A Cosmological Model

by Alfred Kühne

(Second revised and completed Edition)

This paper is dedicated
to my three beloved cats
Mucki and Momo

Summary

In this paper, the author presents a cosmological model capable of explaining the following fundamental physical phenomena and properties of spacetime:

1. Three−dimensionality of space
2. Curvature of spacetime
3. Particle/Wave dualism
4. Relationship between electromagnetism and gravitation
5. Quarks, subquarks and their structure
6. Properties of quanta (especially of those called protons, elektrons and neutrinos)
7. Asymmetry between matter and antimatter in the universe
8. Expansion of the universe – why does that happen?
9. Significance of the so−called „Big Cosmic Numbers“
10. Relationship between smallest and biggest possible error of distance measurement
11. The universe – how big is it and its mass?
12. Dependency between the Sommerfeld Fine Structure Constant and the ratio of proton to electron mass (they’re inversely proportional)
13. Dark matter – what is it?

And the universal validity of Albert Einstein’s theory of relativity[5] can especially be shown for the very beginning of cosmic expansion.

The model handles quanta as sets in the sense of set theory and describes the universe as a subset of the power set of those sets, depending on whatever quantum is chosen as a reference or test−particle in order to find out how the remaining world acts on it.

Acknowledgement

The author wants to give expression to his even−handed deep and affectionate thankfulness towards Mr. Dieter „Deniz“ Stebner, Mr. Klaus−Michael „Rambo“ Kretschmer as well as Mr. Ralph Möhrke for their extremely helpful advices and proposals which have strongly contributed to the completion of this paper.

Introduction

Today’s cosmology so far didn’t give satisfactory answers to some questions already discussed for a long time which are the cause for many speculations up to the present, and the author’s opinion is that until now, nobody really tackled those questions. The reason for this might be that in the first place, cosmology is seen as a playground for speculative physics rather than as a promising field of research, and, for instance, not many physicists do believe that cosmology could provide solutions to the big riddles of fundamental physics; for example, think of the considerable amount of questions concerning an unified field theory. Eminent cosmologists like Eddington or Dirac have dealt with interesting topics like the big cosmic numbers, and in consequence they presented good intellectual approaches. Especially the former has produced a notable body of thought with his „standard uranoid“, which will be discussed later – the model presented here is mainly based on Eddington’s work.

If the reader dedicates himself to cosmology, philosophy surely provides appropriate means to deal with this subject. The author states that already for a long time, natural sciences didn’t badly worry about taking philosophical aspects into closer consideration, and it surely cannot be negated that nowadays, philosophy is suffering a phase of stagnation. It would be nice if this paper could contribute a significant share to change that.

Back to Eddington: In his model, he assumes that space in our universe is curved and therefore finite. He explains that in such an universe the biggest possible error of linear measurements has to be the radius of curvature of spherical space. But there also has to be a lower limit to the precision of such measurements. This is a fact simply because the only way whereby one can measure the distance between to adjacent points is by means of electromagnetic waves. Their wavelength, which as a basic principle has to be bigger than zero (because a wavelength with the value 0 would correspond to an infinite energy E, according to the equation $E = h \cdot c / \lambda$; h is Planck’s constant, c the light velocity in empty space and λ the wavelength of the radiation used), defines in a specific way the error of distance measurement; in other words, it depends on the wavelength of the radiation one uses for this purpose. And spacial localisation is only possible by means of distance measurement. Because E must have a finite value (after all, Eddington assumes that the universe is finite), λ cannot underrun a smallest possible extremal value, and that means that a finite precision of linear measurements cannot be exceeded. So, „distance“ is a concept that looses every sense if a specific boundary is transgressed. Let σ be this threshold value of measurement precision.

Eddington now considers the relationship between the curvature of space and the number of elementary particles in the universe (mostly protons and electrons, if what is called "dark matter" is neglected, which wasn't known by Eddington during his lifetime, and if one also neglects particles which have such a small mass so that even their enormous number does not contribute a noteworthy part to the total mass of the universe, for example neutrinos). To this purpose he idealises the universe; he equates it with the already mentioned "standard uranoid". That is a model of the world in which uniformly distributed particles exist (e.g. protons and electrons) whose temperature is 0° Kelvin; Eddington implies that all particles are at rest relative to each other.

In such an uranoid there is a parameter for the magnitude of overall space bending; this is the already mentioned radius of curvature of spherical space, which shall be called **R**. In the actual world it would be more realistic to call it an average universal radius of curvature. And now Eddington shows by considering a volume extensive enough to include a large number of particles in a still larger assembly of N particles in the uranoid as a background environment, that the curvature of space in which the particles are enbedded is simply a consequence of the natural limit of the precision of linear measurements; more exactly:

$$2 \cdot \sigma = \mathbf{R} / N^{½} ; \qquad (1)$$

or

$$N^{½} = R_{un} : (2 \cdot \pi \cdot \sigma) ; \qquad (2)$$

where R_{un} is the distance between an observer and the opposite pole on the uranoid, which is π times **R**.

And in fact there is an average quantitative match in compliance with equation (2); it is known for quite some time that N is approximately equal to 10^{80}. If one sets R_{un} equal to more or less $13.8 \cdot 10^{9}$ lightyears which is a value approved by modern physics[14], and if σ equates the so−called classical electron radius, then the value of 10^{40} is found on the left side of (2) and approximately 10^{39} on its right.

As is generally known, an electron bears a so−called „elementary" electric charge. Consider now a sphere with radius r which has this static electric charge e*, then its electrostatic energy is equal to e^{*2}/ r . If the radius of this sphere is zero, this energy reaches an infinite value. It is well known that the energy of an electron is finite, even quite small, so the radius of this particle has to be bigger than zero. If one assumes that the whole mass of the electron is of electromagnetic origin, one can show that its radius is

$$r_e = e^{*2}/ (2 m_e \cdot c^2) . \qquad (3)$$

Now, in hydrogen atoms, it's a fact that the proportion between electromagnetic attraction and gravitational pull between proton and electron is also something around 10^{39}. Eddington deduces this ratio as well.

He sets the uranoid equal to a positively curved Einstein universe. If M_{un} is its mass and G the gravitational constant, it can be shown that the following equation applies:

$$\frac{M_{un} \cdot G}{c^2} = \frac{\pi \cdot \mathbf{R}}{2} \; ; \qquad (4)$$

and because there are as many electrons as there are protons in the universe, the number of protons equals N / 2 . The mass of the electrons can be neglected here, because it is about 1,840 times smaller than that of the protons. Therefore, $M_{un} = ½ \, N \, m_p$, where m_p is the mass of a single proton. Hence, with (4) one gets

$$m_p \, G \, / \, (\pi \cdot c^2) = \mathbf{R} \, / \, N \; ; \qquad (5)$$

with equation (1):

$$m_p \, G \, / \, (\pi \cdot c^2) = 2 \cdot \sigma \cdot N^{½} \, / \, N \; ;$$

converted

$$N^{½} \, / \, \pi = 2 \cdot \sigma \cdot c^2 \, / \, m_p \, G \; ; \qquad (6)$$

with equation (3) this is

$$N^{½} \, / \, \pi = e^{*2} \, / \, m_e m_p G \; ; \qquad (7)$$

if it is assumed that the distance r_e is the smallest seperation of two points which can be measured by electromagnetic means, it therefore has to be equal to σ. If the root of N (as mentioned above, N is approximately equal to 10^{80}) is extracted and the solution is divided by the number π , the result is a number with the magnitude order of 10^{39}, and that is of the same scale as the experimentally determined ratio of electromagnetic to gravitational force between proton and electron in the hydrogen atom[1].

The author fosters his conviction that Eddington’s approach is correct, and he intends to create the prerequisites for an adequate proof.

In this paper the **initial assumption** is that the world perceived by the human mind is in quintessence solely its effect on it, exactly as it was stated by the french philosopher Jean−Paul Sartre in his work „Being and Nothingness“[2]: The appearance becomes full positivity; its essence is an ’appearing’, which is [not] [...] opposed to being, but on the contrary is the measure of it. For the being of an existent is exactly what it appears.“

Furthermore, as a **second assumption**, the author postulates that perception depends on the perceiving observer, who from now on shall mostly be called a „subject“, in the sense that his own structure is only allowing perceptions whose structure is corresponding exactly to his own specific structure – what filters out everything not congruent to the structure of the subject. At last, such an approach is the result of a well known thought experiment: „Schrödinger’s Cat“[3].

In this experimental setup a cat is fixated in such a way that it would inevitably be killed by the bullet of a gun, which can be triggered by an electronic device. A single photon hitting an appropriate sensor activates this device and thereby causes the deadly shot. This machinery is mounted behind a half−transparent mirror, so that half of the light is going through it and the other half is reflected. And now, this whole setup is placed inside a box concealing everything happening inside, so no information whatsoever can be gathered from the outside concerning the question if the cat stays alive or already got shot. There's only one hole allowing a single photon to enter the box and to hit the half−transparent mirror inside. What outcome this experiment could possibly have?

At first glance one is apparently confronted with to different scenarios: Either, nothing is happening, because the photon is reflected by the mirror, or, the photon passes through it, hits the sensor and in consequence causes the deadly shot. Before the box is opened, nobody can decide if the cat is alive or already dead, but there can be no doubt about the fact that one of both results has to be true, regardless if somebody is looking into the box or not.

But Schrödinger presents a surprisingly different explanation. As soon as the photon reaches the mirror, as a matter of principle, no statement about whether the photon crosses the mirror or not can be made. It may only be stated that the photon is potentially crossing the mirror **and** that it is potentially reflected. In the first case the cat is dead, in the second it is alive; because both states are „potentially" co−existing, Schrödinger insists that in accordance with orthodox quantum theory the cat is de facto potentially dead and as well potentially alive. But it is only by opening the box that one of both states is realised, and the person who opens the box, i.e. the subject is responsible for the fact that the cat may be dead, simply for the reason this act is realising one of both former potentially co−existent states. The gist is the conclusion that the observed event depends on the observer, who is called „subject" here; it is simply becoming a reality because he observes it!

If in compliance to the first assumption each observed event, which from now on shall be called an „object", is exactly its effect on a subject, not more and not less, and furthermore, in compliance to the second assumption, an event can only be observed by a subject structured in such a way that parts of his consistence are congruent to this object, a quasi solipsistic conclusion can be drawn, that the reality of objects does only exist in the subject. Quite simply, all observed objects are contained in the subject observing them, what causes the author to utter the mathematical statement that the subject is a set whose elements are objects.

To be thorough, an observation is intrinsically tied to a „non−observation", which of course is itself also an observation. This is trivial; in Boolean algebra the observation corresponds to the statement „true", the non−observation to „false", in digital technology to the states „on" respectively „off".

Subsequently the author uses the expressions „positive" and „negative" perception, the latter replacing the term „non−observation".

So far the expressions „observation" and „object" have been used. According to the first assumption the object cannot be anything else than its perception by the subject. Therefore the term „observation" will be discarded; from now on, in the context of this paper, the terms „positive" and „negative objects" will be used in the first place. Thus, the subject is a set whose elements are positive and negative objects.

By now the reader will surely realise that neither subject nor object is explained by something more fundamental, it’s rather their relationship that is defined here.

At this point, the question whether every potentially existent set in the universe is also an element of the subject shall be answered. This results in asking if the set of all sets exists. And this question has already been replied by Bertrand Russell quite a while ago; the statement, something like a set of all sets can exist, winds up in contradictions (Russell’s antinomy)[4].

Thus, all elements of the subject are objects which are not subsets of the subject. In other words, the subsets of the subject are not elements of the subject. So, the subject cannot be the set of its subsets. It can be put as follows: Because of the axiom of power set the set of the subject’s subsets is the power set, the claim that the subject exists results in claiming that there are other sets in addition to the subject (in a manner of speaking, „outside“ the subject), and this consideration forcibly leads to the deduction that the subject isn’t the only existent set – an assertion contradicting a solipsistic perspective.

Based on the assumptions mentioned above the author builds a model of the world which describes a universe (more accurately, an „uranoid“) which contains the utmost minimum of quanta (an amount of them just sufficient to allow a description of fundamental physical phenomena – see chapter I.) and at the same time has the smallest possible extent, in order to show subsequently that this cosmological model can accurately describe the so called „Big Bang“, i.e. the starting point of the expansion of the universe as one can see it nowadays. The author thinks that the present−day magnitude of the Sommerfeld fine−structure constant α (something around $7.297352568 \cdot 10^{-3}$), which in this model isn’t really a constant, can be deduced from the initial conditions of this universal expansion.

Chapter I.

In accordance with the assumptions in the introduction to this paper the world is a set defined by elements which are subsets of the subject, and therefore at least a subset of the power set of the subject.

Accordingly, the set of all protons, antiprotons, electrons and positrons existing in the universe is at least a subset of the power set of a test particle, if this itself is a subject, hence a set and thus defined solely by its elements. These elements have the following physical properties:
1. mass / energy;
2. velocity;
3. electric charge.

They are identical to each other, but have to carry either a positive or a negative electric charge. The directions towards they move may also differ, but not the value of their velocity vectors. What's more, nothing about their „inner life“ may possibly be stated, that's why the author handles them as Black Holes.

Now, the author wants to bring forward a **third assumption**: For each element of the test particle (in this model, each of those elements carries an electric charge by definition) there is exactly one element with the opposite electric charge somewhere in the universe, i.e. in a subset of the power set of the test particle. For example, let a test particle be a set of two elements with a negative and one element with a positive electric charge; then there has to exist exactly one further element of the test particle's power set being a set with exactly one element bearing a positive electric charge. This conforms to the principle found in the contemporary universe, that quanta are always created pairwise. And if someone asks himself the question, how the universal expansion observed by astronomers nowadays might have begun once, this obviously leads to the postulation of a model with the smallest possible extension of spacetime – and also the smallest possible quantity of particles in it. This state is defined by a quantum number which the author calls „image number“ M; at the very beginning of spacetime it is equal to 1. As time goes by, M is getting bigger and bigger. The way of its growth will be discussed later on.

How many particles, i.e. elements of the test particle must at least exist in order to be able to realise the properties 1.−3.? In order to do that, one needs

A. linear movement (translation) and
B. rotation

to be definable. Moreover,

C. charge equalisation

has to be possible.

In order to find out how many particles have to exist in a smallest possible universe, a closer examination of the following cases will help:

First case:	If M =1, exactly one particle exists, the only element of the test set. Because there's no other particle, no charge equalisation is possible. What's more, translation and rotation cannot be defined here; in relation to what frame of reference the element of the test set could possibly move? A. and B. are not definable, C. is impossible.
Second case:	Two particles exist for M =1. In this case, translative movement can be defined (particle 1 can move in relation to particle 2), but not rotation; one would need a third particle as centre of reference in order to define rotational movement. But charge equalisation is possible.
Third case:	Three particles exist for M =1. Here, translation and rotation are definable. Charge equalisation is impossible.
Fourth case:	Four particles exist for M =1. This is the first of the four cases allowing to define A., B. and making the charge equalisation C. possible, thus giving sense to the properties 1.−3.; if one assumes three particles as elements of the test set, and if they do not alltogether bear electric charges having the same algebraic sign, one of them must also be an element of yet another element of the power set of the test particle. If for example two elements of the test set should bear a positive electric charge and the third would be negatively charged, the sole element of the second element of the power set of the test particle would have to bear a negative charge, because otherwise there would be no charge equalisation. Thus, for each particle, i.e. element of the existing elements of the power set of the test particle there exists an anti−particle with the opposite electric charge as an element of one of those elements of said power set, thus realising charge equalisation.

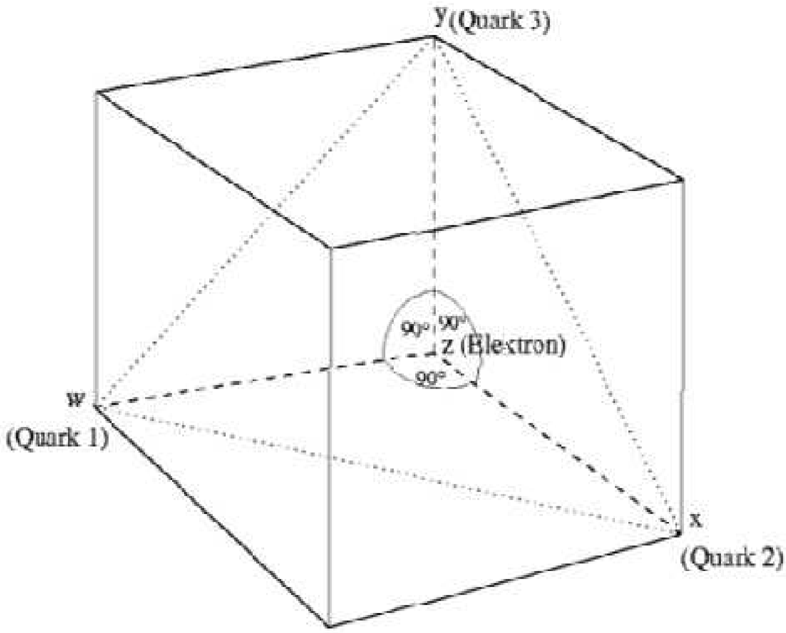

Fig. 1: Lower−dimensional representation of the universe at M =1. The right angles between the connecting lines to the electron are valid in an universe with a positive curvature; in threedimensional, unbent space these angles would amount to 60°

Therefore, from now on, it is assumed that the fourth case describes the situation at M =1 (see also fig. 1 and 2). In the observable universe protons and electrons seem to be the majority; because of this fact it is reasonable to assume that at M =1 the test particle is a primordial proton with a positive total charge. Then, aside of the proton which is defined by two positively and one negatively charged elements, another element of the power set of the test particle exists, and that one is defined by a single element bearing a negative charge, i.e. the electron.

To determine the properties 1.–3. for M =1, the energy theorem will be starting point of the author's calculations. The following equation applies here:

$$E_{e1} = E_{e1}(v_{e1}=0) + E_{tot1}(e^-) \; ; \qquad (8)$$

where E_{e1} is the energy corresponding to the electron's mass acting on a proton, which is the test particle (= test set) here. $E_{e1}(v_{e1}=0)$ is the rest energy and $E_{tot1}(e^-)$ the total energy (i.e. the sum of potential and kinetic energy) of the electron. The elements of the test set have each and all the same properties, left aside the algebraic sign of their electric charge and the direction of their velocity vectors, as already mentioned above. Therefore the following equation applies to the energies of the elements of the test set:

$$E_1(d) = E_1(u_1) = E_1(u_2) \; ; \qquad (9)$$

where $E_1(d)$ is the energy of the element with a negative electric charge, $E_1(u_1)$ the energy of the first positively charged element and $E_1(u_2)$ that of the second.

