8. A Model of the Universe Based on the Unified Field Theory

In this book about physics of elementary processes the last scientific section is dedicated to global predictions of the model for the Unified Field Theory (UFT). The discussion about the universe starts with a qualitative review of celestial mechanics. Then, the development of stars and galaxies is briefly mentioned and the predictions are set in relation to 'well known' and scientifically discussed processes in curved spaces; to building of black holes, to the existences of Schwarzschild radii, to the expansion of the universe and big bang and to inflations and membranes. All of these perceptions are unknown in a model of open physical systems with four kinds of stable particles and with two non-conservative fundamental interactions between those. The Unified Field Theory describes the physical processes in a finite and open Minkowski space with exception of small space-time domains around the elementary particles. The lack of knowledge in very small domains can be handled with space integrals which have finite values and are known as invariant elementary charges. The theory uses only few numbers of invariants and a generalized Boltzmann constant for the equilibrium.

The non-equivalence of gravitational mass m^g and inertial mass m^i, in order of pro mille gives the greatest deviation from the Newtonian gravity. However, the deviation is composition dependent. With

$$m^i(\text{matter}) = m^g\ (1-\Delta(\text{matter})). \qquad (1)$$

The quantity $\Delta(\text{matter}) > 0$ is the mass defect of the matter and can bee calculated from the mass defects of isotopes if the composition of matter is known, Ref. **[1]**. The small value of

Δ(matter) ~ 0.75% allows us occasionally to use the simpler equation

$$m^g(\text{matter}) = m^i(1+\Delta(\text{matter})), \text{ or } m^g = m^i(1+\Delta), \qquad (1')$$

if we need to, without warning in the qualitative discussion of this part.

For the universal gravitational constant ***G*** we shall use, see Ref. **[1]**, the value

$$\boldsymbol{G} = 6.576(6)\text{x}10^{-11}\ \text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}, \qquad (2)$$

which is ~ 1.5 % smaller than the CODATA value (1998)

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

Newton's static equation of motion in the gravitational field has to be modified to

$$m^i a = m^g\ (1-\Delta(\text{matter}))\ a = -\,\boldsymbol{G}\,M^g\ m^g\ / r^2. \qquad (4)$$

which is composition dependent.

Kepler's third law appears in the form of

$$R_j^{\ 3}/T_j^{\ 2}\ \text{x}\ (1+m^i_j/M^i) = \boldsymbol{G}\,M^g\ (m^g_j/m^i_j) = \boldsymbol{G}\,M^g(1-\Delta(j), \qquad (5)$$

for the planet j. The evaluation of (5) offers a 0.15% deviation, Ref. **[2]**, with the nine planets of the sun. Therefore, I see the greatest deviation in celestial mechanics of our theory from the Newtonian gravity in the deviations of Kepler's third law. Moreover, the outer planets have smaller mass defects Δ(j) than the inner planets. The known constituent of the outer planets are elements or compounds of elements with small mass defect. Such elements are H, He, C, N and O. The mass defect of these elements, without H, are 0.63(7)%, see Tab. 1 in Ref. **[1]**. The inner or terrestrial planets have an excess of elements Fe and Ni in their kernels. These elements have a large mass defect, about 0.78%. Thus, the composition dependencies of the planets explain very well the deviations of Kepler's third law. In other words, the evaluation of equation (5) confirms our theory of gravitation and should be used for information about the composition of the planets.

In order to calculate further deviations between our theory and the Newtonian gravity, the next step leads to equation of motion with moving masses. We remember that the gravitational mass of matter arises from the gravitational charge

$$m^{g}\,(\text{matter}) = \mathrm{g}(\text{matter})/g, \qquad (6)$$

whereby g is the specific gravitational charge which produces the gravitational constant

$$\boldsymbol{G} = g^{2}/\,4\,\pi\,. \qquad (7)$$

The motion of a gravitational charge g_{i} in the gravitational field, described with $\mathbf{E}^{g}$ and $\mathbf{B}^{g}$, arises from a force $\mathbf{F}^{g}$,

$$\mathbf{F}^{g} = -\,\mathrm{g}_{i}\,(\mathbf{E}^{g} + \mathbf{v}/c\,\mathbf{x}\,\mathbf{B}^{g}). \qquad (8)$$

which takes with $\mathbf{v}/c$ the velocity of the mass into account. This equation is similar to the Lorentz equation of a moving electric charge q_{i} in the electromagnetic field $\mathbf{E}^{e}$ and $\mathbf{B}^{e}$

$$\mathbf{F}^{e} = +\,q_{i}\,(\mathbf{E}^{e} + \mathbf{v}/c\,\mathbf{x}\mathbf{B}^{e}). \qquad (9)$$

