nuclear processes are determined by h^0 and by the presence of υ_e and not by Planck's constant h, Ref. **[6].** The numbers of υ_e are not a priori known within a nuclei with the mass number A. Only its gravitational mass is known with the number of protons, Ref. **[1]**.

Now, we start an attempt for the determination of the composition of many particle systems consisting of charges particles and neutrinos. Anyhow, they build three types of stationary solutions (stationary states) of variation principles of open systems within the UF Theory. The three types are: bound states, unstable states and condensation states. The condensation states correspond to stationary states in a steady current of electron-neutrinos. Such states are for instance the observed nuclear isotopes. The treatment of these problems with calculus of variation of open physical systems is the topic of a forthcoming article by the author, Ref. **[12]**. The necessary investigations of open systems are also recognised by other authors, Ref. **[11]**. But they used a completely different physical and mathematical basis for their techniques as the here proposed one.

In the following, only some neutral isotopes and unstable particles are considered:

Bound states: υ_e=(e,p), υ_p=(P,E), H atom and the neutron=n^0(e,P), the $\underline{n}^0$="anti-neutron"=(p,E), ${}^2_1$H=(2xe,2xP,nxυ_e), ${}^4_2$He=(4xe,4xP,nxυ_e), etc.

Unstable states: with three distinct particles, e.g. (e,P,E), (P,e,p), unobserved.

Unstable states: n=(e,P,υ_e), ${}^3_1$H=(3xe,3xP,nxυ_e), ${}^5_2$He=(5xe,5xP,nxυ_e), etc., with e=e$^-$, p=e$^+$, P=p$^+$ and E=p$^-$

$\mu^\pm$=(e$^\pm$,υ_e,υ_p), $\pi^\pm$=(e$^\pm$,2υ_e,υ_p), π^0=(2υ_e,υ_p),

K$^\pm$=(e$^\pm$,3υ_e,υ_p), the K^0_L=(5υ_e,2υ_p), K^0_S=(3υ_e,υ_p),

problem arises from the identification of K^0_L and K^0_S,

$\Sigma^\pm$=(p$^\pm$,υ_e,υ_p), $\Sigma^\pm_2$=(p$^\pm$,2υ_e,υ_p), Σ^0=(e$^-$,p$^+$,3υ_e,υ_p),

Λ=(e$^-$,p$^+$,2υ_e,υ_p), Ξ^0=(e$^-$,p$^+$,4υ_e,2υ_p), etc.

The life times of unstable particles are between ~ 2.2x10^{-6} s and ~ 10^{-23} s. The different composition of π^0 and $\pi^\pm$ is remarkable. It could explain the mass difference m_{π^0} = 135 MeV compared with $m_{\pi^\pm}$ = 140 MeV, and the large difference of life times, τ_{π^0} = 0.8x10^{-16}s compared with $\tau_{\pi^\pm}$ = 2,6x10^{-8} s. However, the popular reaction $\pi^0 \rightarrow 2\gamma$ is not allowed in the New Model. The excited neutral Pion decays $\pi^{0*} \rightarrow \pi^0 + 2\gamma$

Many particle decays can be immediately understood

$\mu^\pm \rightarrow$ e$^\pm + \upsilon_e + \upsilon_p$, $\quad\pi^\pm \rightarrow \mu^\pm + \upsilon_e$, (44a)

K$^\pm \rightarrow \mu^\pm + \upsilon_e$, $\quad$K$^\pm \rightarrow$e$^\pm + \pi^0 + \upsilon_e$, (44b)

K$^0_L \rightarrow \pi^+ + \pi^-$, $\quad\Lambda \rightarrow$ p$^+ + \pi^-$ (44c)

$\Sigma^+ \rightarrow$ p$^+ + \pi^0$, $\quad\Sigma^- \rightarrow$ n $+ \pi^-$, etc (44d)

Remarks: The denotation of “antiparticle” used in particle physics has no meaning within the UF theory. Therefore, care should be taken with the assignments to the known denotations, e.g. K$^\pm$ and

$K_2^{\pm} = (e^{\pm}, 3\upsilon_e, 2\upsilon_p)$,

as well as $\Sigma^{\pm}$ and $\Sigma_2^{\pm}$. The known denotations of unstable particles should probably be reassigned.

The UF Theory connects the particle physics with the two fundamental fields. Therefore, the explanations in astrophysics are set on microscopic processes. The consequences stated by the New Model for the Universe which will be outlined by the author in Ref. **[13]:** Two types of stars exist; one type condensates with (P, υ_e, e), the other with (E, υ_e, p). These two types of stars exert a repulsive gravitation to each other. In a given galaxy, only one type is present. The proton-neutrinos υ_p do not condensate in matter under normal conditions. The two kinds of neutrinos build the sought dark matter. All stars rotate in the same direction within the approximate plane of the galaxy because of the presence of the gravitational Lorentz force. The radii of planet orbits are not arbitrary, Ref. **[8].** The "quantized" orbits of solar-like gravitational systems can be determined with a variation principle of open systems. As a consequence of the isotope dependent G_{AB}, many inner planets have an iron/nickel core. Since the so called ground states of the H atom is solely approximately a stationary state, the two-particle system n^0 = (P,e) radiates always electromagnetic and gravitational rays. The Poynting flux of moving unequal gravitational charges is not zero. The consequence of the instability of n^0 and $\underline{n}^0$ leads to the collapse of stars, to the so-called neutron stars. If from the condensed matter all υ_e are removed, and if n^0 and $\underline{n}^0$ in both types of stars reaches the size of υ_p, then the proton-neutrinos react with the neutrino star and a super nova explosion continues the time development of the universe. Each electromagnetic radiation incorporates the much weaker gravitational radiation. The speed of gravity is c and, in a recent measurement, Kopeikin observed, Ref. **[9]**

$c_g/c = 1.06 \pm 0.21$.

The mentioned results collected here are deduced within the New Model without any further additional hypothesis. The utilization of gravitational charges, the discovery of the new constant h^0 which is responsible for neutrinos and nuclear forces show the power of the UF Theory. The differences between the principles of the accepted Standard Model and the New Model are remarkable and are discussed by the author in Ref. **[6]**.

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