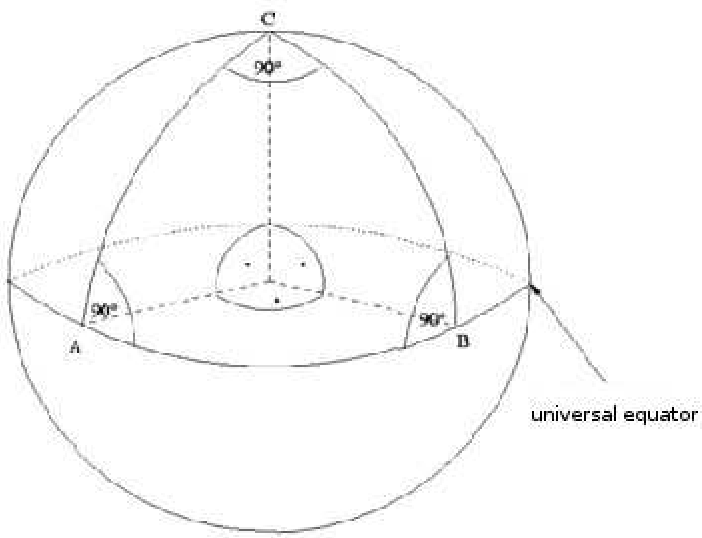

Fig. 2: The above illustration of a 3−sphere is supposed to visualise how the three quarks and the one electron are distributed in the universe at M =1. Aside from the fact one can arrange the three points (A, B and C) in a way so that their radii of curvature are all standing vertically on each other, the homologous situation already depicted in fig. 1 is realised here (quarks and electron reside in the 3−surface of a 4−sphere, if the potential wells caused by their masses are neglected). The distances A–B, A–C and B–C are identical to each other and equivalent to half the distance between the poles of the sphere

At M =1 the electron is defined by one single element, i.e. the only element of the test set bearing a negative electric charge, that's why the following equation applies:

$$E_{e1} = E_1(d) \; ; \qquad (10)$$

and now, already well known to good ole Niels Bohr, the electron's total energy is:

$$E_{tot1}(e^-) = E_{kin1}(e^-) + E_{pot1}(e^-) \; ; \qquad (11)$$

where $E_{kin1}(e^-)$ is the kinetic and $E_{pot1}(e^-)$ the potential energy of the electron. If c is the velocity of light in vacuum, the relativistic equation[5] for the kinetic energy is:

$$E_{kin1}(e^-) = E_{e1}(v_{e1}{=}0) \cdot \left[\left(1 - (v_{e1}^2 / c^2) \right)^{-1/2} - 1 \right] ; \qquad (12)$$

with

$$E_{e1}(v_{e1}{=}0) = m_{e1}(v_{e1}{=}0)\, c^2 \qquad (13)$$

that gives

$$E_{kin1}(e^-) = m_{e1}(v_{e1}{=}0)\, c^2 \left[\left(1 - (v_{e1}^2 / c^2) \right)^{-1/2} - 1 \right] ; \qquad (12.1)$$

$m_{e1}(v_{e1}{=}0)$ is the rest mass and v_{e1} the velocity of the electron relative to a proton at rest – a reasonable point of view, because the proton is a test particle, i.e. subject. Thus, a proton has the rest mass

$$m_{p1}(v_{p1}{=}0) = [\, E_1(d) + E_1(u_1) + E_1(u_2) \,] / c^2 \; ; \qquad (14)$$

with equations (9) and (10):

$$m_{p1}(v_{p1}{=}0) = 3\, E_{e1} / c^2 \qquad (14.1)$$

and with the definition

$$E_{e1} := m_{e1}\, c^2 \qquad (15)$$

the ratio between proton rest mass and electron mass is

$$ß_1 := m_{p1}(v_{p1}{=}0) : m_{e1} = 3 \; ; \qquad (14.2)$$

where m_{e1} is the mass of the electron acting on the resting proton.

If the entire mass in the universe is $M_{un1} := m_{p1}(v_{p1}{=}0) + m_{e1}$, (16)
one gets with equation (14.2) the following result:

$$M_{un1} = 3\, m_{e1} + m_{e1} = 4\, m_{e1} \; ; \qquad (16.1)$$

but now, a closer look at the potential energy $E_{pot1}(e^-)$ is necessary. Alan Guth already stated: „It is said that there's no such thing as a free lunch. But the universe is the ultimate free lunch."[6] With this sentence he wanted to point up the fact that the positive mass−energy in the universe, $E_{un1} := M_{un1}\, c^2$, exactly cancels out the negative binding energy between all quanta in the universe; there, a proton which consists of two up and one down quark is the test particle. At M =1 interactions between the elements of the proton are not definable. Thus, with a clear conscience, one may say that the potential energy in the universe which is equal to the potential energy of the electron is also equal to the negative mass energy in the universe, if M =1:

$$E_{pot1}(e^-) = -4\, E_{e1}\ ; \qquad (17)$$

and now, the well−disposed reader may turn his attention to Rudolf Claudius' virial theorem[7]. It provides a general equation that relates the average over time of a stable system's total kinetic energy consisting of mass points, bound by potential forces, with that of its total potential energy, where the average over time of the enclosed quantity doesn't change (at this point, the attentive reader will ask himself why the author is stating this in the face of the fact that the universe is obviously expanding, but that apparent contradiction shall be discussed later). Now, in the case of M=1, in compliance with the virial theorem the following equation is valid for gravitation and Coulomb attraction:

$$E_{kin1}(e^-) = -\, E_{tot1}(e^-)\ ; \qquad (18)$$

with equation (11):

$$E_{tot1}(e^-) = ½\, E_{pot1}(e^-)\ ; \qquad (11.1)$$

where

$$E_{pot1}(e^-) = -\frac{m_{p1}(v_{p1}=0)\; m_{e1}\; G}{r_1} - \frac{e_1^{*2}}{r_1}\ ; \qquad (19)$$

is the potential energy of the electron, i.e. the amount of energy contained in both gravitational and Coulomb attraction. r_1 is the distance between electron and proton.

With equation (17):

$$E_{tot1}(e^-) = ½\,(\,-4\, E_{e1}\,)\ ;$$

$$E_{tot1}(e^-) = -2\, E_{e1}\ ; \qquad (11.2)$$

in (8):

$$E_{e1} = E_{e1}(v_{e1}=0) - 2\, E_{e1}\ ;$$

$$E_{e1}(v_{e1}=0) = 3\, E_{e1}\ ; \qquad (11.3)$$

that yields with (13) and (12.1)

$$E_{kin1}(e^-) = 3\, E_{e1} \left[\left(1 - (v_{e1} / c)^2 \right)^{-½} - 1 \right] ;$$

with (18):

$$-E_{tot1}(e^-) = 3\, E_{e1} \left[\left(1 - (v_{e1} / c)^2 \right)^{-½} - 1 \right] ;$$

and with (11.2):

$$2\,E_{e1} = 3\,E_{e1}\left[\left(1 - (v_{e1} / c)^2\right)^{-½} - 1\right] ;$$

the outcome of this is:

$$2 : 3 = \left(1 - (v_{e1} / c)^2\right)^{-½} - 1 ;$$

$$\left(1 - (v_{e1} / c)^2\right)^{½} = 3 : 5 ; \qquad \text{/ squared}$$

$$1 - (v_{e1} / c)^2 = 9 : 25 ;$$

$$\frac{v_{e1}^2}{c^2} = \frac{16}{25} ;$$

because $v_{e1} > 0$:

$$\frac{v_{e1}}{c} = \frac{4}{5} ; \qquad (12.2)$$

given an image number M =1, this equation states that the velocity of the electron as particle circling around the motionless proton is four fifth of the velocity of light.

Now, the author uses a trick. He splits time into two orthogonal dimensions; he calls one of those the „cyclic time dimension“ ξ. And he calls the other one ψ, the „translative time dimension“, being perpendicular to ξ. If the image number M equals one, the universe is seen as if time would „stand still“ into the direction of ψ, in the sense that the only elapsed time is cyclic. A full time cycle corresponds to a complete revolution of the electron around the resting proton, the quanta being seen here as particles. Along the translative time dimension ψ, which is orthogonal to ξ, an observer gets the impression as if the electron would literally be everywhere on its orbit around the proton at the same time. The reader is now surely realising that the author is assigning translative time to the direction of time as humans experience it, while the state of the universe at M =1 is described in the context of cyclic time. Using this frame of reference, it becomes obvious why Claudius' virial theorem is applicable here. In the direction of cyclic time the electron has always definable whereabouts, while this is not true in the context of the translative time dimension – there, the electron is „fuzzy“ and presents itself as a standing wave with the energy

$$E_{e1} = h\,\nu_{e1} ; \qquad (20)$$

h is the Planck constant and ν_{e1} the standing wave's frequency on the Bohr radius of the hydrogen atom. Thus, equation (12.2) describes the electron in the context of cyclic time, where it circles around the proton with 4/5th of the velocity of light, while equation (20) makes a statement about the electron along the translative timeline. And the frequency ν_{e1} is in turn defined as follows:

$$\nu_{e1} := c : \lambda_{e1} ; \qquad (21)$$

where λ_{e1} is the wavelength.

The frequency is exactly equal to the reciprocal value of the time needed to generate a standing wave on the Bohr radius of the hydrogen atom. This time is

$$t_{e1} := 1 / \nu_{e1} \; ; \qquad (22)$$

$t_{\xi 1}$ is the time the electron needs into the direction of cyclic time at M =1 to accomplish a full revolution along its orbit. its velocity is

$$v_{e1} = \lambda_{e1} : t_{\xi 1} \; ; \qquad (23)$$

with equation (21):

$$v_{e1} = \frac{c}{\nu_{e1}} \cdot \frac{1}{t_{\xi 1}} \; ; \qquad (23.1)$$

and with (22):

$$v_{e1} = c \cdot t_{e1} \cdot \frac{1}{t_{\xi 1}} \; ;$$

$$\frac{v_{e1}}{c} = \frac{t_{e1}}{t_{\xi 1}} \; ;$$

with (12.2):

$$\frac{t_{e1}}{t_{\xi 1}} = \frac{4}{5} \qquad (12.3)$$

In cyclic time, at the end of t_{e1}, the electron has covered the distance

$$s_{e1} := v_{e1} \cdot t_{e1} \qquad (24)$$

$$s_{e1} = \frac{4}{5} c \cdot t_{e1} \; ;$$

and as soon as $t_{\xi 1}$ has elapsed, the electron has accomplished to circle around the complete orbit in the context of cyclic time, as already mentioned earlier.

The radius of the electron's orbit is r_1. So the following equation applies:

$$\lambda_{e1} = 2 \cdot \pi \cdot r_1 \; ; \qquad (25)$$

with equation (19) one gets

$$E_{pot1}(e^-) = -\frac{2 \cdot \pi \cdot [\, m_{p1}(v_{p1}=0)\, m_{e1}\, G + e_1^{*2} \,]}{\lambda_{e1}} \; ;$$

with (14.2):

$$E_{pot1}(e^-) = -\frac{2 \cdot \pi \cdot [\, 3\, m_{e1}^2\, G + e_1^{*2} \,]}{\lambda_{e1}} \; ;$$

together with (20) and (21), this results in

$$E_{pot1}(e^-) = -\frac{2 \cdot \pi \cdot E_{e1} [\, 3\, m_{e1}^2\, G + e_1{}^{*2} \,]}{c \cdot h}\ ;$$

with equation (15) und $h = 2 \cdot \pi \cdot \hbar$:

$$E_{pot1}(e^-) = -\frac{m_{e1}\, c\, [\, 3\, m_{e1}^2\, G + e_1{}^{*2} \,]}{\hbar}\ ;$$

with (11.1) :

$$2\, E_{tot1}(e^-) = -\frac{3\, m_{e1}^3\, c\, G + m_{e1}\, c\, e_1{}^{*2}}{\hbar}\ ;$$

and (11.2) :

$$4\, E_{e1} = \frac{3\, m_{e1}^3\, c\, G + m_{e1}\, c\, e_1{}^{*2}}{\hbar}\ ;$$

with (15), if $m_{e1} > 0$:

$$4\, c\, \hbar = 3\, m_{e1}^2\, G + e_1{}^{*2}\ ;$$

$$4 = 3\ m_{e1}^2\ \left(c\, \hbar / G\right)^{-1} + \frac{e_1{}^{*2}}{c\, \hbar}\ ;$$

this results in

$$\frac{e_1{}^{*2}}{c\, \hbar} = 4 - 3 \cdot m_{e1}^2 \cdot \left(c\, \hbar / G\right)^{-1}. \qquad (19.1)$$

The electron is a subset of the subject which is defined by the only single element that has a negative electric charge. This is a Black Hole; the author already mentioned that at the beginning of this chapter. Therefore the Kerr−Newman equation[8] for the static boundary applies here; and at this point, the reader may bring himself to mind that this discussion treats of a smallest possible universe. And if it is „smallest possible“, the Bohr radius is exactly equal to the static boundary:

$$r_1 = m_{e1}\, G\, c^{-2} + (m_{e1}^2\, G^2\, c^{-4} - e_1{}^{*2}\, G\, c^{-4})^{½}\ ; \quad (26)$$

it has to be considered that the complete Kerr−Newman equation for the static boundary is

$$r_1 = m_{e1}\, G\, c^{-2} + [\, m_{e1}^2\, G^2\, c^{-4} - e_1{}^{*2}\, G\, c^{-4} - (S_{e1}^2/m_{e1}^2 c^2) \cos^2\vartheta \,]^{½};$$

where S_{e1} is the angular momentum of the Black Hole and ϑ the angle between its axis of rotation and the radial line connecting the Hole and its observer; for the equatorial plane, ϑ is equal to 90°, for its north pole 0° and for its sout h pole 180°. However, the author assumes for this model that the elements of the test set do not have spin, simply because the lack of a discribable inner structure of those elements prevents spin to be definable. This means that $S_{e1} = 0$; furthermore, only equation (26) is valid here, a solution of the Reissner−Nordström metric. Together with equation (19.1) this results in

$$r_1 = m_{e1}\, G\, c^{-2} + 2\, (m_{e1}^2\, G^2\, c^{-4} - G\, h\, c^{-3})^{½} \; ; \quad (26.1)$$

equation (19) with (11.1) und (11.2) yields

$$4\, E_{e1} = \frac{m_{p1}(v_{p1}{=}0)\, m_{e1}\, G}{r_1} + \frac{e_1{}^{*2}}{r_1} \; ;$$

$$r_1 = \frac{m_{p1}(v_{p1}{=}0)\, m_{e1}\, G + e_1{}^{*2}}{4\, E_{e1}} \; ;$$

with equations (15) and (14.2)

$$r_1 = \frac{3\, m_{e1}^2\, G + e_1{}^{*2}}{4\, m_{e1}\, c^2} \; ;$$

and with equation (19.1) that results in

$$r_1 = \frac{3\, m_{e1}^2\, G + 4\, c\, h - 3\, m_{e1}^2\, G}{4\, m_{e1}\, c^2} \; ;$$

$$r_1 = \frac{h}{m_{e1}\, c} \; ; \quad (19.2)$$

with equation (26.1):

$$\frac{h}{m_{e1}\, c} = m_{e1} \frac{G}{c^2} + 2\, [\, m_{e1}^2\, G^2\, c^{-4} - G\, h\, c^{-3}\,]^{½} \; ;$$

and eventually, after some transformations, that results in

$$m_{e1}^4 - 2/3\left(c\, h / G\right) m_{e1}^2 - 1/3\left(c\, h / G\right)^2 = 0 \; ;$$

hence:

$$m_{e1}^2 = 1/3\, \left(c\, h / G\right) \pm 2/3\, \left(c\, h / G\right) \; ;$$

imaginary masses shall be excluded; therefore the result for the squared electron mass is

$$m_{e1}^2 = \left(c\, h / G\right) \; ;$$

whose radix is

$$m_{e1} = \left(c\, h\, /G\right)^{½} ; \qquad (26.2)$$

what corresponds exactly to one Planck mass (and is > 0).

Inserted in equation (19.1):

$$\frac{e_1{}^{*2}}{c\, h} = 4 - 3 \cdot \left(c\, h\, /G\right) \cdot \left(c\, h\, /G\right)^{-1} ;$$

$$\alpha_1 = \frac{e_1{}^{*2}}{c\, h} = 4 - 3 = 1 ; \qquad (19.3)$$

this means that the elementary electric charge was significantly bigger at M = 1 than today (approximately 11.7 times) if it is correct that in the case of M = 1 the described situation corresponds to the beginning of the expansion of the universe – a statement not yet proven. The static boundary which is identical to the distance between electron and proton is the result of equations (26.2) und (19.2); at M = 1 it is identical to the Planck length:

$$r_1 = \left(G\, h\, /c^3\right)^{½} . \qquad (26.3)$$

Now, the kinetic energy of the electron shall be calculated. Equations (26.2) and (15) give

$$E_{e1} = \left(c\, h\, /G\right)^{½} \cdot c^2 ; \qquad (27)$$

this with equation (11.3):

$$E_{e1}(v_{e1}{=}0) = 3 \cdot \left(c\, h\, /G\right)^{½} \cdot c^2 ; \qquad (27.1)$$

what is insofar of interest, as the rest mass of the electron is identical to the rest mass of the test particle, i.e. the proton.

With equations (12.1), (12.2) and (13) the result for the electrons kinetic energy is

$$E_{kin1}(e^-) = 2 \cdot \left(c\, h\, /G\right)^{½} \cdot c^2 ; \qquad (27.2)$$

but this is definitely **not** the kinetic energy of the one element of the test set bearing a negative electric charge, which was perhaps somewhat prematurely called a „down quark“by the author, and in consequence neither of the two other so−called „up quarks“, because in this model, the elements of the test set do not show any differences between each other concerning their mass, electric charge or velocity. Here, the significant criterion consists in the fact that the electron has potential energy, but not the three „quarks“, because they exist inside the test particle and therefore at the bottom of its potential well; they cannot possibly „fall deeper“ towards the observer!

But they also have kinetic energy inside the test particle; they have to have it, if they are moving around. So, the following equation applies here:

$$E_{e1} = E_1(d;\, v_{d1}=0) \,/\, \{[1 - (v_{d1}^2 / c^2)]\}^{½} \,; \qquad (28)$$

where v_{d1} is the velocity of the„Down−Quark“, which is identical to the velocity v_{e1} of the electron (because the element is the same). And now it becomes clear that the rest mass of the „down quark“, $E_1(d; v_{d1}=0)$, cannot be identical to the rest mass of the electron. This shall be deduced as follows: With

$$v_{e1} = v_{d1}$$

as well as equations (26.2) and (27) one gets

$$E_1(d;\, v_{d1}=0) = \left(c\, h\, /G\right)^{½} \cdot c^2 \cdot \{[1 - (v_{e1}^2 / c^2)]\}^{½} \,; \qquad (28.1)$$

what yields with equation (12.2)

$$E_1(d;\, v_{d1}=0) = 3/5 \cdot \left(c\, h\, /G\right)^{½} \cdot c^2 \,. \qquad (28.2)$$

In consequence, the kinetic energy of the „down quark“ is

$$E_{e1} - E_1(d;\, v_{d1}=0) = \left(1 - 3/5\right) \cdot \left(c\, h\, /G\right)^{½} \cdot c^2$$

or

$$E_{e1} - E_1(d;\, v_{d1}=0) = 2/5 \cdot \left(c\, h\, /G\right)^{½} \cdot c^2 \,; \qquad (28.3)$$

what shall be defined here as $E_{kin1}(d)$:

$$E_{kin1}(d) := 2/5 \cdot \left(c\, h\, /G\right)^{½} \cdot c^2 \,; \qquad (28.4)$$

and it’s completely clear that

$$E_{kin1}(u_1) = E_{kin1}(u_2) = E_{kin1}(d) \,; \qquad (29)$$

because in this model, the impetus’ scalar value of each of those three „quarks“ is assumed as being identical.

An important and non−trivial consequence is that at M =1 the kinetic energy of the electron is five times as big as the kinetic energy of the „quarks“. The latter accounts for 40% of the total observable mass of each particular „quark“. This isn’t much, compared to the present situation where the energy of the quarks is mostly kinetic.

Back to the Kerr−Newman equation.

Earlier in this chapter, the author used the equation for the static boundary in order to calculate the distance between the test particle, i.e. the proton, and its orbiting electron. Now, this equation is only valid for non−rotating Black Holes, because it doesn't contain the term with the angular momentum; the Reissner−Nordström equation. It is identical to the Kerr−Newman equation, here with the term in question:

$$r_1 = m_{e1}\, G\, c^{-2} + \left[\, m_{e1}^2\, G^2\, c^{-4} - e_1^{*2}\, G\, c^{-4} - (S_{e1}^2/m_{e1}^2 c^2)\, \right]^{1/2};$$

and without this term, simply because „frame dragging" cannot be avoided under these circumstances (the rotation of the Black Hole imposes itself on the test particle), this leads to equation (26). Therein, r_1 stands also for the Schwarzschild radius of an electric charged Black Hole. At M =1 it is equal to the radius of the electron.

In the introduction the discussion of Eddington's considerations led to the assumption that the entire mass of the electron has an electromagnetic cause. It was mentioned that its radius could be shown to be the result of the following equation:

$$r_e \;=\; e^{*2}/\,(\,2\, m_e \cdot c^2)\,. \qquad (\,3\,)$$

At M =1 gravitational interaction between electron and proton is exactly equal to their electromagnetic interaction; see equation (19.3). Hence r_e obeys a corrected relation which shall be derived now.