Which phenomena in celestial mechanics can support the existence of the force $\mathbf{F}^g$? First, the nearly circular orbits of most planets have to be mentioned. Without the velocity- dependent part of the force, all elliptic orbits with the same semi major axis would be equally probable. Furthermore, the 43 arcseconds per century shift of the perihelium of Mercury can be also used to test the theory. In contrary, this test has been considered up to now as the first confirmation of Einstein's theory of gravity. We have here a possible other explanation of this most favour deviation of Newton's theory of gravity.

Other unexplained deviations have been observed in the trajectories of some space missions. The Pioneer 10 and 11 spacecrafts and the Voyager 1 and 2 offered deviations from the usual calculated trajectories. The Pioneer spacecrafts have been affected by an unexpected tiny deceleration force. The velocity dependent part of the force (8) can be used to recalculate the trajectories.

Another aspect of our theory comes from the considerations of the planet orbits as stationary solutions of variation calculations. Some researchers recognized a "quantisation rule" of the satellite orbits moving around a central star, Ref **[3]**. The rule is similar to the quantized orbits of an electron in Bohr's theory. In the Unified Field Theory, we have a common variation principle for the electromagnetic field and the gravitational field. To use this variation principle in the celestial mechanics offers a completely new way to calculate the planet orbits.

With this comment, I close the possible implications of the new theory in celestial mechanics and turn over shortly to another apparent confirmation of Einstein's Theory of General Relativity, to the deflection of light in the gravitational field. Within the Unified Field Theory, the gravity and the electromagnetism is caused by two types of elementary charges of the particles. Therefore, the two fields are independent from each other. The stronger electric field does not influence the weaker gravitational field and vice versa. Therefore, the apparently measured deflection of light in the vicinity of the sun must be reconsidered very carefully.

The Unified Field Theory considers both fundamental fields as non-conservative fields. Therefore, the velocity dependent expressions for the forces (8) and (9) must be considered in both cases as approximations. The energy violating part is not contained in these expressions. Can we see some evidence for a non-conservative gravity in the universe? Yes, we can probably do it. The observations of double neutron stars by astrophysicists offer a decreasing of the relative distances of the objects. This decrease can probably be explained with the radiation of gravitation waves by fast moving neutron stars which is described completely with the field equations of the gravitational field and which explains the energy loss.

Another possible confirmation of the new theory can arise from the two types of condensation of matter. The one type uses protons and electrons and the other type eltons and positrons. Our matter condenses with proton and electron. Now between the two kinds of condensed matter rules a repulsive gravitational force. A proton-galaxy removes itself from an elton-galaxy. The removal of the galaxies from each other can be observed as the Doppler effect of the emitted light. Thus, we get an explanation of the red shift of far galaxies because of the existence of repulsive gravitation. In this sense, the red shift of light is not the evidence of an expansion of the universe and not a confirmation of the big bang theory for the beginning of the development our universe. In our theory the four types of elementary particles are stable; they can never be generated and can never annihilate. The approximate stability of proton is believed to be 10^{30} s which is much longer than the age of the universe $3x10^{17}$ s after the big bang. The stability of elementary particles and the assumed age of the universe are controversial anyhow. Therefore, I believe that the state of the universe in a finite space-time domain Ω is in equilibrium with the rest of the universe outside of Ω. The spectrum of the back ground radiation at a temperature of 2.72 K could be the equilibrium temperature of the universe. Since I consider the properties of the fields as to be conserved (the Lorentz condition), and the propagation of fields with the velocity c is invariant; I suppose that the equilibrium temperature was 2.72 K before $15x10^{9}$ years too. In other words, the universe was always in the same global state as it is in the present time. A generalized Boltzmann constant, which includes also the dark matter discussed later on, would be able to describe the equilibrium of the universe. The universe itself changes only local but not global. The radical local change happens for instance with supernova explosions which ends the development of stars and begins a new one.

In order to understand the supernova explosions, I have to explain the development of neutron stars and the role of neutrinos in the universe. Our theory fixes two kinds of neutrinos, the electron-neutrino υ_e = (e,p) with a size of $7.03x10^{-14}$ cm = 0.703 fm and the proton-neutrino υ_P = (P,E) with a size of $3.83x10^{-17}$cm = $0.383x10^{-3}$ fm. Both neutrinos are the ingredients of the dark matter, but they play a different role in the condensation of matter. The electron-neutrinos built the nuclear forces; this neutrino binds the protons and electrons together to an atomic nucleus. A stable neutron (P,e) has also the size of the electron-neutrino, Ref. **[6]**. Under normal conditions, the proton-neutrino does not interact with a nucleus, because it is not only much smaller in size but the interactions radius is also smaller than the size of the nuclei.

Let us look for the following processes in the production of matter in the sun, Ref. **[4].**

With the mass M_{Sun} = $1.99x10^{33}$ g and radius r_{Sun} = $6.96x10^{10}$ cm the averaged mass density of the sun (the mass density in the centre of the sun: 153 g/cm^{3}) is

$$\rho_{Sun} = M_{Sun} / (4\pi/3\, r_{Sun}^{3}) = 1.41 \text{ g/cm}^3 . \qquad (10)$$

Since the sun is composed of 75% H and 25% He the averaged distance of protons is ~ 10^{-8} cm. The density of the sun is mainly permeable for the e-neutrinos.

The nuclear reaction are usually written without shell electrons

$$^{1}_{1}\text{H} + {}^{1}_{1}\text{H} = {}^{2}_{1}\text{H} + p + \nu + 1.44 \text{ MeV}, \qquad (11)$$

$$^{2}_{1}\text{H} + {}^{2}_{1}\text{H} = {}^{3}_{2}\text{He} + \gamma + 5.49 \text{ MeV}, \qquad (12)$$

$$^{3}_{2}\text{He} + {}^{3}_{2}\text{He} = {}^{4}_{2}\text{He} + 2\,{}^{1}_{1}\text{H} + 12.85 \text{ MeV}. \qquad (13)$$

They are considered as the first steps of nuclei condensations, as nuclear fusions.

Within the UFT the first reaction would be the conversion of a hydrogen atom in a neutron ${}^{1}_{0}\text{n} = (P,e)$ with production of energy

H-atom = ${}^{1}_{0}\text{n}$ + 2.04 MeV.

Such a conversion can take place already at normal pressure and density for instance in palladium metal. The stable neutron can catch an electron-neutrino $\upsilon_e = (e,p)$ to build an instable neutron

$${}^{1}_{0}\text{n} + \upsilon_e = (P,e,p,e).$$

Therefore, in the sun the hydrogen atoms decrease and the neutrons increase, first without building of deuterons.

Because of the mass density (10) in the sun, the reaction with υ_P does not play a role. In the s.c. *PP*-cycle, calculated first by Bethe and Critchfield (1938), the appearing neutrino could be an electron-neutrino υ_e. In this case at least two additional e-neutrinos are needed at the left hand side of (11) for the fusion of

${}^1_1$H + ${}^1_1$H = P + P. The conservation of elementary particle numbers is would be fulfilled by a reaction

$${}^1_1\mathrm{H} + {}^1_1\mathrm{H} + 2\,\upsilon_e = {}^2_1\mathrm{H} + p + 1.44\ \mathrm{MeV}, \tag{14}$$

due to the fact that the deuteron

$${}^2_1\mathrm{H} = (P, e, p, e, P), \tag{15}$$

which is a five particle system. But the brought inner energy of the two e-neutrinos is with