The classical model of the electron describes it as a homogenous sphere with the mass m_e, while its electrical charge is evenly spread over its surface. But here, this particle is thought to be a Black Hole, so nothing can be legitimately stated about its innards; therefore, one is forced to assume that also its mass is evenly spread over its surface. So there is neither an electric nor a gravitational field inside this sphere. This corresponds to the statement that both electrical and gravitational field intensity equal to zero inside the sphere and thus can be calculated by integrating them over the outside space.

Let E_e be the electrical and E_g be the gravitational field intensity. It is noteworthy in this context that the latter represents a physical quantity which is pretty controversely discussed.

In order to explain what's the problem here, the author needs to haul off a little bit. If two electric charges come together, the field energy collapses and the potential energy of the field is transformed into kinetic energy of these charges. More accurately: An electric field between a positive and a negative charge has a definite total energy which is proportional to the integral of E_e^2 and smaller than the sum of the energy of the separate fields of each of both charges which are assumed here as point−shaped. If they approach each other, their total energy diminishes, because work is performed on them. As soon as both charges come together, the field and its potential energy vanish. If a gravitational field is considered, the integral of E_g^2 is bigger than the respective integrals for each of both involved masses; if they approach each other, the total integral becomes bigger, in spite work is performed on them. As soon as both masses combine, the integral reaches a maximum, although no potential energy is left.

The author offers the following way out of this problem: Try to imagine that a Black Hole has a Schwarzschild radius which is bigger than zero simply because a repelling force from within keeps the Black Hole from collapsing to a mathematical point, i.e., a singularity. It has to be completely clear that this is only a theoretical workaround, because the extent of a Black Hole is a consequence of the well known laws of gravitation. In order to avoid conflicts and contradictions with the latter the author uses this workaround only within the range of the Black Hole. Outside the Hole there is no such force. Its introduction into this model represents only an alternative method of approach and is thought to illustrate the analogies between the equations describing electro−magnetic repulsion and those dealing with the gravitational properties of a Black Hole. In no case so−called „antigravitation" shall be introduced through a loophole into this model. The author hopes to be able to make it absolutely clear that the assumption of such a repelling force playing an antagonist role to gravitational attraction would make it possible to calculate the Schwarzschild radius, i.e. the extent of a Black Hole, exactly like the extent of an electrically charged particle, i.e. an electron. Therefore, the author introduces here a so−called „gravitational elementary charge" g* :

$$g^* := \iota\, m_e\, G^{½} \; ; \qquad (30)$$

ι is the imaginary number, the square root of -1; m_e stands for the mass of the electron. Nota bene, the author doesn't set mass equal to gravitational charge, as it may be widely accepted by others; he will justify the reason later.

The field connected to this gravitational elementary charge doesn't act on anything outside the electron. Nevertheless it will be used here as hypothetical auxiliary quantity. In order to avoid possible inconsistencies, the author postulates another universe, in which this field inside the Schwarzschild radius is extending itself. The Hole would thus have to exist in both universes.

And now, in the first run, the author turns his attention to the unproblematic part; let the electrical field intensity be

$$E_e = e^* / \; 4\pi\varepsilon_0 r^2 \; ; \qquad (31)$$

In this paper, he uses the MKS unit system, and that's why he sets the dielectric constant as follows:

$$\varepsilon_0 := \frac{1}{4\pi} \; ; \qquad (32)$$

under these conditions, the energy density of an electric field is

$$\rho_e = \frac{1}{8\pi} \cdot \; E_e^2 \; ; \qquad (33)$$

and now to this controversial discussion about gravitational field intensity. The electron at M =1, i.e. its single element, a Black Hole, is not only a carrier of an electric, but also of a gravitational charge g_1^*. In analogy to electric charge and in unison with it, the latter causes the element of the set which is the electron to maintain its extent in cyclic time.

First of all, the question has to be asked to what extent Gauß's law

$$-\nabla^2\Phi_e = \vec{\nabla} \cdot \vec{E}_e = 4\pi \ \rho_e \qquad (34)$$

is valid for gravitational fields; ∇ is the divergence operator; in Euklidean space ∇^2 is often referred to as the „Laplace−Operator"; let Φ_e be the scalar potential generated by electric charge. In the case of Euklidean space the Poisson equation can be written as follows:

$$\nabla^2\Phi = f\,.$$

In three−dimensional Cartesian coordinates, this takes the form[22]:

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right)\varphi(x,y,z) = f(x,y,z).$$

There's repulsion between homopolar electric charges, but masses attract each other; so equation (34) has to be provided with an extra minus sign in order to be valid for gravitational fields; therein, the electric potential, the electric field intensity and the electromagnetic field energy density have to be replaced by their gravitational counterparts. That leads to equation (34.1) :

$$-\nabla^2\Phi_g = \vec{\nabla} \cdot \vec{E}_g = -4\pi \ \rho_g \,. \qquad (34.1)$$

Let the gravitational field intensity of the electron at M =1 be

$$E_{g1} = g_1^* / \ r_{e1}^2 \,; \qquad (35)$$

now, it's one of the author's main concerns to point out how important it is to be aware that this gravitational charge is sort of existing only infinitesimally inside the Schwarzschild radius; it doesn't have any effect on the outside world. But the same physical laws apply as for the electric charge. Thus the model postulates an electrical charge dispersion outside and a gravitational charge dispersion „inside" the Schwarzschild radius – their joint repulsion is stabilising the Black Hole, i.e. the single element of the electron at M =1. The author emphasises again that the gravitational charge has no effect outside this Black Hole; the mentioned repulsion is only acting on the single element of the electron itself.

Starting with equation (34.1), one gets by integrating over the space outside the sphere occupied by the single element of the electron which is identical to the extent of the electron (there's nothing else inside it)

$$W_{g1}(e^-) = ½ \cdot \int d^3 \ \vec{r}' \ \ \rho_{g1} \, \Phi_{g1} \,; \qquad (36)$$

with (34.1) for M =1:

$$-\nabla^2\Phi_{g1} = \vec{\nabla} \cdot \vec{E}_{g1} = -4\pi \ \rho_{g1} \,; \qquad (34.2)$$

at this point it shall be mentioned that equation (34.2) illustrates a negative algebraic sign of the gravitational field intensity, the reason for the controversies in this matter:

$$\rho_{g1} = -\frac{1}{8\pi} \cdot E_{g1}^2 .$$

With (34.2), (36) results in

$$W_{g1}(e^-) = 1/8\pi \cdot \int d^3 \vec{r}' \;\; \Phi_{g1}\nabla^2\Phi_{g1} ; \qquad (36.1)$$

by applying a three−dimensional equivalent of a partial integration using Green's formula[9] one gets

$$W_{g1}(e^-) = 1/8\pi \cdot \int \vec{\nabla}\Phi_{g1} \, \vec{\nabla}\Phi_{g1} \, d^3r; \qquad (36.2)$$

$-\vec{\nabla}\Phi_{g1} = \vec{E}_{g1}$; => $\qquad W_{g1}(e^-) = 1/8\pi \cdot \int \vec{E}_{g1} \, \vec{E}_{g1} \; d^3r;$

what results in

$$W_{g1}(e^-) = 1/8\pi \cdot \int d^3 \vec{r}' \;\; E_{g1}^2 ; \qquad (36.3)$$

at M =1, the electromagnetic field energy density is

$$\rho_{e1} := \frac{1}{8\pi} \cdot E_{e1}^2 ; \qquad (33.1)$$

in analogy to the method of deducing equation (36) from (34.1), starting with (34) one gets the following equation for the electromagnetic field energy by integrating over the space outside the sphere occupied by the electron as already described earlier:

$$W_{e1}(e^-) = ½ \cdot \int d^3 \vec{r}' \;\; \rho_{e1} \, \Phi_{e1} ; \qquad (37)$$

for M =1, equation (34) ends up as

$$-\nabla^2\Phi_{e1} = \vec{\nabla} \cdot \vec{E}_{e1} = 4\pi \;\rho_{e1} ; \qquad (34.3)$$

together with (37) :

$$W_{e1}(e^-) = -1/8\pi \cdot \int d^3 \vec{r}' \;\; \Phi_{e1}\nabla^2\Phi_{e1} ; \qquad (37.1)$$

and also here, by applying a three−dimensional equivalent of a partial integration using Green's formula[9], one gets

$$W_{e1}(e^-) = -1/8\pi \cdot \int \vec{\nabla\Phi}_{e1}\, \vec{\nabla\Phi}_{e1}\, d^3r; \qquad (37.2)$$

$-\vec{\nabla\Phi}_{e1} = \vec{E}_{e1}$; =>

$$W_{e1}(e^-) = -1/8\pi \cdot \int \vec{E}_{e1}\, \vec{E}_{e1}\, d^3r;$$

hence:

$$W_{e1}(e^-) = -1/8\pi \cdot \int d^3\, \vec{r}\,'\; E_{e1}^2\,; \qquad (37.3)$$

and finally, the sum of the electromagnetic and gravitational field energies is

$$W_1(e^-) = W_{g1}(e^-) + W_{e1}(e^-)\,; \qquad (38)$$

with (36.3) and (37.3):

$$W_1(e^-) = 1/8\pi \cdot \int d^3\, \vec{r}\,'\; \left[E_{g1}^2 - E_{e1}^2\right]; \qquad (38.1)$$

What is the author driving at? It is a preliminary adjustment of equation (3) for M =1, as already mentioned above.

(31) with (32):

$$E_{e1} = e_1^* / r_{e1}^2\,; \qquad (31.1)$$

this and (35) transform (38.1) into

$$W_1(e^-) = 4\pi \cdot \int_{r_{e1}}^{\infty} ((g_1^{*2} - e_1^{*2}) : (8\pi\, r'^4)) \cdot r'^2\, dr'\,;$$

$$W_1(e^-) = \int_{r_{e1}}^{\infty} ((g_1^{*2} - e_1^{*2}) : (2\, r'^4)) \cdot r'^2\, dr'\,;$$

$$W_1(e^-) = ½ \cdot (g_1^{*2} - e_1^{*2}) \cdot \int_{r_{e1}}^{\infty} 1/r'^2\, dr'\,; \qquad (38.2)$$

$$W_1(e^-) = ½ \cdot (g_1^{*2} - e_1^{*2}) \cdot 1/r_{e1}\,; \qquad (38.3)$$

equation (30) at M =1:

$$g_1^* = \iota\, m_{e1}\, G^{½}\,; \qquad (30.1)$$

this into (38.3), which makes it clear why the author had chosen to define gravitational charge like that and not to simply equate it with mass:

$$W_1(e^-) = ½ \cdot (-m_{e1}^2\, G - e_1^{*2}) \cdot 1/r_{e1}\;;$$

$$W_1(e^-) = -½ \cdot (m_{e1}^2\, G + e_1^{*2}) \cdot 1/r_{e1}\;; \qquad (38.4)$$

and if one sets the absolute value of this total, negative field energy of the electron equal to its mass energy, hence

$$\left|W_1(e^-)\right| = E_{e1}\;; \qquad (39)$$

then one gets with (19.3), (26.2) and (27)

$$r_{e1} = ½ \cdot 2 \cdot c\,h \,\big/\, ((c\,h/G)^{½} \cdot c^2)\;;$$

and that results in

$$r_{e1} = \left(G\,h/c^3\right)^{½} \qquad (3.1)$$

thus, at M =1, the classical electron radius is equal to the Planck length; see equation (26.3) as well. It is obvious that this distance has the significance of σ as defined by Eddington:

$$\sigma_1 = \left(G\,h/c^3\right)^{½}. \qquad (3.2)$$

Let's change the topic.

At this point, the author thinks that it could be necessary to devote himself again to the fourth case which was already discussed at the beginning of this chapter. The reason for this is that there is yet another case in addition to that which presents a test particle defined by three elements, two of them bearing the same electric charge, while the third exhibits the opposite one.

The reader may visualise a test particle defined by merely two elements which bear each an opposite electric charge. Thus, the power set of the test set is defined by 2^2 elements, i.e. the test set itself, an empty set, a subset of the test set with a single positive and another with a single negative electric charge. So that's also a case with a total of four particles: The two elements of the test particle and the two other particles being each the single element of two subsets of the test set (leaving aside the empty set, i.e. a further subset of the test set).

But at this point, an interesting question arises: How stable can such a system possibly be? This means that if a test set is defined by two elements, one bearing a positive and the other a negative electric charge, obviously nothing can keep both of them from eventually colliding with each other − they are definitely moving around in a very confined and limited quantity of space. But if they collide, they transform themselves instantly into a photon, because they are particle and antiparticle. In consequence, the test set is an empty set, the power set has only this empty set as a single element, and that's it – the world's gone.

O.K. – this conclusion may appear somewhat uncouth, but it throws a light on an aspect which should not be neglected here: What about the stability of the universe and its constituent parts? This kind of problem doesn't seem to show up in the first alternative of the fourth case discussed earlier in this chapter; in a test particle defined by three elements, only two elements bearing opposite charges could destroy each other in a collision. That would result in the disappearance of the test particle's subset defined by one negatively charged element (the electron), but this displeasing singular situation being represented by one single existing element bearing a positive electric charge would instantly be revoked for a very practical reason; a solitary particle bearing an electric charge is inducing in the surrounding space at least one pair of oppositely charged particles (vacuum polarisation), and the result is the previously described case of a smallest possible test set defined by three elements. This scenario may also be described the other way round: The spontaneous creation of a pair of particle and antiparticle is a necessary consequence of the model – if a particle and its antiparticle would destroy each other, only one element with a positive electric charge would be left, charge equalisation would not be possible any more – hence, a pair of particle and corresponding antiparticle would immediately come into existence in order to eradicate this breach of rule (the funny thing is that this mechanism is described in contemporary physics as a violation of the law of conservation of energy, but in contrast is needed here to avoid a set−theoretic breach of rule). The author therefore is forced to deduce a factual absolute stability of the test particle as well as of the subset of the test set defined by a single element needed to establish charge equalisation. Anyway it's sure that there is no further case besides those discussed above, if four particles are involved and charge equalisation takes place, unless the case of a test particle defined by four elements is included, two of them bearing a positive and the other two having a negative electric charge, the consequence of this being the exclusion of all other subsets of the test set with the exception of an empty set. But the elements of the test particle do not exist for each other at M =1, and that's why a research into this scenario cannot reasonably be conducted; hence this case will be excluded. However, only one of the other two variants is obviously really stable. Maybe this could be a contribution helping to clarify the reason why protons, electrons and their antiparticles are stable, as far it is known yet.

On the one hand something is still missing, and that's the answer to the question, how big this minute universe at M =1 might be. Its mass M_{Un1} is already known; in compliance with equations (16.1) and (26.2) it corresponds to four Planck masses.

Be it that the distance between the test particle and its antipole in this positively bent model of an universe is defined as D_{Un1}. The test particle is at rest; thus also its antipole. Why?

From the perspective of the test particle its antipole lies in **every** direction. This is so because all light beams originating from the antipole diverge in all directions, and as they approach the test particle, they are increasingly bended towards each other by four−dimensional spacetime (in this context time is translative), and in consequence, after having crossed the universal equator, they aspire to each other, until they meet again at the antipole of the antipole, i.e. the location of the test particle. Metaphorically spoken, it wouldn't matter how madly someone „outside“ the universe would shake this four−dimensional balloon, the test particle would not notice anything, even at M =1. Relative to the test particles position its antipole doesn't change its own position neither. Hence, everything located at the antipole is at rest relative to the test particle. The antipole would then also be the location of the resting electron, if one could obtain the necessary energy to achieve this at M =1. But in an universe with a very small image number, obviously there is no such animal as an energy rental, save, one would enlarge the universe itself, but that's only possible if one increases the image number... At M =1, the electron orbits around the test particle along the universal equator, so r_1 doubled is equal to D_{Un1}.

On the other hand an important question has also to be discussed here. A basic principle in this paper is that the test particle which can be compared to a filter or a kind of spectacles quasi tied to an observer has an inner structure that determines the structure of the world, a subset of the power set of the test set, by exactly this very inner structure, i.e., its elements. So, in the final analysis, it's logically consistent to ask the question what exactly defines an observer. That's easy to answer: An observation! And this consists in the world of quanta in the encounter of two particles.

Besides the case of two elements of the test set colliding with each other, an incident already discussed above, the reader will now ask himself what other quanta encounters could possibly happen in this mini universe at M =1, where only an electron and the test particle itself exist. And this question is also easily answered; according to equation (11.3) the rest energy of the electron is exactly thrice the mass energy of the electron on the Bohr radius around the test particle. Hence, its rest energy is precisely equal to that of the proton. The observation of the world is in consequence, that a free electron which initially is at rest and thus plays the role of a test particle in an universe where it is an antiproton, sends a photon with the energy $2 \cdot E_{e1}$ eagerly caught by a positron on its Bohr radius which thereby mutates into a proton, thus becoming the new test particle in an universe where the former antiproton is now an electron orbiting on its Bohr radius.

That's the sought−after energy rental!

It could be described as a ball game which consists in an alternate succession of universe/antiuniverse creations at M =1, each ball contact creating the point of departure for a discrete (anti−)universal expansion along the translative time dimension ψ.

Chapter II.

Presently, if one takes a closer look at the results of the considerations in the previous chapter, some interesting conclusions can be made.

It’s clear that the model of the author derives both gravitational and electromagnetic interaction from the laws of the mathematical theory of sets, what puts him into the position of being able to present an explanation for their existence and relationship. The test particle, i.e. the subject chosen by the author, is a set whose three elements bear an electric charge, namely two with a positive and one with a negative arithmetic sign. Because charge equalisation has to take place inside the subset of the power set of the subject which was defined as „universe“ in chapter I., there has to exist another subset of the subject with exactly one element carrying a negative electric charge. It cannot be stated too often: It is the same element that bears a negative electric charge inside the subject! Hence, it has literally the same properties; it’s moving around in an identical manner. The electron, the set defined by only one element bearing a negative electric charge, exhibits exactly the same movements as the identical element of the test particle which plays the role of a proton here, the subject. It’s not difficult to learn from the equations in the previous chapter that the electromagnetic repulsion between both of these identical elements is exactly cancelled by gravitational attraction. In an allegorical way one could describe the electron (or rather its sole element) at M =1 as a „shadow“ of the proton’s element bearing a negative electric charge.

It could also be expressed as follows: As a consequence of the laws of set theory, the subset of the test set called „electron“ defined by one element bearing a negative electric charge is moving exactly like the electrically negative element of the test set itself, and this results in both always keeping the same separation distance between each other in the context of cyclic time. After all, it’s the same element being a component of both sets, i.e. on the one hand of the test set, the proton, and on the other hand of the electron, a subset of this test set being in relative motion to the latter. And now it turns out that such a constant separation distance can only be realised if there is a repelling force which cancels exactly the gravitational attraction between those elements carrying a negative electric charge, which de facto are both one and the same. It follows from this that the existence of both forces can indeed be simply explained by the laws of set theory alone. In other words, if one introduces something like gravitation into this model, one is forced to also introduce an equally strong repelling force between identical elements: The electromagnetic repulsion between those elements, them being absolutely identical in every aspect aside from their whereabouts. Alternatively one can do it the other way round, what might indeed be somewhat more obvious: The introduction of electric charges and their interactions into the model brings along the necessity to postulate an attractive force which acts also on the elements of sets bearing a negative electric charge, the test set in this model being defined by three elements, two of them carrying a positive and one bearing a negative electrical charge, and this attractive force is gravitation; in the context of cyclic time, it is necessary in order to physically ensure the permanent stability of the separation distance between the elements having a negative electric charge. And now, the attractive force between the test set’s elements with a positive electric charge and the element defining the electron has to be a logical consequence under these circumstances, although the author has to emphasize further down that for those elements bearing a positive electric charge, the electron doesn’t exist, but, and quite in contrast, it is indeed existing for the proton in its entirety, although the latter also has a positive total charge.