$$4 \text{ x } \mathrm{m}_e c^2 = 2.04\ \mathrm{MeV}, \tag{16}$$

too small for the binding energy of ${}^2_1$H in the range of 2.22 MeV and for the additional 1.44 MeV. Therefore, another sort of particle plays a role in (14) than υ_e; most possibly an electric neutral compound ($P, \upsilon_e, \upsilon_e, E$) = ($P,e,p,e,p,E$) which looks like a neutral Pion π^0. Within the UFT, the correct form of reaction (11) is

$${}^1_1\mathrm{H} + {}^1_1\mathrm{H} + \pi^0 = {}^2_1\mathrm{H} + p + \upsilon_P + 1.44\ \mathrm{MeV}, \tag{17}$$

with a produced proton-neutrino υ_P at the right side. The υ_P can leave the sun from the place of reaction because of the small mass density.

In the UFT it is easy to see that ${}^2_2$He can not exists because it would be

$${}^2_2\mathrm{He} = (P, e, p, P).$$

One electron-neutrino can not bind two positive charged protons together.

These steps explain the unrecognized uncertainties of all three reactions (11)-(13) in respect to neutrinos. The occurrences and the meaning of additional electric neutral particles and mass-less particles on both sides of the usually written down nuclear reactions are uncertain. We recognised this situation already in the composition of nuclei: the number of e-neutrinos is unknown within a nucleus, Refs. **[6, 7]**. We do not know how many electron-neutrinos are within ${}^{3}_{2}\mathrm{He}$ and ${}^{4}_{2}\mathrm{He}$. This uncertainty can be handled only within model calculations with variation principles of the UFT for electric neutral and mass-less particle system, whereby the mass-less property means the systems are neutral also in respect of the gravitational charges.

A few words about the neutral Pion have to be said. The most popular decay of π^0 is usually written down as, Ref. **[5]**

$$\pi^0 \rightarrow 2\,\gamma\,. \tag{18}$$

But this reaction is incorrect because of particle number conservation. In the UFT the decay (17) must be

$$\pi^{0*} \rightarrow \pi^0 + 2\,\gamma\,. \tag{19}$$

This equation means the decay of the excited Pion π^{0*} to its ground state

$$\pi^0 = (P,e,p,e,p,E), \tag{20}$$

by radiation of electromagnetic waves.

The question, where the neutral Pion derived from, touches the problem of dark matter. The UFT consider namely the dark matter as to be consisting of the two kinds of neutrinos, of π^0 and of similar compounds

dark matter = { υ_P ; υ_e ; υ_{eP} =(P,e,p,E);

π^0 =(P,e,p,e,p,E); (N x P, M x (e,p), N x E)}, (21)

with suitable numbers N and M. But the size of υ_P is considerably smaller than the size of all other compounds. The compounds in the dark matter can not condensate on each other, but most possibly they accumulate within and in the vicinity of stars. In several astrophysical models, the dark matter and the dark energy give 95% of the whole mass and energy contain of the universe. Therefore, the presence of dark matter plays a crucial role at the fusion reactions (11) – (13) at the production of star matter. Model calculations of the distribution of the dark matter will result in more insight in the developments of stars and of galaxies.

The inverse process to production of condensed matter is its destruction. Inside of large stars the atoms lost their electron shell and the nuclei will be instable. The repulsive Coulomb force disbands the constituents of nuclei. The disbanded constituents are stable neutrons n^0 = (P,e), e-neutrinos and protons. The free protons catch free electrons and build also neutrons. If the free e-neutrinos remove from the matter only neutrons n^0 remain over a pure neutron star is generated. The maximal mass density of such neutron stars is in the range of the mass density of nuclei

$$\rho = 1.67 \text{ x}10^{-24} \text{ g }/4.189(0.7\text{x}10^{-13} \text{ cm})^3$$
$$= 1.16 \text{ x } 10^{15} \text{ g/cm}^3. \qquad (22)$$

But, without the stabilizing e-neutrinos of the nuclei, the originally stable neutrons n^0 in the inner of neutron star collapse further, until they have a size under 10^{-16} cm. In all probability, there exists also a stable state of the (P,e) system calculated, Ref. **[6]**, with

$$h^{-} = h^{0}/(m_P/m_e)^{1/2} = h^{0}/44.$$

In this range of proton-electron distances, the collapsed neutrons can interact with the proton-neutrinos which have a $3.83\text{x}10^{-17}$ cm size and under heavy production the supernova explosion starts. Shortly before the supernova explosion, the mass density in inner regions of neutron stars is the greatest density of condensed matter. An estimation of the maximal mass density is given by

$$\rho_{\max} = 1.67\ \text{x}10^{-24}\ \text{g}/(10^{-16})^{3}\ \text{cm}^{3} = 1.67\ \text{x}\ 10^{24}\ \text{g/cm}^{3}. \quad (23)$$

This mass density is unbelievable high, but finite. The mass of the sun $M_{Sun} = 1.989\text{x}10^{33}$ g would be compressed in a ball with a radius of 6.57 m. The Schwarzschild radius of a mass 1.4 M_{Sun} is R_S = 2.95 km. The mass density would be only

$$\rho_S = 1.4\ M_{Sun}/(4/3\pi\ R_S^{\ 3}) = 2.59\text{x}10^{13}\ \text{g/cm}^{3}. \quad (24)$$

Nevertheless, the compressed neutron stars before the supernova explosion are far from being to be black holes.

The development of stars begins with a supernova explosion from new on. This is a local process only and there is no need for a global big bang in order to generate the whole universe at one moment in the far past. The big bang theories meet, beside other inconsistencies, the discrepancy how the estimated 10^{30} s stability of elementary particles corresponds with the 1.5 G year's = $4.7\text{x}10^{17}$ s age of the universe.

The UFT with the two fundamental interactions, the electromagnetic (e.m.) and the gravitational interaction, and with the four kinds of elementary particles (e, p, P and E) describes the universe between 10^{-17} cm particle distances and the detectable 10^{10} light-year's global distances in the (3+1) dimensional Minkowski space. The field equations of the e.m.- and the g-field are Lagrange equations of a Hamilton principle, Ref. **[8]**. There are no scientific associations necessary about curvature of space, more than 4 dimensions, inflation processes, super strings and some kinds of membranes.

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Values of constants in universe

Velocity of light and gravity	c	$2.99\text{x}10^{10}$ m s^{-1}
Elementary electric charge	q	$4.80\text{x}10^{-10} m^{3/2} kg^{1/2} s^{-1}$
Electron mass	m_e	$9.91\text{x}10^{-31}$ kg
Proton mass	m_P	$1.67\text{x}10^{-27}$ kg
Gravitational constant	$\boldsymbol{G}$	$6.57\text{x}10^{-11} m^3 kg^{-1} s^{-2}$
Specific gravitational charge, $g = (4\pi \boldsymbol{G})^{1/2}$	g	$2.87\text{x}10^{-4} m^{3/2} kg^{-1/2} s^{-1}$
Elementary gravitational charge of proton	gm_P	$4.97\text{x}10^{-31} m^{3/2} kg^{1/2} s^{-1}$
Planck's constant, h=1/8$^{1/2}$ x q^2 x(m'/E_0)$^{1/2}$	h	$6.62\text{x}10^{-34}$ Js
m' the reduced mass, E_0 the ionization energy of hydrogen		
The h^0 constant, h^0=1/(4 x 2$^{1/2}$) x q^2/c	$h^0 = h/387$	$1.71\text{x}10^{-36}$ Js
Size of electron-neutrino	r_{ν_e}	$7.03\text{x}10^{-14}$ cm
Size of proton-neutrino, minimal distance	r_{ν_P}	$3.83\text{x}10^{-17}$ cm
Minimal time distance	r_{ν_P}/c	$1.27\text{x}10^{-27}$ s
Maximal mass density, $m_P/(10^{-16}\ \text{cm})^3$	ρ_{max}	$1.67\text{x}10^{24}$ kg cm^{-3}
Loschmidt number	L	$6.02\text{x}10^{23}$ mol^{-1}
Boltzmann constant	k	$1.38\text{x}10^{-23}$ mol K^{-1}
Temperature of background radiation	T_{bg}	2.75 K
Maximal detectable distance	R_Ω	10^{10} light-year ~10^{27} cm