Something else also has to be emphasized here: $t_{\xi 1}$ is a time span that exists only in theory along the cyclic time dimension − as a matter of principle, that's because in this frame of reference, a full revolution on the electrons orbit around the proton is not observable. At M =1, in the context of cyclic time, the electron at all times has covered the distance s_{e1}, and this took the time t_{e1}; a more distant past than t_{e1} doesn't exist at M =1, but actually also none less distant. At M =1, the time t_{e1} is not only the longest possible duration, but as well the sole time that exists along the cyclic temporal dimension. The electron is moving in relation to the proton, and the elements of the latter show also relative movement, but always in a manner that allows the proton in its entirety to stay at rest. This event lasts exactly for the time t_{e1}, and that's also the shortest possible moment.

What humans (normally?) experience is the translative time dimension. Nowadays humanity looks back on an universe several billions of years old. But what did happen to allow an evolution of the universe along the translative time dimension starting from M =1 to a contemporary one with M »1? The basics helping to answer this question shall be discussed now and in the following chapter.

Considerations in this regard may start with a look at the structure of the test particle. Its constituents, the elements of the test set, do not exist for each other at M =1 – they do not interact. The effect the electron is exercising on the test particle can be split up into three orthogonal vectors, in spite of the fact that the electron doesn't exist for both elements with a positive electric charge (this will be explained further down). And interactions between the elements of the subject are not definable at M =1, as already explained before.

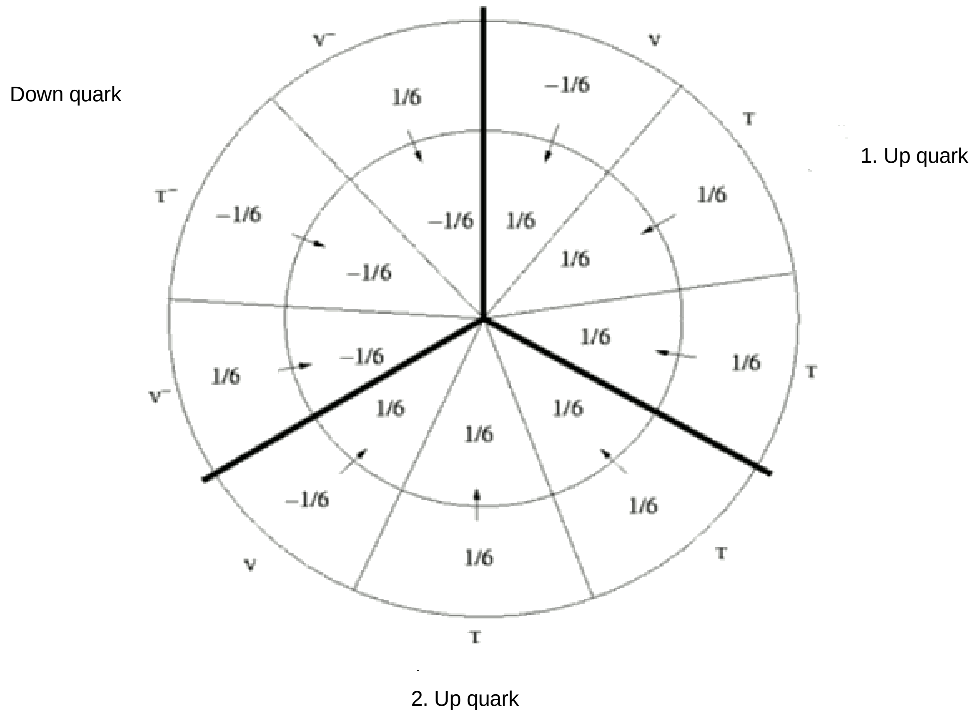

Fig. 3: Here, the result of the reciprocal mapping of the test set's three elements at M =1 is depicted – that's the structure of the test set at M = 2

But what does happen if the image number gets bigger and bigger? It seems likely that M increases if translative time ψ goes by.

Let it be that M = 2. The working hypothesis is that the universe expands and gets bigger; therefore, the translative time $t_{\psi 2}$ is also longer than $t_{\psi 1}$. Although it is correct that interactions between the elements of the test particle were not definable at M =1, this is not true anymore; translative time went by and therefore, the elements of the test particle had the opportunity to act upon each other in the meantime; now, they are mutually existent. Mathematically, those are transformations; each element of the test particle maps itself on oneself and on the other two, and that's why the structure of these elements has changed during the transit to M = 2 (see fig. 3).

The author thinks it's important here to mention that at M =1, the electron is only existent for the proton as a whole (i.e. as a set), because one element of this test set is exactly identical to the element that defines the electron as a set; it is precisely the same element. Without it, its „match" in the electron would simply not exist. Thus, the element also doesn't exist for the other elements of the test set. That's because they do not have an inner structure which would allow them to perceive the electron, according to the second assumption of this paper. So, for them, there is no electron. It follows from this that the elements of the test set bearing a positive electric charge are negative objects (perception interrupts), and the element carrying a negative electric charge is a positive object (a perception)... Here, Murphy strikes again; already a long time ago, science experienced something comparable, as it was found that electrons which carry a negative electric charge are emitted by the cathode, the positive pole, whereas the anode (i.e. the negative pole) sucks them in! Anyway it's a fact within the limits of the three basic assumptions of this paper that the electron doesn't exist for the elements of the test set bearing a positive electric charge, and that's a state of affairs literally yelling to be abolished. But this problem can only be solved if the elements of the test set are allowed to map themselves mutually as well as on themselves.

The transformation process takes course as follows: By mapping each element on itself and on both others, nine new elements are created; respectively three are elements of sets originating from each of the protons three elements at M =1. In detail the situation at M = 2 looks like this:

1. The element bearing a negative electric charge (Θ) maps itself as follows:
   - $\Theta \rightarrow \Theta$ (T^-)
   - $\Theta \rightarrow \oplus_1$ (V)
   - $\Theta \rightarrow \oplus_2$ (V)
2. The first element with a positive electric charge ($\oplus_1$) maps itself as follows:
   - $\oplus_1 \rightarrow \oplus_1$ (T)
   - $\oplus_1 \rightarrow \oplus_2$ (T)
   - $\oplus_1 \rightarrow \Theta$ (V^-)
3. The second element with a positive electric charge ($\oplus_2$) maps itself as follows:
   - $\oplus_2 \rightarrow \oplus_2$ (T)
   - $\oplus_2 \rightarrow \oplus_1$ (T)
   - $\oplus_2 \rightarrow \Theta$ (V^-)

So the elements existing at M =1 become sets at M = 2, provided that the state at M =1 is really lying in the past of this universe. The elements of the resulting sets are the following transformations:

1st set:	$\Theta \rightarrow \Theta$	(T^-)	(–1/3 e_2*)
	$\oplus_1 \rightarrow \Theta$	(V^-)	(no total electric charge)
	$\oplus_2 \rightarrow \Theta$	(V^-)	(no total electric charge)
2nd set:	$\oplus_1 \rightarrow \oplus_1$	(T)	(+1/3 e_2*)
	$\oplus_2 \rightarrow \oplus_1$	(T)	(+1/3 e_2*)
	$\Theta \rightarrow \oplus_1$	(V)	(no total electric charge)
3rd set:	$\oplus_2 \rightarrow \oplus_2$	(T)	(+1/3 e_2*)
	$\oplus_1 \rightarrow \oplus_2$	(T)	(+1/3 e_2*)
	$\Theta \rightarrow \oplus_2$	(V)	(no total electric charge)

Thus, 18 elements result from those three mappings. They are bound in pairs to each other. Arguably, according to the prerequisites in chapter I. (3rd assumption), mass and electric charge of each of these elements are equal (each element bears one sixth of the elementary electric charge e_2*). However, binding energy is contained in these linkages, the nine mappings, and therefore they cannot possibly still have the sum of the masses of their constituents. Well, after the transformations, their electric charges have changed either, as will be shown later.

The above list shows the distribution of electric charge in a proton at M = 2: After the transformation process, the element with negative electric charge becomes the first set with a charge of $-{}^{1}/_{3}\ e_2$*, and the elements with positive electric charge become the second and third set with $+{}^{2}/_{3}\ e_2$*. It's interesting that these are the electric charges of the quarks in nowadays protons. And each element of the sets which originated from the primordial elements of the proton at M =1 are themselves mappings, i.e. sets defined by two elements being bound together by a transformation.

The reader of this paper may now bring to his mind that the smallest elements of the test set bear the same amount of electric charge (either with a leading positive or negative arithmetic sign). Concerning the transformation process depicted above, the quanta bearing the informations of the original elements mapping themselves on others have to have an electric charge. They have to conform to the prerequisites of smallest particles as soon as they begin to exist; the quantised information cannot be available in the form of a smaller particle as the smallest possible components of the test set, because otherwise those wouldn't be the smallest possible components, nor could it be bigger, because virtually as a fragment of a smallest component of the test set before the dispatch of the quantised information it is thus characterised by a lack of an inner structure – and only with such an inner structure could it be possible that the quantised information would be bigger than the smallest components of the test set, because it would then itself be made up of exactly those smallest components. It can be deduced from this that such a smallest component is forced to decay into two exactly commensurate daughter products, i.e. new and smaller components, one of which is the quantised information mentioned above.

If by chance the reader knows about the rishon model of Haim Harari[10], there's certainly something he or she has already noticed in this paper: Beside the three transformation groups listed above, the letters T, V, T^- und V^- can be found in parentheses. These are the symbols for the components of quarks and leptons suggested by Harari; they stand for the T, the V, the anti−T and the anti−V rishon, respectively. Their equivalents in the cosmological model presented in this paper have exactly the same properties as the rishons proposed by Harari. However, it transcends the rishon model that the sets corresponding to the rishons are mappings of the three elements of the test set at M =1 on each other. Furthermore, the rishon model doesn't have an explanation for the asymmetry between matter and antimatter, quite in contrast to this model here.

The rishon properties which were already mentioned above shall now be discussed more thoroughly. Harari derives the colors of the quarks from the so−called hypercolors of the rishons, which he calls „hyperred", „hyperyellow", „hyperblue", „anti−hyperred", „anti−hyperyellow", „anti−hyperblue". But also in this respect, it can be shown that the cosmological model presented here comes up with considerable simplifications; the reader may try to imagine that the elements of the test set at M =1 are kind of „arranged" sequentially. It's totally clear that this definition is completely nonsensical at M =1. But as soon as these elements map on each other, such a sequential arrangement suddenly makes sense. In order to illustrate that, the reader may imagine the first element as „red", the second as „green" and the third as „blue". And if the first element has a negative electric charge, then one gets at M = 2, after the transformation, the case of a „red on red" T^- rishon. Of course the first element can also be „green" or „blue". The result is then „green on green" or „blue on blue"for this T^- rishon, respectively. These colors become imaginable parameters if one tries to visualise that they have to correspond to the impetus vectors of the respective rishon. At M =1 the impetus sum of the three test set elements is zero, because the test particle is at rest. Each impetus has the same scalar value, so the sum of these impetus vectors is nil, what means that the test particle is colorless. If one of those impetus vectors is removed, one „red" and one „green" impetus vector is left, for example – and together, those would form an „antiblue" vector – it's opposed to the „blue" impetus vector. Obviously, at the transit from M =1 to M = 2, the 18 elements created from the original three elements of the test set at M =1 have quantitatively smaller impetus vectors, but each of them has the same scalar value. As a consequence of the situation at M =1, they are collinear with the vectors at M =1. So one can also speak here of „red", „green" and „blue" vectors and elements. For example, let the test set element with a negative electric charge at M =1 be „red", the first element with a positive electric charge be „green" and the second such element be „blue". Then the result for M = 2 is

1st set:	$\Theta \rightarrow \Theta$	(T^-)	(–1/3 e_2^* −red on red)
	$\oplus_1 \rightarrow \Theta$	(V^-)	(no total electric charge −green on red)
	$\oplus_2 \rightarrow \Theta$	(V^-)	(no total electric charge −blue on red)
2nd set:	$\oplus_1 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −green on green)
	$\oplus_2 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −blue on green)
	$\Theta \rightarrow \oplus_1$	(V)	(no total electric charge −red on green)
3rd set:	$\oplus_2 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −blue on blue)
	$\oplus_1 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −green on blue)
	$\Theta \rightarrow \oplus_2$	(V)	(no total electric charge −red on blue)

and, at M =1, if the test set element with the negative charge is called „green“, the first element with a positive charge „blue“ and the second such element „red“, at M = 2 the result is

1^{st} set:	$\Theta \rightarrow \Theta$	(T^-)	(–1/3 e_2^* −green on green)
	$\oplus_1 \rightarrow \Theta$	(V^-)	(no total electric charge −blue on green)
	$\oplus_2 \rightarrow \Theta$	(V^-)	(no total electric charge −red on green)
2^{nd} set:	$\oplus_1 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −blue on blue)
	$\oplus_2 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −red on blue)
	$\Theta \rightarrow \oplus_1$	(V)	(no total electric charge −green on blue)
3^{rd} set:	$\oplus_2 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −red on red)
	$\oplus_1 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −blue on red)
	$\Theta \rightarrow \oplus_2$	(V)	(no total electric charge −green on red)

and as well as in the case of a „blue“ test set element with a negative charge, a first „red“ and a second „green“ element with positive charge at M = 2 :

1^{st} set:	$\Theta \rightarrow \Theta$	(T^-)	(–1/3 e_2^* −blue on blue)
	$\oplus_1 \rightarrow \Theta$	(V^-)	(no total electric charge −red on blue)
	$\oplus_2 \rightarrow \Theta$	(V^-)	(no total electric charge −green on blue)
2^{nd} set:	$\oplus_1 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −red on red)
	$\oplus_2 \rightarrow \oplus_1$	(T)	(+1/3 e_2^* −green on red)
	$\Theta \rightarrow \oplus_1$	(V)	(no total electric charge −blue on red)
3^{rd} set:	$\oplus_2 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −green on green)
	$\oplus_1 \rightarrow \oplus_2$	(T)	(+1/3 e_2^* −red on green)
	$\Theta \rightarrow \oplus_2$	(V)	(no total electric charge −blue on green)

and it’s not difficult to see that one has to deal here with a total of 27 different elements.

Given this „color arithmetic“, the reader may feel free to play around with it a little bit; „blue on blue“ gives „doubleblue“, for example, „red“ on „blue“ „antigreen“ etc. It’s easily discernible that Hararis hypercolors are now obsolete, because in the model of the author, three colors are by far sufficient.

Back to the second assumption. The test set at M = 2, a nearly „modern“ proton, is defined by the elements of the quarks described above (the rishons), which in turn are transformations of the elements of the test set at M =1. Elements of the power set of the test set have to be altogether sets which are subsets of the test set and therefore defined by elements of the latter. And these elements have **exactly the same properties** as those elements which define the test set, not only the same electric charges, but also the same masses/energies! And into the bargain, they even move exactly the same way.

The electron which orbits around the resting test particle is for example a set defined by three T^- rishons – it can be derived from the above list which ones:

$\Theta \rightarrow \Theta$	(T^-)	(−1/3 e_2^* −red on red)
$\Theta \rightarrow \Theta$	(T^-)	(−1/3 e_2^* −green on green)
$\Theta \rightarrow \Theta$	(T^-)	(−1/3 e_2^* −blue on blue)

and that leads the baffled reader at once to ask the question, how the three elements possibly might combine to one electron, while they originate from three completely **different** initial situations. They cannot be simultaneous, can they?!?

That will be answered as follows: Without including the „color model“ explained above, the test set is a proton whose only element completely set up of negative electric charges is a T^- rishon. Under these circumstances, a charge equalisation is not possible; in addition, not each element of the proton would have a corresponding anti−particle or rather its counter−element somewhere in the world, which in this model is a subset of the power set of the test set. In this case the world as a whole would have a total electric charge of $+ {}^2/_3$ e_2*, and not each particle its anti−particle. Both are properties of the universe not observed today. So, at M = 2, there's a kind of „veil“ hiding this displeasing two−third charge, perhaps causing the shortest measurable chronological uncertainty $\tau_2 := \sigma_2 /c$ to exceed Planck time – it might even triple it. This uncertainty creates the successive states of the test sets T^- rishon, i.e. "red on red", "green on green" and "blue on blue" as an example, to be de facto isochronous. And so the model provides an explanation for the fact that the boundary value of the precision of localisation measurements σ is so much bigger than Planck length in nowadays universe.

At M = 2, the reader may have a look at the subset of the power set of the proton, in which each element as a particle has its anti−particle as element of the said subset of that power set; he will then realise that this subset of the power set of the test particle is defined by the following elements: Three protons, accordingly also three electrons, and in addition six neutrinos as well as their anti−particles, six anti−neutrinos. This is definitely the maximum number of those quanta. So, in this variation of the model, at M = 2, the world is assigned to a state in which all three electrons are orbiting on their highest possible radius with a main quantum number n = 2. If all these electrons are falling back on their Bohr radius, three photons are added to the particle zoo described above.

Here, as already implied by the term „variation“ used above, the author sets the focus on the mathematically simplest case with all three electrons orbiting on the highest possible radii of their respective hydrogen atoms with n = 2.

In order to describe this universe at M = 2, at first the masses and the mass energies of the smallest elements of all quanta have to be calculated. From now on, the author calls them „epsilons“; each rishon is composed of 2 epsilons.

To illustrate this: The T^- rishon is the result of mapping the down quark at M =1 on itself. Let E_{Tu2} be the mass energy of the T^- rishon (as well as of its anti−particle, the T rishon) at M = 1, if it's „unicolored“.

So, what the hack does that mean now?

The author calls rishons „uni−colored“, if they are composed of equally colored epsilons, i.e. if they are the result of red−on−red, blue−on−blue or green−on−green mappings. „Varicolored“ will describe such rishons that are composed of epsilons with different colors.

The following relativistic equation applies for the unicolored T^- rishon:

$$[E_{Tu2}]^2 = [E_{Tu2}(v_{Tu2}=0)]^2 + (p_{Tu2} \cdot c)^2 ; \qquad (40)$$

where $E_{Tu2}(v_{Tu2}=0)$ is the rest energy and p_{Tu2} the impetus of the unicolored T^- rishon.

$$E_{Tu2} = 2 \cdot E_{\varepsilon 2} ; \qquad (41)$$

where $E_{\varepsilon 2}$ is the energy of the epsilon. It also has a rest energy, and that is $E_{\varepsilon 2}(v_{\varepsilon 2}=0)$.

Because two epsilons combine to form a T^- rishon (it could also be expressed as follows: One is mapping itself on the other) which originate from the same quark at M =1, no potential energy differences exist; gravitational attraction and electrical repulsion are equal:

$$m_{\varepsilon 2}^2 \cdot G = \left| -[1/6 \cdot e_2^*]^2 \right| ;$$

that results in

$$m_{\varepsilon 2}^2 \cdot G = e_2^{*2} : 36 ; \qquad (42)$$

and the impetus is

$$p_{\varepsilon 2} = m_{\varepsilon 2} \cdot v_{\varepsilon 2} ; \qquad (43)$$

(40) and (41) give

$$[2 E_{\varepsilon 2}]^2 = [E_{Tu2}(v_{Tu2}=0)]^2 + (p_{Tu2} \cdot c)^2 ; \qquad (40.1)$$

the total kinetic energy is the sum of the kinetic energies of the epsilons:

$$[2 E_{\varepsilon 2}]^2 = [2 E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 + (p_{Tu2} \cdot c)^2 ;$$

therefore, p_{Tu2} is also the sum of the discrete impetuses of the epsilons:

$$[2 E_{\varepsilon 2}]^2 = [2 E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 + (2 \cdot p_{\varepsilon 2} \cdot c)^2 ; \quad / : 4 ;$$

$$E_{\varepsilon 2}^2 = [E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 + (p_{\varepsilon 2} \cdot c)^2 ; \qquad (40.2)$$

with (43):

$$E_{\varepsilon 2}^2 = [E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 + (m_{\varepsilon 2} \cdot v_{\varepsilon 2} \cdot c)^2 ;$$

and with

$$E_{\varepsilon 2} = m_{\varepsilon 2} \cdot c^2 \qquad (44)$$

one gets

$$E_{\varepsilon 2}{}^2 = [E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 + E_{\varepsilon 2}{}^2 \cdot v_{\varepsilon 2}{}^2 / c^2 ;$$

$$[E_{\varepsilon 2}(v_{\varepsilon 2}=0)]^2 = E_{\varepsilon 2}{}^2 \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right) ; \qquad / \sqrt{\ }$$

$$E_{\varepsilon 2}(v_{\varepsilon 2}=0) = E_{\varepsilon 2} \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right)^{½} ;$$

or

$$E_{\varepsilon 2} = E_{\varepsilon 2}(v_{\varepsilon 2}=0) \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right)^{-½} ; \qquad (40.3)$$

for unicolored T^- rishons, with (41), this results in

$$E_{Tu2} = 2 \cdot E_{\varepsilon 2}(v_{\varepsilon 2}=0) \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right)^{-½} ; \qquad (40.4)$$

the unicolored T^- rishon moves, as already discussed, always exactly the same way as its components, the epsilons. So the following equation applies:

$$v_{Tu2} = v_{\varepsilon 2} ; \qquad (45)$$

whith (40.4), that results in

$$E_{Tu2} = 2\, E_{\varepsilon 2}(v_{\varepsilon 2}=0) \cdot \left(1 - (v_{Tu2} / c)^2\right)^{-½} ; \qquad (40.5)$$

but now, the varicolored rishons shall be discussed. In their case, the total impetus of the T or T^- rishon is exactly equal to that of an epsilon (may the reader be reminded that red−on−blue gives anti−green – in contrast, red−on−red would give doublered, blue−on−blue doubleblue):

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + (p_{\varepsilon 2} \cdot c)^2 ; \qquad (46)$$

with the equations (43) and (44), that results in

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + E_{\varepsilon 2}{}^2 \cdot v_{\varepsilon 2}{}^2 / c^2 ; \qquad (46.1)$$

but this is also correct:

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + (p_{Tb2} \cdot c)^2 ; \qquad (47)$$

with

$$p_{Tb2} = m_{Tb2} \cdot v_{Tb2} \qquad (48)$$

and with

$$E_{Tb2} = m_{Tb2} \cdot c^2 \qquad (49)$$

(47) results in:

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}{=}0)]^2 + E_{Tb2}^2 \cdot v_{Tb2}^2 / c^2 \; ; \qquad (47.1)$$

$$E_{Tb2} = E_{Tb2}(v_{Tb2}{=}0) \cdot \Big(1 - (v_{Tb2} / c)^2\Big)^{-½} ; \qquad (47.2)$$

and (47.1) gives with (46.1)

$$E_{\varepsilon 2}^2 \cdot v_{\varepsilon 2}^2 / c^2 = E_{Tb2}^2 \cdot v_{Tb2}^2 / c^2 \; ;$$

here, in analogy to the case of the unicolored T and T^- rishons, it is correct that

$$v_{Tb2} = v_{\varepsilon 2} \; ; \qquad (50)$$

=> $$E_{\varepsilon 2}^2 \cdot v_{\varepsilon 2}^2 / c^2 = E_{Tb2}^2 \cdot v_{\varepsilon 2}^2 / c^2 \; ;$$

$$E_{\varepsilon 2}^2 = E_{Tb2}^2 \; ; \qquad / \sqrt{\;}$$

(since mass energies are positive) $E_{\varepsilon 2} = E_{Tb2}$;

$$E_{Tb2} = E_{\varepsilon 2} \; ; \qquad (50.1)$$

with (41):

$$E_{Tu2} = 2 \cdot E_{Tb2} \; ; \qquad (50.2)$$

now, back to the electrons. It’s easy to learn from the previous remarks that electrons, whose elements are T^- rishons, have different energies depending on whether their elements are uni− or varicolored. The reader may now recognise that here, only one electron is yielded that does exclusively consist of three unicolored T^- rishons, two electrons are defined by three varicolored rishons, and three electrons are defined by an uni− and two varicolored T^- rishons. It’s understood that, seen from the outside, the electrons are colorless.

Let now be

$$E_{e2} = m_{e2} \, c^2 \qquad (51)$$

the mass energy of the electron orbiting around the test particle on the Bohr radius; let m_{e2} be its mass.

Let

$$E_{e2}(n=2) = m_{e2}(n=2)\ c^2 \qquad (52)$$

be the mass energy of the electron orbiting on the 2nd radius around the test particle; let $m_{e2}(n=2)$ be its mass.

Let

$$E_{e2}(H;n=1) = m_{e2}(H;n=1)\ c^2 \qquad (53)$$

be the mass energy of the electron orbiting on the Bohr radius around one of both protons in the universe at M = 2 not playing the role of a test particle; let $m_{e2}(H;n=1)$ be its mass.

At last, let

$$E_{e2}(H;n=2) = m_{e2}(H;n=2)\ c^2 \qquad (54)$$

be the mass energy of the electron orbiting on the 2nd radius around one of both protons in the universe at M = 2 not playing the role of a test particle; let $m_{e2}(H;n=2)$ be its mass.

Because by definition, the test particle is always at rest relative to an observer, the electron being the only moving particle in the test set's hydrogen atom, but then, in contrast to this, in the other two hydrogen atoms existing at M = 2 the proton as well as the electron orbiting around a common centre of mass, one may draw the conclusion that the formula for the reduced mass can be used here in order to describe the relationship between those four different electron types. On the one hand, the relation between the masses of the electrons orbiting on the Bohr radius and the mass of the proton at rest $m_{p2}(v_{p2}=0)$ is

$$m_{e2}(H;n=1) = \frac{m_{p2}(v_{p2}=0) \cdot m_{e2}}{[\ m_{p2}(v_{p2}=0) + m_{e2}\ ]}\ ; \qquad (55)$$

on the other hand, the relation between the masses of the electrons orbiting on the 2nd radius around the test particle and the rest mass of the proton is

$$m_{e2}(H;n=2) = \frac{m_{p2}(v_{p2}=0) \cdot m_{e2}(n=2)}{[\ m_{p2}(v_{p2}=0) + m_{e2}(n=2)\ ]}\ ; \qquad (56)$$

(55) yields

$$m_{p2}(v_{p2}=0) = \frac{m_{e2} \cdot m_{e2}(H;n=1)}{m_{e2} - m_{e2}(H;n=1)}\ ; \qquad (55.1)$$

and (56) can be converted into

$$m_{p2}(v_{p2}=0) = \frac{m_{e2}(n=2) \cdot m_{e2}(H;n=2)}{m_{e2}(n=2) - m_{e2}(H;n=2)}\ ; \qquad (56.1)$$

(55.1) equalised with (56.1) :

$$\frac{m_{e2} \cdot m_{e2}(H;n=1)}{m_{e2} - m_{e2}(H;n=1)} = \frac{m_{e2}(n=2) \cdot m_{e2}(H;n=2)}{m_{e2}(n=2) - m_{e2}(H;n=2)} \; ; \qquad (56.2)$$

and now the three electron states already mentioned above come into play. The one with the highest energy, defined by three unicolored T^- rishons, is exactly the very one which the author identifies as being the electron orbiting on the 2^{nd} radius of the test particle:

$$m_{e2}(n=2) = m_{eu2} \; ; \qquad (57)$$

m_{eu2} stands for the mass of the electron being a combination of three unicolored T^- rishons.

$$m_{eu2} = 3 \cdot 2 \cdot m_{\varepsilon 2} \; ; \qquad (58)$$

(57) and (58):

$$m_{e2}(n=2) = 6 \cdot m_{\varepsilon 2} \; ; \qquad (57.1)$$

and the electrons with the least energy orbit on the Bohr radii of both protons which do not play the role of a test particle:

$$m_{e2}(H;n=1) = m_{eb2} \; ; \qquad (59)$$

m_{eb2} stands for the mass of an electron consisting exclusively of varicolored T^- rishons:

$$m_{eb2} = 3 \cdot m_{\varepsilon 2} \; ; \qquad (60)$$

(59) $\overset{!}{=}$ (60):

$$m_{e2}(H;n=1) = 3 \cdot m_{\varepsilon 2} \; ; \qquad (59.1)$$

and now, it can be expected that the electrons which are each built of one uni− and two varicolored T^- rishons, if this model is correct (two uni− and one varicolored T^- rishons cannot form an electron, because in this case, it couldn't be colorless), whose mass would thus be

$$m_{em2} = 4 \cdot m_{\varepsilon 2} \; , \qquad (61)$$

could either be electrons with the mass m_{e2} or such with tha mass $m_{e2}(H;n=2)$. After all, those are the only electrons in this model being available for these roles.

(57.1) and (59.1) in (56.2):

$$\frac{m_{e2} \cdot \; 3 \cdot m_{\varepsilon 2}}{m_{e2} - 3 \cdot m_{\varepsilon 2}} = \frac{6 \cdot m_{\varepsilon 2} \cdot m_{e2}(H;n=2)}{6 \cdot m_{\varepsilon 2} - m_{e2}(H;n=2)} \; ;$$

resultant:

$$m_{e2}(H;n=2) \cdot \Big[\, 3\, m_{e2} - 6\, m_{\varepsilon 2} \Big] = m_{e2} \cdot 6\, m_{\varepsilon 2} \; ;$$

$$m_{e2} \cdot \Big[\, 3\, m_{e2}(H;n=2) - 6\, m_{\varepsilon 2} \Big] = m_{e2}(H;n=2) \cdot 6\, m_{\varepsilon 2} \; ;$$

and now the statement follows that m_{e2} has to be equal to $4 \cdot m_{\varepsilon 2}$ [= m_{em2} , according to equation (61)];

=> $$4\, m_{\varepsilon 2} \cdot \Big[\, 3\, m_{e2}(H;n=2) - 6\, m_{\varepsilon 2} \Big] = m_{e2}(H;n=2) \cdot 6\, m_{\varepsilon 2} \; ;$$

$$12\, m_{e2}(H;n=2) - 24\, m_{\varepsilon 2} = 6\, m_{e2}(H;n=2) \; ;$$

$$6\, m_{e2}(H;n=2) = 24\, m_{\varepsilon 2} \; ;$$

$$m_{e2}(H;n=2) = 4\, m_{\varepsilon 2} \; ;$$

=> $$m_{e2} = m_{e2}(H;n=2) \; ; \qquad V \qquad \text{q.e.d.}$$

Hence:

$$m_{e2}(n=2) = m_{eu2} = 6\, m_{\varepsilon 2} \; ; \qquad (\,57\,),\ (\,57.1\,)$$

$$m_{e2} = m_{e2}(H;n=2) = m_{em2} = 4\, m_{\varepsilon 2} \; ; \qquad (\,56.3\,),\ (\,56.4\,),\ (\,56.5\,)$$

$$m_{e2}(H;n=1) = m_{eb2} = 3\, m_{\varepsilon 2} \; ; \qquad (\,59.1\,),\ (\,60\,)$$

(56.5) and (60) into (55.1):

$$m_{p2}(v_{p2}=0) = \frac{4\, m_{\varepsilon 2} \cdot 3\, m_{\varepsilon 2}}{4\, m_{\varepsilon 2} - 3\, m_{\varepsilon 2}} \; ;$$

$$m_{p2}(v_{p2}=0) = 12\, m_{\varepsilon 2} \; ; \qquad (\,55.2\,)$$

in order to check this, (57.1) and (56.5) in (56.1):

$$m_{p2}(v_{p2}=0) = \frac{6\ m_{\varepsilon 2} \cdot 4\ m_{\varepsilon 2}}{6\ m_{\varepsilon 2} - 4\ m_{\varepsilon 2}} ;$$

$$m_{p2}(v_{p2}=0) = \frac{24\ m_{\varepsilon 2}}{2} ;$$

$$m_{p2}(v_{p2}=0) = 12\ m_{\varepsilon 2} ; \qquad (56.6)$$

thus, (55.2) and (56.6) are identical. *V* q.e.d.

$$E_{p2}(v_{p2}=0) = m_{p2}(v_{p2}=0)\ c^2 ; \qquad (62)$$

this with (56.6) and (44):

$$E_{p2}(v_{p2}=0) = 12\ E_{\varepsilon 2} ; \qquad (62.1)$$

now, the case in which the electron orbiting around the test particle reaches the 2^{nd} radius shall be discussed. Because the electron orbiting around the test particle on the Bohr radius consists of one uni− and two varicolored T^- rishons and thus has the energy $4 \cdot E_{\varepsilon 2}$, and, furthermore, the electron orbiting around the test particle on the 2^{nd} radius consists of three unicolored T^- rishons and therefore has the energy $6 \cdot E_{\varepsilon 2}$, the energy difference between both must be $2 \cdot E_{\varepsilon 2}$. This energy is twice as big as in the case of the other electrons, if they change from the Bohr to the 2^{nd} radius of their orbit around the other two protons. So the difference between the energy of the proton at a main quantum number n = 2 and its energy on the orbit with the Bohr radius is

$$E_{p2}(n=2) - E_{p2} = E_{\varepsilon 2} ; \qquad (63)$$

and this proton at n = 2 has to have less energy than the resting proton. For example, the following combination seems to be likely:

$$E_{p2}(n=2) = (E_{Vb2} + E_{Tb2} + E_{Vu2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) ; \qquad (64)$$

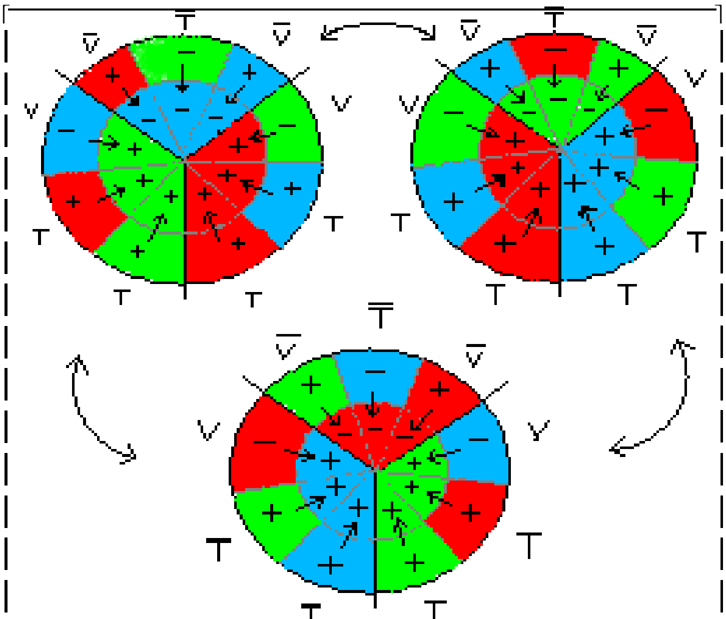

Fig. 4: Each „+“ stands for „+1/6“, each „−“ for „−1/6“ e*

E_{Vb2} is the mass energy of a varicolored and E_{Vu2} of a unicolored V oder V⁻ rishon. Until now it isn’t known how much energy the V and V⁻ rishons have at M = 2, but one can confidently assume that it’s smaller than the energy of the unicolored T or T⁻ rishons; after all, neutrinos nowadays have extremely small mass, and in accordance with the Harari model they are made up of three V⁻ rishons. It’s not beside the point to assume that this trend began to take its course at M = 2.

With (41) and (50.1):

$$E_{p2}(n=2) = (E_{Vb2} + E_{\varepsilon 2} + E_{Vu2}) + (E_{Vb2} + 2\,E_{\varepsilon 2} + E_{Tb2}) + (E_{Vb2} + 2\,E_{\varepsilon 2} + E_{Tb2})\ ;$$

that results in

$$E_{p2}(n=2) = 7\,E_{\varepsilon 2} + 3\,E_{Vb2} + E_{Vu2}\ ; \qquad (64.1)$$

something else is yet missing:

$$E_{p2} = (E_{Vb2} + E_{Tb2} + E_{Vu2}) + (E_{Vu2} + 2\,E_{Tb2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2})\ ; \qquad (65)$$

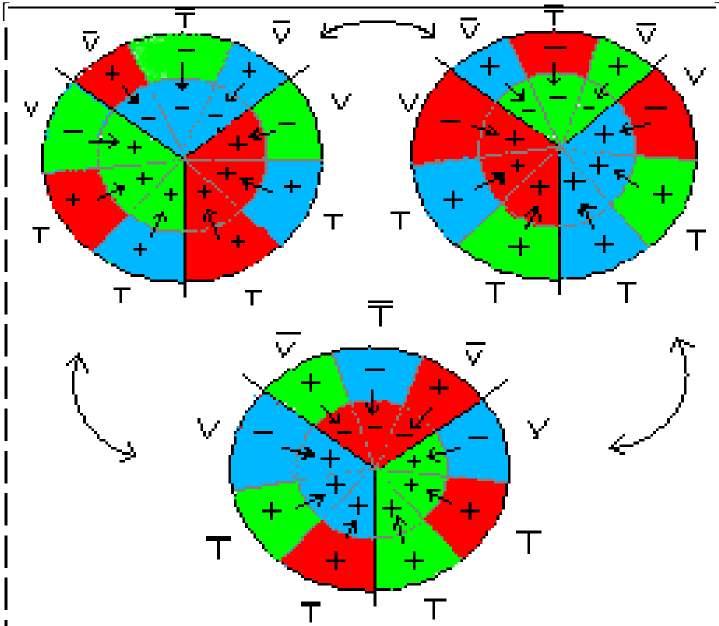

Fig. 5: Again, each „+“ stands for „+1/6“, every „−“ for „−1/6“ e*

with (41) and (50.1):

$$E_{p2} = (E_{Vb2} + E_{\varepsilon 2} + E_{Vu2}) + (E_{Vu2} + 2\,E_{\varepsilon 2}) + (E_{Vb2} + 3\,E_{\varepsilon 2})\;;$$

$$E_{p2} = 6\,E_{\varepsilon 2} + 2\,E_{Vb2} + 2\,E_{Vu2}\;; \qquad (65.1)$$

for the sake of completeness it has to be mentioned that at M = 2, the case of a proton with remarkable low energy exists which consists of one vari− and one unicolored V^- rishon, two unicolored V rishons, one varicolored T^- and four varicolored T rishons. Fig. 6 shows this case.

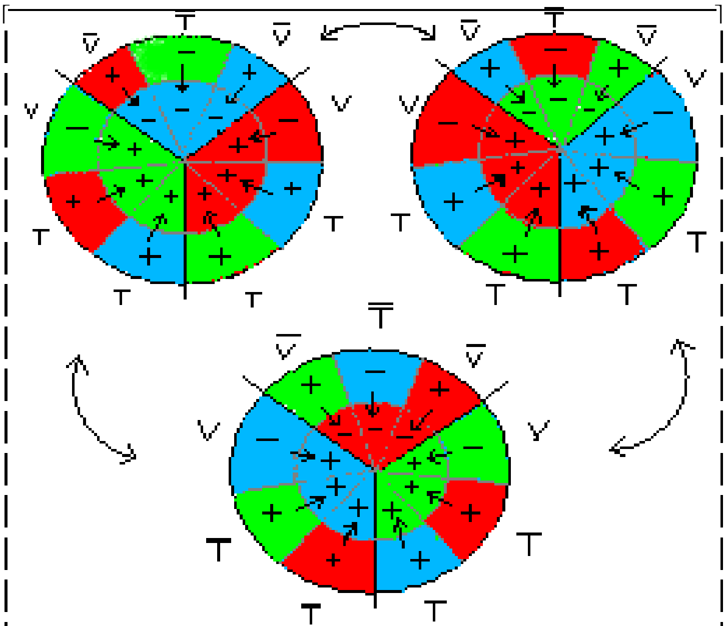

Fig. 6: Each „+“ stands also here for „+1/6“, „−“ for „−1/6“ e*

It may be noticed at once that quite in contrast to the other cases, there are no differences between the upper right and the lower left u quark; similarly, there is no difference between the u quark at the lower right side and the left u quark on the upper left side. So this case is kind of incomplete and will therefore be excluded here. All quark states have to be different, otherwise the states which are identical are simply the same sets.

Again a little bit more explicit: The case displayed in fig. 6 is excluded for the proton.

(64.1) and (65.1) into (63) :

$$7\,E_{\varepsilon 2} + 3\,E_{Vb2} + E_{Vu2} - (6\,E_{\varepsilon 2} + 2\,E_{Vb2} + 2\,E_{Vu2}) = E_{\varepsilon 2}\,;$$

$$E_{\varepsilon 2} + E_{Vb2} - E_{Vu2} = E_{\varepsilon 2}\,;$$

$$E_{Vb2} = E_{Vu2}\,; \qquad (63.1)$$

back to the resting proton; here the following equation applies:

$$E_{p2}(v_{p2}{=}0) = (2\,E_{Vb2} + E_{Tu2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) + (E_{Tb2} + E_{Tu2} + E_{Vb2})\,; \qquad (66)$$

with (41) and (50.1) :

$$E_{p2}(v_{p2}{=}0) = (2\,E_{Vb2} + 2\,E_{\varepsilon 2}) + (E_{Vb2} + 2\,E_{\varepsilon 2} + E_{\varepsilon 2}) + (E_{\varepsilon 2} + 2\,E_{\varepsilon 2} + E_{Vb2})\,;$$

with (62.1) :

$$12\,E_{\varepsilon 2} = E_{\varepsilon 2}\cdot(2+3+3) + E_{Vb2}\cdot(2+1+1)\,;$$

$$4\,E_{Vb2} = (12-8)\cdot E_{\varepsilon 2}\,;$$

$$4\,E_{Vb2} = 4\,E_{\varepsilon 2}\,;$$

$$E_{Vb2} = E_{\varepsilon 2}\,; \qquad (66.1)$$

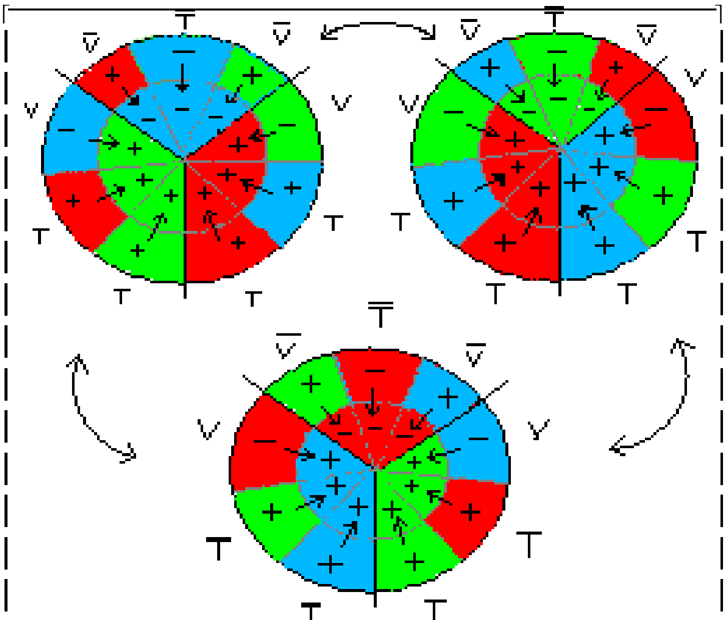

Fig. 7: Again, each „+“ stands for „+1/6“, each „−“ for „−1/6“ e*

this equation applies here:

$$E_{p2}(v_{p2}{=}0) = (2\ E_{Vb2} + E_{Tu2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) + (E_{Tb2} + E_{Tu2} + E_{Vb2})\ ; \qquad (66)$$

with (41) and (50.1) :

$$E_{p2}(v_{p2}{=}0) = (2\ E_{Vb2} + 2\ E_{\varepsilon 2}) + (E_{Vb2} + 2\ E_{\varepsilon 2} + E_{\varepsilon 2}) + (E_{\varepsilon 2} + 2\ E_{\varepsilon 2} + E_{Vb2})\ ;$$

with (62.1):

$$12\ E_{\varepsilon 2} = E_{\varepsilon 2} \cdot (2 + 3 + 3) + E_{Vb2} \cdot (2 + 1 + 1)\ ;$$

$$4\ E_{Vb2} = (12 - 8) \cdot E_{\varepsilon 2}\ ;$$

$$4\ E_{Vb2} = 4\ E_{\varepsilon 2}\ ;$$

$$E_{Vb2} = E_{\varepsilon 2}\ ; \qquad (66.1)$$

with (63.1):

$$E_{Vu2} = E_{\varepsilon 2}\ ; \qquad (63.2)$$

(65.1) with (63.2) and (66.1):

$$E_{p2} = 6\ E_{\varepsilon 2} + 2\ E_{\varepsilon 2} + 2\ E_{\varepsilon 2}\ ;$$

$$E_{p2} = 10\ E_{\varepsilon 2}\ ; \qquad (65.2)$$

(64.1) with (63.2) and (66.1):

$$E_{p2}(n{=}2) = 7\ E_{\varepsilon 2} + 3\ E_{\varepsilon 2} + E_{\varepsilon 2}\ ;$$

$$E_{p2}(n{=}2) = 11\ E_{\varepsilon 2}\ ; \qquad (64.2)$$

because of (66.1) and (63.2) all neutrinos consisting of 3 vari− or unicolored V rishons and their antiparticles consisting of the corresponding V^- rishons have the same mass energy

$$E_{\nu 2} = 3\ E_{\varepsilon 2}\ ; \qquad (67)$$

however, they might possibly have different kinetic energy. In plain language: Uni−, vari− and mixed−colored neutrinos (to depict it in a somewhat incorrect manner, because V and V^- rishons, the components of neutrinos, have colors, but neutrinos themselves are colorless) may perhaps have different velocities.

For the sake of completeness, the energies of the different electron states at M = 2 will be calculated now. First, starting from equations (51), (56.3), (56.4) and (56.5):

$$E_{e2} = 4\ E_{\varepsilon 2}\ ; \qquad (68)$$

that's the energy of the electron orbiting the test particle on the Bohr radius. Next:

$$E_{e2}(n{=}2) = 6\ E_{\varepsilon 2}\ ; \qquad (69)$$

resulting from equations (52) and (57.1), this is the energy of the electron with a main quantum number n = 2 orbiting the test particle. At M = 2, because of equations (53) and (60), the energy of an electron on its Bohr radius in one of both hydrogen atoms whose proton is not a test particle is

$$E_{e2}(H;n{=}1) = 3\ E_{\varepsilon 2}\ ; \qquad (70)$$

and, last not least, because of equations (54) and (56.4) the energy of an electron orbiting with a main quantum number n = 2 in those hydrogen atoms is

$$E_{e2}(H;n{=}2) = 4\ E_{\varepsilon 2}\ ; \qquad (71)$$

but now, back to the proton.

The following equation is valid:

$$E_{tot2}(p^+) = E_{kin2}(p^+) + E_{pot2}(p^+)\ ; \qquad (72)$$

where

$$E_{kin2}(p^+) = E_{p2}(v_{p2}{=}0) \cdot \left[\left(1 - (v_{p2} / c)^2\right)^{-½} - 1\right]\ ; \qquad (73)$$

$E_{tot2}(p^+)$ is the total energy of each of both protons at M = 2 not playing the role of a test particle, $E_{kin2}(p^+)$ is the kinetic and $E_{pot2}(p^+)$ the potential energy of each of them; v_{p2} is the velocity of these protons relative to the test particle (all this is valid if the main quantum number n equals 1).

From

$$E_{p2} = E_{p2}(v_{p2}{=}0) + E_{tot2}(p^+) \qquad (74)$$

one gets with (62.1) and (65.2):

$$10\ E_{\varepsilon 2} = 12\ E_{\varepsilon 2} + E_{tot2}(p^+)\ ;$$

$$E_{tot2}(p^+) = –2\ E_{\varepsilon 2}\ ; \qquad (74.1)$$

with the virial equation

$$E_{tot2}(p^+) = ½ \cdot E_{pot2}(p^+) \qquad (75)$$

(72) results in

$$½ \cdot E_{pot2}(p^+) = E_{kin2}(p^+) + E_{pot2}(p^+) \; ;$$

$$E_{kin2}(p^+) = –½ \cdot E_{pot2}(p^+) \; ; \qquad (72.1)$$

(75) with (74.1):

$$½ \cdot E_{pot2}(p^+) = –2\, E_{\varepsilon 2} \; ;$$

into (72.1):

$$E_{kin2}(p^+) = 2\, E_{\varepsilon 2} \; ; \qquad (72.2)$$

with (62.1) into (73):

$$\cancel{2}\, E_{\varepsilon 2} = 6\; \cancel{12}\, E_{\varepsilon 2} \cdot \left[\left(1 - (v_{p2} / c)^2\right)^{-½} - 1\right] \; ;$$

$$1/6 = \left(1 - (v_{p2} / c)^2\right)^{-½} - 1 \; ;$$

$$7/6 = \left(1 - (v_{p2} / c)^2\right)^{-½} \; ;$$

$$6/7 = \left(1 - (v_{p2} / c)^2\right)^{½} \; ; \qquad / \text{ squared}$$

$$36 = 49 \cdot \left(1 - (v_{p2} / c)^2\right) ;$$

$$(v_{p2} / c)^2 = (49 - 36) : 49 \; ; \qquad / \sqrt{\;}$$

$$v_{p2} = \sqrt{13} \;\; / \;\; 7 \;\cdot c \; ; \qquad (73.1)$$

$$v_{p2} \approx 0.51507875363771275615... \qquad (73.2)$$

Furthermore, the following equation applies:

$$E_{e2} = E_{e2}(v_{e2}{=}0) + E_{tot2}(e^-) \; ; \qquad (76)$$

$$E_{tot2}(e^-) = E_{kin2}(e^-) + E_{pot2}(e^-) \; ; \qquad (77)$$

$$E_{kin2}(e^-) = E_{e2}(v_{e2}{=}0) \cdot \left[\left(1 - (v_{e2} / c)^2\right)^{-½} - 1\right] ; \qquad (78)$$

(virial equation:)

$$E_{pot2}(e^-) = –2\, E_{kin2}(e^-) \; ; \qquad (79)$$

(79) into (77):

$$E_{tot2}(e^-) = E_{kin2}(e^-) – 2\, E_{kin2}(e^-) \; ;$$

$$E_{tot2}(e^-) = – E_{kin2}(e^-) \; ; \qquad (77.1)$$

into (76):

$$E_{e2} = E_{e2}(v_{e2}{=}0) – E_{kin2}(e^-) \; ; \qquad (76.1)$$

with (78):

$$E_{e2} = E_{e2}(v_{e2}=0)\cdot\left[2-\left(1-(v_{e2}/c)^2\right)^{-1/2}\right]; \quad (76.2)$$

with (68):

$$4\,E_{\varepsilon2} = E_{e2}(v_{e2}=0)\cdot\left[2-\left(1-(v_{e2}/c)^2\right)^{-1/2}\right];$$

$$E_{e2}(v_{e2}=0) = 4\cdot E_{\varepsilon2}\cdot\left[2-\left(1-(v_{e2}/c)^2\right)^{-1/2}\right]^{-1}; \quad (76.3)$$

now it's suitable to set the focus again on the proton. In the case of the hydrogen atoms not containing a test particle with a main quantum number n = 2, this equation applies:

$$E_{tot2}(p^+;n=2) = E_{kin2}(p^+;n=2) + E_{pot2}(p^+;n=2)\;; \quad (80)$$

where

$$E_{kin2}(p^+;n=2) = E_{p2}(v_{p2}=0)\cdot\left[\left(1-(v_{p2}(n=2)/c)^2\right)^{-1/2}-1\right]; \quad (81)$$

and from

$$E_{p2}(n=2) = E_{p2}(v_{p2}=0) + E_{tot2}(p^+;n=2) \qquad (82)$$

one gets with (62.1) and (64.2)

$$11\cdot E_{\varepsilon2} = 12\cdot E_{\varepsilon2} + E_{tot2}(p^+;n=2)\;;$$

$$E_{tot2}(p^+;n=2) = -\,E_{\varepsilon2}\;; \qquad (82.1)$$

with the virial equation

$$E_{tot2}(p^+;n=2) = ½\cdot E_{pot2}(p^+;n=2)\;; \qquad (83)$$

(80) results in

$$½\cdot E_{pot2}(p^+;n=2) = E_{kin2}(p^+;n=2) + E_{pot2}(p^+;n=2)\;;$$

$$E_{kin2}(p^+;n=2) = -½\cdot E_{pot2}(p^+;n=2)\;; \qquad (80.1)$$

into (83):

$$E_{tot2}(p^+;n=2) = -\,E_{kin2}(p^+;n=2)\;; \qquad (83.1)$$

with (82.1) and (83):

$$E_{kin2}(p^+;n=2) = E_{\varepsilon2}\;; \qquad (80.2)$$

into (81):

$$E_{\varepsilon2} = E_{p2}(v_{p2}=0)\cdot\left[\left(1-(v_{p2}(n=2)/c)^2\right)^{-1/2}-1\right];$$

with (62.1):

$$E_{\varepsilon2} = 12\,E_{\varepsilon2}\cdot\left[\left(1-(v_{p2}(n=2)/c)^2\right)^{-1/2}-1\right];$$

$$1/12 = \left(1-(v_{p2}(n=2)/c)^2\right)^{-1/2}-1\;;$$

$$13/12 = \left(1-(v_{p2}(n=2)/c)^2\right)^{-1/2}\;;$$

$$12/13 = \left(1 - \left(v_{p2}(n{=}2)/c\right)^2\right)^{½} \;;$$

$$144/169 = 1 - \left(v_{p2}(n{=}2)/c\right)^2 \;;$$

$$\left(v_{p2}(n{=}2)/c\right)^2 = (169 - 144) : 169 \;;$$

$$\left(v_{p2}(n{=}2)/c\right)^2 = 25/169 \;; \qquad / \sqrt{\;}$$

$$v_{p2}(n{=}2) = 5/13\ c \;; \qquad (81.1)$$

$$v_{p2}(n{=}2) = 0.\overline{384615} \cdot c \;; \qquad (81.2)$$

furthermore, the energy of an electron with a main quantum number n = 2 orbiting in one of the hydrogen atoms without a test particle is

$$E_{e2}(H;n{=}2) = E_{e2}(v_{e2}{=}0) + E_{tot2}(H;e^-;n{=}2) \;; \quad (84)$$

$$E_{tot2}(H;e^-;n{=}2) = E_{kin2}(H;e^-;n{=}2) + E_{pot2}(H;e^-;n{=}2) \;; \qquad (85)$$

$$E_{kin2}(H;e^-;n{=}2) = E_{e2}(v_{e2}{=}0) \cdot \left[\left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½} - 1\right] \;; \quad (86)$$

(virial equation:) $$E_{pot2}(H;e^-;n{=}2) = -2\ E_{kin2}(H;e^-;n{=}2) \;; \qquad (87)$$

(87) into (85):

$$E_{tot2}(H;e^-;n{=}2) = E_{kin2}(H;e^-;n{=}2) - 2\ E_{kin2}(H;e^-;n{=}2) \;;$$

$$E_{tot2}(H;e^-;n{=}2) = -E_{kin2}(H;e^-;n{=}2) \;; \qquad (85.1)$$

into (84):

$$E_{e2}(H;n{=}2) = E_{e2}(v_{e2}{=}0) - E_{kin2}(H;e^-;n{=}2) \;; \qquad (84.1)$$

with (86):

$$E_{e2}(H;n{=}2) = E_{e2}(v_{e2}{=}0) - E_{e2}(v_{e2}{=}0) \cdot \left[\left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½} - 1\right] \;;$$

$$E_{e2}(H;n{=}2) = E_{e2}(v_{e2}{=}0) \cdot \left[2 - \left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½}\right] \;; \quad (84.2)$$

with (71):

$$4\ E_{\varepsilon 2} = E_{e2}(v_{e2}{=}0) \cdot \left[2 - \left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½}\right] \;;$$

$$E_{e2}(v_{e2}{=}0) = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½}\right]^{-1} \;; \qquad (84.3)$$

$(76.3) \overset{!}{=} (84.3)$:

$$4\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - \left(v_{e2}/c\right)^2\right)^{-½}\right]^{-1} = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - \left(v_{e2}(H;n{=}2)/c\right)^2\right)^{-½}\right]^{-1} \;;$$

$$2-\left(1-\left(v_{e2}(H;n=2)/c\right)^2\right)^{-1/2} = 2-\left(1-\left(v_{e2}/c\right)^2\right)^{-1/2} ;$$

$$\left(1-\left(v_{e2}/c\right)^2\right)^{-1/2} = \left(1-\left(v_{e2}(H;n=2)/c\right)^2\right)^{-1/2} ;$$

$$\left(1-\left(v_{e2}(H;n=2)/c\right)^2\right)^{1/2} = \left(1-\left(v_{e2}/c\right)^2\right)^{1/2} ; \qquad \text{/squared}$$

$$1-\left(v_{e2}(H;n=2)/c\right)^2 = 1-\left(v_{e2}/c\right)^2 ;$$

$$\left(v_{e2}/c\right)^2 = \left(v_{e2}(H;n=2)/c\right)^2 ;$$

given that velocities are supplied with a positive algebraic sign:

$$v_{e2} = v_{e2}(H;n=2) ; \qquad (84.4)$$

now, equation (53) applies to the electron orbiting on the Bohr radius of those hydrogen atoms whose proton is not the test particle:

$$E_{e2}(H;n=1) = m_{e2}(H;n=1)\,c^2 ;$$

and

$$E_{e2}(H;n=1) = E_{e2}(v_{e2}=0) + E_{tot2}(H;e^-;n=1) ; \qquad (88)$$

$$E_{tot2}(H;e^-;n=1) = E_{kin2}(H;e^-;n=1) + E_{pot2}(H;e^-;n=1) ; \qquad (89)$$

$$E_{kin2}(H;e^-;n=1) = E_{e2}(v_{e2}=0)\cdot\left[\left(1-\left(v_{e2}(H;n=1)/c\right)^2\right)^{-1/2} - 1\right] ; \qquad (90)$$

(virial equation:) $$E_{pot2}(H;e^-;n=1) = -2\,E_{kin2}(H;e^-;n=1) ; \qquad (91)$$

(91) into (89):

$$E_{tot2}(H;e^-;n=1) = E_{kin2}(H;e^-;n=1) - 2\,E_{kin2}(H;e^-;n=1) ;$$

$$E_{tot2}(H;e^-;n=1) = -E_{kin2}(H;e^-;n=1) ; \qquad (89.1)$$

into (88):

$$E_{e2}(H;n=1) = E_{e2}(v_{e2}=0) - E_{kin2}(H;e^-;n=1) ; \qquad (88.1)$$

with (90):

$$E_{e2}(H;n=1) = E_{e2}(v_{e2}=0) - E_{e2}(v_{e2}=0)\cdot\left[\left(1-\left(v_{e2}(H;n=1)/c\right)^2\right)^{-1/2} - 1\right] ;$$

$$E_{e2}(H;n=1) = E_{e2}(v_{e2}=0)\cdot\left[2-\left(1-\left(v_{e2}(H;n=1)/c\right)^2\right)^{-1/2}\right] ; \qquad (88.2)$$

with (70):

$$3\,E_{\varepsilon2} = E_{e2}(v_{e2}=0)\cdot\left[2-\left(1-\left(v_{e2}(H;n=1)/c\right)^2\right)^{-1/2}\right] ;$$

$$E_{e2}(v_{e2}=0) = 3\,E_{\varepsilon2}\cdot\left[2-\left(1-\left(v_{e2}(H;n=1)/c\right)^2\right)^{-1/2}\right]^{-1} ; \qquad (88.3)$$

In the case of an electron with a main quantum number n = 2 orbiting around the test particle, the following equations apply:

$$E_{e2}(n{=}2) = E_{e2}(v_{e2}{=}0) + E_{tot2}(e^{-};n{=}2)\ ; \qquad (92)$$

$$E_{tot2}(e^{-};n{=}2) = E_{kin2}(e^{-};n{=}2) + E_{pot2}(e^{-};n{=}2)\ ; \qquad (93)$$

$$E_{kin2}(e^{-};n{=}2) = E_{e2}(v_{e2}{=}0) \cdot \left[\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2} - 1\right]\ ; \qquad (94)$$

(virial equation:) $$E_{pot2}(e^{-};n{=}2) = -\,2 \cdot E_{kin2}(e^{-};n{=}2)\ ; \qquad (95)$$

(95) into (93):

$$E_{tot2}(e^{-};n{=}2) = E_{kin2}(e^{-};n{=}2) - 2 \cdot E_{kin2}(e^{-};n{=}2)\ ;$$

$$E_{tot2}(e^{-};n{=}2) = -E_{kin2}(e^{-};n{=}2)\ ; \qquad (93.1)$$

this into (92):

$$E_{e2}(n{=}2) = E_{e2}(v_{e2}{=}0) - E_{kin2}(e^{-};n{=}2)\ ; \qquad (92.1)$$

with (94):

$$E_{e2}(n{=}2) = E_{e2}(v_{e2}{=}0) - E_{e2}(v_{e2}{=}0) \cdot \left[\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2} - 1\right]\ ;$$

$$E_{e2}(n{=}2) = E_{e2}(v_{e2}{=}0) \cdot \left[2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]\ ; \qquad (94.1)$$

with (69):

$$6 \cdot E_{\varepsilon 2} = E_{e2}(v_{e2}{=}0) \cdot \left[2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]\ ; \qquad (94.2)$$

with (76.3):

$$6 \cdot E_{\varepsilon 2} = 4 \cdot E_{\varepsilon 2} \cdot \left[2 - \left(1 - \left(v_{e2}/c\right)^2\right)^{-1/2}\right]^{-1} \cdot \left[2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]\ ;$$

$$3/2 \cdot \left[2 - \left(1 - \left(v_{e2}/c\right)^2\right)^{-1/2}\right] = 2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\ ;$$

$$6 - 3 \cdot \left(1 - \left(v_{e2}/c\right)^2\right)^{-1/2} = 4 - 2 \cdot \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\ ;$$

$$3 \cdot \left(1 - \left(v_{e2}/c\right)^2\right)^{-1/2} = 2 \cdot \left[1 + \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]\ ; \qquad \text{/squared}$$

$$9 \cdot \left(1 - \left(v_{e2}/c\right)^2\right)^{-1} = 4 \cdot \left[1 + \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]^2\ ;$$

$$\left(v_{e2}/c\right)^2 = 1 - 9/4 \cdot \left[1 + \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right]^{-2}\ ;$$

extracting the root, provided that the velocity of the electron orbiting around the test particle on the Bohr radius has a positive arithmetic sign:

$$v_{e2}/c = \left\{ 1 - 9/4 \cdot \left[1 + \left(1 - \left(v_{e2}(n{=}2)/c \right)^2 \right)^{-\frac{1}{2}} \right]^{-2} \right\}^{\frac{1}{2}} ; \qquad (94.3)$$

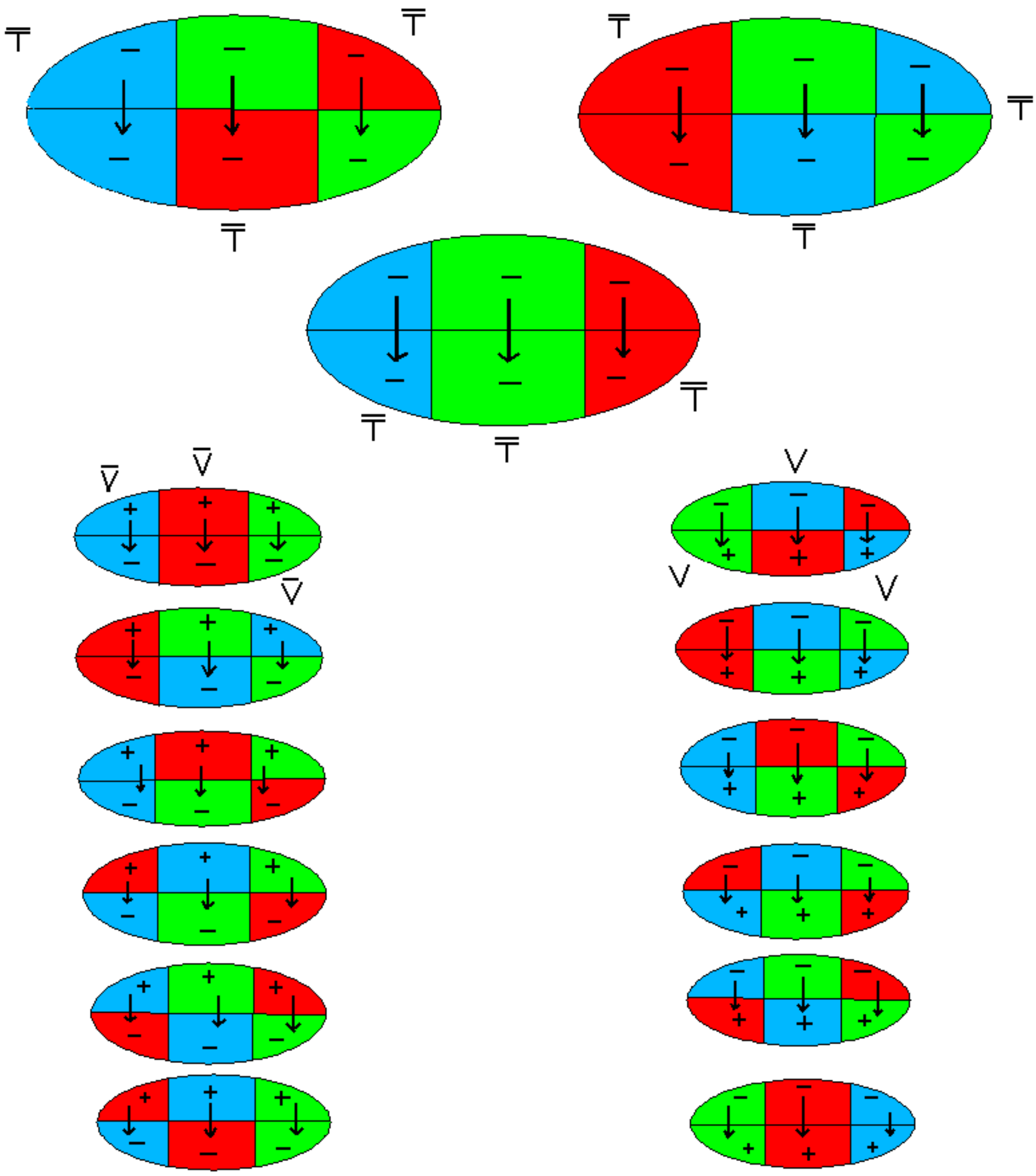

Fig. 8: At the top, 3 electrons are depicted; beneath, on the left side, 6 antineutrinos, and on the right side, 6 neutrinos are shown. „+“ stands for +1/6th, „–“ for –1/6th of the elementary electric charge. In this illustration, neutrinos as well as their antiparticles are arranged in a more or less arbitrary fashion

Next, the author wants to take a closer look at the particle/antiparticle ratio at M = 2, if the protons and electrons in all hydrogen atoms have a main quantum number n = 2; in other words, if all electrons orbit on their highest possible radii at M = 2. For this purpose, one needs a proton like the one represented in fig. 7 and two of the three represented in fig. 4; the last have to differ concerning the color combinations of their rishons, otherwise they would be identical. But what about the associated electrons and neutrinos? This is exemplified above by the illustration in fig. 8.

Aside from three protons the electrons and neutrinos / antineutrinos shown in fig. 8 are the entirety of quanta being able to exist under the conditions already postulated above. All mass energy existing at M = 2 manifests itself in the tree protons, one of them being the test particle and therefore at rest, and in the particles depicted in fig. 8, i.e. the electron of the test particle orbiting around it with a main quantum number n = 2 and consisting of three unicolored rishons, then two more electrons forming two hydrogen atoms with the other two protons, also in a state characterised by n = 2, and, last not least, the six neutrinos and their antiparticles, six anti−neutrinos. In this situation, photons are not possible, because all particles already reside in their highest possible energy states, so photons cannot act on any other quanta; hence, according to the fundamental assumptions in this paper, they simply don’t exist. But because electrons rapidly fall back on an orbit with the Bohr radius (what they do in translative as well as cyclic time), three photons are thus created which are able to move around freely; they may subsequently interact with any appropriate quanta. But it would go beyond the scope of this paper if the author would discuss all possible situations at M = 2. So he limits himself to the scenario outlined above which is mathematically very simple.

May the willing reader now redirect his attention to fig. 8. Therein he can easily identify two electrons with four (those with one unicolored and two varicolored rishons) and one with six epsilon mass energies (only unicolored rishons) as well as 12 neutrinos / anti−neutrinos with three epsilon mass energies each. In addition, there is the test particle with 12 and two more protons with 11 epsilon mass energies each; that’s the entirety of mass energy existing at M = 2:

$$E_{Un2} = E_{p2}(v_{p2}=0) + 2\ E_{p2}(n=2) + 2\ E_{e2}(H;n=2) + E_{e2}(n=2) + 12\ E_{\nu 2}\ ; \qquad (96)$$

with (62.1), (64.2), (67), (69) and (71):

$$E_{Un2} = 12\ E_{\varepsilon 2} + 2 \cdot 11\ E_{\varepsilon 2} + 2 \cdot 4\ E_{\varepsilon 2} + 6\ E_{\varepsilon 2} + 12 \cdot 3\ E_{\varepsilon 2}\ ;$$

$$E_{Un2} = 12\ E_{\varepsilon 2} + 22\ E_{\varepsilon 2} + 8\ E_{\varepsilon 2} + 6\ E_{\varepsilon 2} + 36\ E_{\varepsilon 2}\ ;$$

$$E_{Un2} = 84\ E_{\varepsilon 2}\ ; \qquad (96.1)$$

as at M =1 it’s also correct here that the negative potential energy of all particles in the universe equals their total mass energy; see equation (17) :

$$E_{pot2}(Un) = -84\ E_{\varepsilon 2}\ ; \qquad (97)$$

virial equation:

$$E_{kin2}(Un) = -E_{tot2}(Un)\ ; \qquad (98)$$

because of

$$E_{tot2}(Un) = E_{kin2}(Un) + E_{pot2}(Un) \qquad (99)$$

the result with (98) is

$$E_{pot2}(Un) = 2\,E_{tot2}(Un)\;; \qquad (99.1)$$

and that gives with (97)

$$E_{tot2}(Un) = -42\,E_{\varepsilon 2} \qquad (97.1)$$

with (98) one gets

$$E_{kin2}(Un) = 42\,E_{\varepsilon 2}\;. \qquad \text{(Douglas−Adams[11]−equation, 97.2)}$$

Let be

$$E_{e2} = h \cdot \nu_{e2}\;; \qquad (100)$$

h is the Planck constant and ν_{e2} the frequency of the electron orbiting the test particle on its Bohr radius:

$$\nu_{e2} = \frac{c}{\lambda_{e2}}\;; \qquad (101)$$

λ_{e2} is the wavelength of the electron.

$$\lambda_{e2} = 2\,\pi\,r_2\;; \qquad (102)$$

with (44), (56.5) and (51) into (100):

$$4\,E_{\varepsilon 2} = h \cdot \nu_{e2}\;; \qquad (100.1)$$

with (101):

$$4\,E_{\varepsilon 2} = h \cdot \frac{c}{\lambda_{e2}}\;;$$

with (102):

$$4\,E_{\varepsilon 2} = \frac{c\,h}{2\,\pi\,r_2}\;;$$

with h := $2\,\pi \cdot \mathit{h}$: $\qquad (103)$

$$4\,E_{\varepsilon 2} = \frac{c\mathit{h}}{r_2}\;;$$

$$E_{\varepsilon 2} = \frac{c\,h}{4 \cdot r_2} \; ; \qquad (100.2)$$

and now all steps starting with equation (100) will be repeated, but this time for the orbit with n = 2.

$$E_{e2}(n{=}2) = h \cdot \nu_{e2}(n{=}2) \; ; \qquad (104)$$

$$\nu_{e2}(n{=}2) = \frac{c}{\lambda_{e2}(n{=}2)} \; ; \qquad (105)$$

$$n \cdot \lambda_{e2}(n{=}2) = 2\,\pi\, r_2(n{=}2) \; ;$$

well, it’s clear as daylight that n = 2 :

$$2 \cdot \lambda_{e2}(n{=}2) = 2\,\pi\, r_2(n{=}2) \; ; \qquad (106)$$

with (69) into (104):

$$6\, E_{\varepsilon 2} = h \cdot \nu_{e2}(n{=}2) \; ;$$

with (105):

$$6\, E_{\varepsilon 2} = h \cdot \frac{c}{\lambda_{e2}(n{=}2)} \; ;$$

with (106) and n = 2 :

$$6\, E_{\varepsilon 2} = h \cdot \frac{2 \cdot c}{2\,\pi\, r_2(n{=}2)} \; ;$$

with (103):

$$3\, E_{\varepsilon 2} = \frac{c\,h}{r_2(n{=}2)} \; ;$$

$$E_{\varepsilon 2} = \frac{c\,h}{3 \cdot r_2(n{=}2)} \; ; \qquad (104.1)$$

now, in analogy to the calculations related to the electron of the test particle, the properties of the electrons being constituents of the hydrogen atoms not containing protons playing the role of a test particle shall be discussed.

If n = 2, the energy of one of these latter electrons may be written as follows:

$$E_{e2}(H;n=2) = h \cdot \nu_{e2}(H;n=2) \; ; \qquad (107)$$

in analogy to the correspondent equations for E_{e2} and $E_{e2}(n=2)$, the frequency is

$$\nu_{e2}(H;n=2) = \frac{c}{\lambda_{e2}(H;n=2)} \; ; \qquad (108)$$

$$n \cdot \lambda_{e2}(H;n=2) = 2\,\pi\, r_2(H;e^-;n=2) \; ; \qquad (109)$$

this yields with n = 2 :

$$2 \cdot \lambda_{e2}(H;n=2) = 2\,\pi\, r_2(H;e^-;n=2) \; ; \qquad (109.1)$$

(107) with (71):

$$4\, E_{\varepsilon 2} = h \cdot \nu_{e2}(H;n=2) \; ; \qquad (107.1)$$

with (108):

$$4\, E_{\varepsilon 2} = h \cdot \frac{c}{\lambda_{e2}(H;n=2)} \; ;$$

with (109.1):

$$4\, E_{\varepsilon 2} = \frac{2\, c\, h}{2\,\pi\, r_2(H;e^-;n=2)} \; ;$$

$$2\, E_{\varepsilon 2} = \frac{c\, h}{2\,\pi\, r_2(H;e^-;n=2)} \; ;$$

with (103):

$$2\, E_{\varepsilon 2} = \frac{c\, \hbar}{r_2(H;e^-;n=2)} \; ;$$

$$E_{\varepsilon 2} = \frac{c\, \hbar}{2\, r_2(H;e^-;n=2)} \; ; \qquad (107.2)$$

$$r_{e2}(H;n=2) = \frac{c\, \hbar}{2\, E_{\varepsilon 2}} \; ; \qquad (107.3)$$

and furthermore,

$$E_{e2}(H;n=1) = h \cdot \nu_{e2}(H;n=1) \; ; \qquad (110)$$

again, in analogy to the case discussed before, the following equation applies:

$$\nu_{e2}(H;n=1) = \frac{c}{\lambda_{e2}(H;n=1)} \; ; \qquad (111)$$

$$n \cdot \lambda_{e2}(H;n=1) = 2\,\pi\, r_2(H;e^-;n=1) \; ;$$

this yields with n = 1 :

$$\lambda_{e2}(H;n=1) = 2\,\pi\, r_2(H;e^-;n=1) \; ; \qquad (112)$$

(110) with (70) :

$$3\,E_{\varepsilon 2} = h \cdot \nu_{e2}(H;n=1) \; ; \qquad (110.1)$$

with (111) :

$$3\,E_{\varepsilon 2} = h \cdot \frac{c}{\lambda_{e2}(H;n=1)} \; ;$$

with (103) :

$$3\,E_{\varepsilon 2} = \frac{c \cdot 2\pi\, \hbar}{\lambda_{e2}(H;n=1)} \; ;$$

with (112) :

$$3\,E_{\varepsilon 2} = \frac{c\, \hbar}{r_2(H;e^-;n=1)} \; ; \qquad (110.2)$$

$$r_2(H;e^-;n=1) = \frac{c\, \hbar}{3\,E_{\varepsilon 2}} \; ; \qquad (110.3)$$

but now, back to (104.1); this equation is solved as follows:

$$r_2(n=2) = \frac{c\, \hbar}{3\,E_{\varepsilon 2}} \; ; \qquad (104.2)$$

this and (110.3) :

$$r_2(H;e^-;n=1) = r_2(n=2) \; ; \qquad (110.4)$$

(107.3) / (110.3) :

$$\frac{r_2(H;e^-;n=2)}{r_2(H;e^-;n=1)} = 3 : 2 \; ; \qquad (110.5)$$

so, with (110.4) one gets:

$$\frac{r_2(H;e^-;n=2)}{r_2(n=2)} = 3 : 2 \; ; \qquad (110.6)$$

(100.2) yields:

$$r_2 = \frac{c\,h}{4\,E_{\varepsilon 2}} \; ; \qquad (100.3)$$

(104.2) / (100.3) :

$$\frac{r_2(n=2)}{r_2} = 4 : 3 \; ; \qquad (104.3)$$

=>

$$\frac{r_2(H;e^-;n=2)}{r_2} = 2 : 1 \; ; \qquad (110.7)$$

let it now be that

$$\frac{\Delta r_2(H)}{\Delta r_2} = \frac{r_2(H;e^-;n=2) - r_2(H;e^-;n=1)}{r_2(n=2) - r_2} \; ; \qquad (113)$$

with (100.3), (104.2), (107.3) and (110.3), this yields

$$\frac{\Delta r_2(H)}{\Delta r_2} = \frac{c\mathit{h} / 2E_{\varepsilon 2} - c\mathit{h} / 3E_{\varepsilon 2}}{c\mathit{h} / 3E_{\varepsilon 2} - c\mathit{h} / 4E_{\varepsilon 2}} \; ;$$

$$\frac{\Delta r_2(H)}{\Delta r_2} = \frac{1/2 - 1/3}{1/3 - 1/4} \; ;$$

$$\frac{\Delta r_2(H)}{\Delta r_2} = \frac{(3-2) : 6}{(4-3) : 12} \; ;$$

$$\frac{\Delta r_2(H)}{\Delta r_2} = 2 : 1 \; ; \qquad (113.1)$$

hence, the distance between the radii of electron orbits with n = 1 and n= 2 in those hydrogen atoms whose proton is not a test particle is twice as big as the corresponding distance in the hydrogen atom containing the test particle. In consequence, there is no smaller range in the universe at M = 2, and that makes Δr_2 a good candidate for σ_2 ;

$$\Delta r_2 = \frac{c\,h}{E_{\varepsilon 2}} \cdot (1/3 - 1/4) \; ; \qquad (114)$$

$$\Delta r_2 = \frac{c\,h}{12\, E_{\varepsilon 2}} \; ; \qquad (114.1)$$

that's the Compton wavelength of the resting proton, divided by 2π; there's no particle with a bigger mass at M = 2. So it's allowed to state

$$\Delta r_2 = \sigma_2 \; ; \qquad (114.2)$$

at M = 2, this is the smallest possible distance measurement error.

Now the question arises what might be the biggest possible distance measurement error. This has to be the distance between the test particle and the equator of the universe, and of that, an easily interpreted description can be generated: It shall be assumed that the universe is finite and the (average) distance of the universal horizon is R_{Un}. If one is asked how far away an arbitrary object might be, whose effective distance was not yet measured, the statement is obviously correct that the distance to this object is

$$½\, R_{Un} \pm ½\, R_{Un}$$

what means half the universal radius plus or minus the biggest possible distance measurement error. But the latter has itself at least a smallest possible error, because, as Eddington already had pointed out, an absolutely exact distance measurement cannot be performed; the Heisenberg uncertainty principle forbids it. Therefore the above statement that the distance to the arbitrary object equals $½R_{Un} \pm ½R_{Un}$ is not quite correct. Consequently, in a manner of speaking, there is a „major biggest possible" and a „minor biggest possible" error. There is nothing comparable concerning the smallest possible error, because otherwise, a smaller than the smallest possible error would exist, thus underrunning the limit of the smallest possible error, causing an obvious contradiction, because the smallest possible error wouldn't be smallest possible any more.

Well, and what kind of relationship do minor and major biggest possible errors have? The Gaussian formula for the error propagation is helping here:

$$\Delta X = \left[\left[\frac{\partial X}{\partial x} \cdot \Delta x \right]^2 + \left[\frac{\partial X}{\partial z} \cdot \Delta z \right]^2 \right]^{½} \; ; \qquad (115)$$

$\frac{\partial X}{\partial x}$ and $\frac{\partial X}{\partial z}$ are partial derivatives of the function $X = f(x,z)$ with respect to the variables x and z. But because Δx, Δz and ΔX are all referring to the same quantity y yet to be calculated, which symbolises the distance between the test particle and an arbitrary object A in the universe, equation (115) can be simplified by omitting the partial derivatives; they have to be equal to 1. The only fact known for sure about y is that A has to lie in the distance $x \pm \Delta x$ where $x = \Delta x$, while the extension of the universe is $R_{Un2} = 2 \cdot x$:

$$0 \leq y \leq 2 \cdot x \ .$$

Hence, (115) yields

$$\Delta X = [(\Delta x)^2 + (\Delta z)^2]^{½} \ ; \qquad (115.1)$$

Δx is the minor biggest possible error, Δz the smallest possible error and ΔX the major biggest possible error.

Here, one is concerned with a biggest possible error which cannot be pinned down to something more exact than the smallest possible error allows. So the biggest possible error lies exactly in the middle between the minor and major biggest possible error; this average biggest possible error is identical to the static boundary of an electrically charged Black Hole:

$$\Delta x \leq R_{Stat} \leq \Delta X \ .$$

But why is it so that the static boundary is of the same order of magnitude as $½R_{Un}$ and not, for instance, twice as big? The attentive reader surely didn’t miss that...

The author will try to depict it.

Let a Black Hole lie with its centre of mass on the universal equator. As time goes by, more and more mass is drawn into it by gravitational pull, and thus its Schwarzschild radius is getting bigger and bigger. But let its centre of mass stay in this example (as) exactly (as possible) on the universal equator.

Somewhere along the way, the Black Hole will have engulfed nearly all matter in the universe. Now it’s nearly as big as the whole universe, but its centre of mass hasn’t changed its position away from the universal equator. So, as soon as it has swallowed everything but the test set, the radius of this Black Hole is equal to the distance between the latter and the universal equator, i.e. $½R_{un}$. And that’s approximately equal to R_{Stat} .

Hopefully it becomes clear now why the static boundary has to be only half as big as the distance between the universal horizon and the test particle.

Back to the error topic. The author adds the values of the major and minor biggest possible error which were calculated with the simplified Gaussian error propagation formula already deduced above and divides the result by two in order to calculate R_{Stat} as their arithmetic average:

$$R_{Stat} = ½ \cdot \left\{ \Delta X + \Delta x \right\} ;$$

with (115.1): $R_{Stat} = ½ \cdot \{ [(\Delta x)^2 + (\Delta z)^2]^{½} + [(\Delta X)^2 - (\Delta z)^2]^{½} \}$;

again with (115.1): $R_{Stat} = ½ \cdot \{ [(\Delta X)^2]^{½} + [(\Delta X)^2 - (\Delta z)^2]^{½} \}$;

$$R_{Stat} = ½ \cdot \Delta X + [¼ \cdot (\Delta X)^2 - ¼ \cdot (\Delta z)^2]^{½} \; ; \qquad (115.2)$$

that does also help in this context is the Kerr−Newman equation for the static boundary of electrically charged and rotating Black Holes; the author used this equation already for the case M =1 :

$$R_{Stat} = \mathrm{M} \cdot G/c^2 + [\, \mathrm{M}^2 \cdot G^2/c^4 - Q^2 \cdot G/c^4 - (S^2/\mathrm{M}^2 \cdot c^2) \cdot \cos^2\vartheta \,]^{½} \; ;$$

where M is the mass of the Black Hole, Q its electric charge and S its angular momentum. ϑ is the smallest angle enclosed between the axis of rotation and the orbital plane of the test particle, i.e. 90° minus the orbital inclination (defined as the angle between an orbital plane and a reference plane, the latter being perpendicular to the axis of rotation). So, if the particles orbit crosses the axis of rotation over the north and the south pole of the Black Hole, this angle is 0°, and if the particles orbit lies in the equatorial plane of the Black Hole, 90°. But because the test particle is orbiting directly on the static boundary of what's literally the rest of the universe (M stands in this case for M_{un}, Q is an electric charge corresponding quantitatively to the charge of the test particle, but with the opposite algebraic sign, and S is the angular momentum of the rest of the universe relative to the test particle), the frame dragging phenomenon comes here into play, according to which the rotating Black Hole sweeps everything in its vicinity along, including spacetime, and thus, the test particle is at rest relative to the Black Holes rotation. Therefore, S equals zero, and that results in the Reissner−Nordström equation:

$$R_{Stat} = \mathrm{M} \cdot G/c^2 + [\, \mathrm{M}^2 \cdot G^2/c^4 - Q^2 \cdot G/c^4 \,]^{½} \; ;$$

but here it's necessary to be a little bit more thorough; M is equal to the mass of the universe minus the mass of the test set. Aside from the case M =1, the latter undoubtedly consists of sundry protons; i.e., according to the explanations on pages 31f, a test set consisting of three protons is needed to realise electric charge equalisation at M = 2. But this test set can be „used" in different ways; for example sequentially, seen from the standpoint of a single proton, but as many times as there are protons in the test set, or synchronically from the perspective of the whole test set with all its protons; that would correspond to the situation at M =1: All elements of the test set are virtually isochronic and thus inexistant for each other, because merely the rest of the universe acts on the test set, not the elements of the test set themselves.

Not the sequential, but the synchronic case shall be examined here. At M = 2 the tree protons which were already thoroughly discussed above are quasi disassembled (without destroying the set−theoretical structure of those three protons defining the test set). In all elements of the test set as well in the elements of these elements etc., 3 times 18 elements, i.e. epsilons, can be found, what results in a totality of 54 epsilons. M is then equal to

$$[M_{Un2} - M_{Test2}(v_{Test2}=0)]$$

(i.e. universal mass minus mass of all epsilons in the test set), where

$$M_{Test2}(v_{Test2}=0) = 54\ m_{\varepsilon 2}\ . \qquad (116)$$

With

$$E_{Un2} = M_{Un2}\ c^2 \qquad (117)$$

(96.1) results in

$$M_{Un2} = 84\ m_{\varepsilon 2}\ ; \qquad (96.2)$$

and in the special case of the Reissner−Nordström metric, the Kerr−Newman equation for the static boundary at M = 2 has to be written as follows:

$$R_{Stat2} = [\ M_{Un2} - M_{Test2}(v_{Test2}=0)\ ] \cdot \frac{G}{c^2} + \left[\ [\ M_{Un2} - M_{Test2}(v_{Test2}=0)\ ]^2 \cdot \frac{G^2}{c^4} - [Q_2]^2 \cdot \frac{G}{c^4} \right]^{½} ; \qquad (118)$$

here, $Q_2 = 3\ e_2^*$, because the equivalent of three protons including their electric charge is contained in the test set – in order to accomplish charge equalisation, the rest of the world, i.e. the Black Hole has to bear three elementary electric charges with the opposite algebraic sign:

$$R_{Stat2} = [\ 84 - 54\ ] \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[[\ 84 - 54\ ]^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 3^2 \cdot e_2^{*2} \cdot \frac{G}{c^4} \right]^{½} ;$$

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[30^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 9 \cdot e_2^{*2} \cdot \frac{G}{c^4} \right]^{½} ;$$

with (42):

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[900 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 9 \cdot 36 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} \right]^{½} ;$$

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[900 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 324 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} \right]^{½} ; \qquad (118.1)$$

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[576 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} \right]^{½} ;$$

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + 24 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ;$$

$$R_{Stat2} = 54 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (118.2)$$

as already explained earlier, this is half the distance between the test set and the universal horizon. $2 \cdot R_{Stat2}$ is the mean universal radius, i.e. the arithmetic average of the doubled major and the doubled minor biggest possible error:

$$2 \cdot R_{Stat2} = 108 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (118.3)$$

(115.2) with (118.1) for M = 2 :

$$½ \cdot \Delta X_2 = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ;$$

$$\Delta X_2 = 60 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (118.4)$$

with (44):

$$\Delta X_2 = 60 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} ; \qquad (118.5)$$

and, deduced also from (115.2) and (118.1) for M = 2 :

$$\tfrac{1}{4}\cdot(\Delta z_2)^2 = 324 \cdot [E_{\varepsilon 2}]^2 \cdot \frac{G^2}{c^8} \;;$$

$$(\Delta z_2)^2 = 4 \cdot 324 \cdot [E_{\varepsilon 2}]^2 \cdot \frac{G^2}{c^8} \;;$$

$$(\Delta z_2)^2 = 1296 \cdot [E_{\varepsilon 2}]^2 \cdot \frac{G^2}{c^8} \;; \qquad / \sqrt{\;}$$

(only errors with a positive value:)

$$\Delta z_2 = 36 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (118.6)$$

because the smallest possible error does not refer to a particle with three elementary charges, but only to one with a single such charge, the above result must be divided by three:

$$1/3 \cdot \Delta z_2 = \Delta z'_2 = 1/3 \cdot 36 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;;$$

$$\Delta z'_2 = 12 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (119)$$

the test set has a certain physical extent. In the most unfavourable case, its centre of gravity is in the minor biggest distance to the universal equator, while in the most favourable case, it lies in the major biggest distance to it. In the least favourable case, the test set is short of being sucked into the Black Hole, and in the opposite case it barely touches the event horizon of the Hole. Both cases represent the biggest possible divergencies from the mean orbit of the test particle around the Black Hole, i.e. its static boundary, and these said divergencies are described by the second solution of the Reissner−Nordström equation, this special case of the Kerr−Newman equation discussed here, which admittedly had been withheld by the author up to now; this result is also called the „Cauchy horizon“ of the electrically charged Black Hole:

$$r_{-2} = [\, M_{Un2} - M_{Test2}(v_{Test2}=0) \,] \cdot \frac{G}{c^2} - \left[[\, M_{Un2} - M_{Test2}(v_{Test2}=0) \,]^2 \cdot \frac{G^2}{c^4} - 9\, e_2{}^{*2} \cdot \frac{G}{c^4} \right]^{1/2} \;;$$

with (42), (44), (96.2), (116) and (117)

$$r_{-2} = 30 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} - 24 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;;$$

$$r_{-2} = 6 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;;$$

and that's nothing else as half of the smallest possible error according to (119) :

$$\tfrac{1}{2} \cdot \Delta z'_2 = 6 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (119.1)$$

well, it's absolutely comprehensible that the reader asks himself now what half of something smallest possible might possibly be?!? A smallest possible error cannot be smallest possible any more if it can be cut in half. But there's a surprisingly simple answer to that: The static boundary corresponds to a mean statistical value, and r_{-2} is its deviation maximum; in fact, the test particle is always on an orbit around the Black Hole with a radius of either ΔX_2 or Δx_2, but the distance is never equal to R_{Stat2} – this variable has a purely statistical meaning.

(119) is now equated with (114.1), simply because the smallest possible error is nothing else than σ as defined by Eddington:

$$\frac{c h}{12 \cdot E_{\varepsilon 2}} = 12 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (119.2)$$

transformed, the root extracted and limiting oneself to the positive solution:

$$E_{\varepsilon 2} = 1/12 \cdot \left(c h / G\right)^{1/2} \cdot c^2 \;; \qquad (119.3)$$

with (62.1) :

$$E_{p2}(v_{p2}=0) = 12 \cdot 1/12 \cdot \left(c h / G\right)^{1/2} \cdot c^2 \;;$$

$$E_{p2}(v_{p2}=0) = \left(c h / G\right)^{1/2} \cdot c^2 \;; \qquad (119.4)$$

with (62) :

$$m_{p2}(v_{p2}=0) = \left(c h / G\right)^{1/2} \;; \qquad (119.5)$$

that's the Planck mass! This is noteworthy insofar that at M =1, the mass of the electron is also equal to the Planck mass. The difference consists in the fact that m_{e1} is moving and $m_{p2}(v_{p2}=0)$ is a mass at rest.

(119.3), (42) and (44) yields the Sommerfeld fine structure constant M = 2; the two last−mentioned equations give

$$\alpha_2 := \frac{e_2^{*2}}{c\,h} = 36\,(E_{\varepsilon 2})^2\, G\; c^{-5}\, h^{-1}\,; \qquad (120)$$

with (119.3):

$$\alpha_2 = 1/4\,; \qquad (42.1)$$

$$\alpha_2 = 0.25\,; \qquad (42.2)$$

$$1/\alpha_2 = 4\,; \qquad (42.3)$$

(96.2) yields with (44) and (119.2)

$$E_{Un2} = 84/12 \cdot \left(ch / G\right)^{1/2} \cdot c^2\,;$$

$$E_{Un2} = 7 \cdot \left(ch / G\right)^{1/2} \cdot c^2\,; \qquad (96.3)$$

this results with (117) in the total mass of the universe:

$$M_{Un2} = 7 \cdot \left(ch / G\right)^{1/2}\,; \qquad (96.4)$$

Because at M =1 (15), (16.1) and (26.2) yield the following mass of the universe

$$M_{Un1} = 4 \cdot \left(ch / G\right)^{1/2},$$

by raising M from 1 to 2, a relative mass accretion of

$$\frac{\Delta M_{Un2}}{M_{Un1}} = \frac{M_{Un2} - M_{Un1}}{M_{Un1}}$$

$$\frac{\Delta M_{Un2}}{M_{Un1}} = \frac{7-4}{4}\,;$$

$$\frac{\Delta M_{Un2}}{M_{Un1}} = 75\,\% \qquad (96.5)$$

is the result.

And now it can be stated with some eligibility that two times the major biggest error is identical to the extent of the universe, whose radius can simply be called R_{Un} ; for M = 2 :

$$R_{Un2} := 2 \cdot \Delta X_2 \; ; \qquad (121)$$

that yields with (118.4) :

$$R_{Un2} = 120 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \; ;$$

and with (119.3) :

$$R_{Un2} = 120/12 \cdot \left(ch / G\right)^{½} \cdot c^2 \cdot \frac{G}{c^4} \; ;$$

$$R_{Un2} = 10 \cdot \left(Gh / c^3\right)^{½} \; ; \qquad (121.1)$$

now the last important thing that's missing here is the smallest possible error; it is calculated by using the equations (114.1), (114.2) and (119.3) :

$$\sigma_2 = \frac{ch}{12 \cdot 1/12 \cdot \left(ch / G\right)^{½} \cdot c^2} \; ;$$

that yields

$$\sigma_2 = \left(Gh / c^3\right)^{½} \; ; \qquad (122)$$

hence, at M = 2, the amplitude of the proton's Compton wavelength is equal to the Planck length.

Now the velocities of the electrons shall be calculated for this model at M = 2. Some preceding considerations are necessary.

To begin with, the question how fast the hydrogen atoms move if their main quantum number n equals 2 has to be asked.

At this point, the reader is reminded that electrons composed of varicolored rishons have a mass energy of $3 \cdot E_{\varepsilon 2}$, and electron composed of mixed colored rishons have a mass energy of $4 \cdot E_{\varepsilon 2}$; the sole electron that is composed of unicolored rishons has a mass energy of $6 \cdot E_{\varepsilon 2}$. The electrons of the hydrogen atoms without a test particle are composed of mixed rishons at n = 2, and this is attended by the fact that they cannot possibly reach a state with more mass energy; $6 \cdot E_{\varepsilon 2}$ is barred for them, because the single possible such quantum state is already reserved for the electron of the test particle. A lower energy state, which theoretically could be reached by slowing down the hydrogen atoms, would though correspond to an electron mass energy of $3 \cdot E_{\varepsilon 2}$, like it could already be realised in the case concerning the electrons being components of the hydrogen atoms without test particle and with a main quantum number n =1. Would this state correspond to the hydrogen atoms without a test particle and a main quantum number n = 2 being at rest relative to the test proton, this should come along with two superimposing quantum states; on the one hand, the hydrogen atom would be at rest, its electron orbiting on a radius with n = 2, and on the other hand, its electron would orbit at n =1 on the Bohr radius, while the hydrogen atom would move around with a certain velocity bigger than zero. In the excited state, the total impetus of the hydrogen atom would be zero, while in its ground state, it

would move around with a certain velocity, slower than the velocity of light but unequal to zero. The total impetus though would have to be the same for both states, because no photon or other quantum is emitted in order to reach the other appropriate state; and because this is not the case, it’s a plain violation against the laws of conservation of momentum. Conclusion: At n = 2 both hydrogen atoms whose protons aren’t test particles have to be at rest relative to the test proton!

That gives the author the opportunity to present a very simple scenario: In both hydrogen atoms being at rest relative to the test particle, as "seen" from the latter, the proton as well as the electron rotate with the same angular speed ω_{H2} around a common centre of gravity. According to equation (81.1), the proton moves around with 5/13 of the velocity of light, what lies definitively already in the relativistic range.

Therefore the following equation applies:

$$v_{p2}(n=2) = \frac{r_2(p^+;n=2) \cdot \omega_{H2}}{\left[1 + \dfrac{(r_2(p^+;n=2) \cdot \omega_{H2})^2}{c^2} \right]^{½}}; \qquad (123)$$

and also this one:

$$v_{e2}(H;n=2) = \frac{r_2(H;e^-;n=2) \cdot \omega_{H2}}{\left[1 + \dfrac{(r_2(H;e^-;n=2) \cdot \omega_{H2})^2}{c^2} \right]^{½}}; \qquad (124)$$

the orbit radii $r_{p2}(n=2)$ and $r_{e2}(H;n=2)$ arise from the particles’ wavelength. The protons energy is, if it’s a component of a hydrogen atom and not a test particle,

$$E_{p2}(n=2) = h \cdot \nu_{p2}(n=2) \qquad (125)$$

if its main quantum number n = 2.

With

$$\nu_{p2}(n=2) = \frac{c}{\lambda_{p2}(n=2)}\,, \qquad (126)$$

where $\lambda_{p2}(n=2)$ is the Compton wavelength of the excited proton, (125) results in

$$E_{p2}(n=2) = h \cdot \frac{c}{\lambda_{p2}(n=2)}\,; \qquad (125.1)$$

with

$$2 \cdot \lambda_{p2}(n=2) = 2\pi \cdot r_2(p^+;n=2) \qquad (127)$$

(125.1) yields

$$E_{p2}(n=2) = \frac{2\,c\,h}{2\pi \cdot r_2(p^+;n=2)}\,; \qquad (125.2)$$

with (103):

$$E_{p2}(n=2) = \frac{2\,c\,\mathit{h}}{r_2(p^+;n=2)}\,; \qquad (125.3)$$

$r_{p2}(n=2)$ is the radius of the protons orbit around the common centre of gravity with the electron at n = 2.

Equation (64.2) with (125.3):

$$r_2(p^+;n=2) = \frac{2\,c\,\mathit{h}}{11 \cdot E_{\varepsilon 2}}\,; \qquad (125.4)$$

now, (123) and (124) have to be solved for $(\omega_{H2})^2$ and then equated with each other.

(123) yields

$$\frac{[r_2(p^+;n=2) \cdot \omega_{H2}]^2}{[v_{p2}(n=2)]^2} = 1 + \frac{[r_2(p^+;n=2) \cdot \omega_{H2}]^2}{c^2}\,;$$

$$(\omega_{H2})^2 = \frac{1}{[r_2(p^+;n=2)]^2 \cdot \left[\dfrac{1}{[v_{p2}(n=2)]^2} - \dfrac{1}{c^2}\right]}\,; \qquad (123.1)$$

and in the same way, (124) yields

$$(\omega_{H2})^2 = \frac{1}{[r_2(H;e^-;n=2)]^2 \cdot \left[\dfrac{1}{[v_{e2}(H;n=2)]^2} - \dfrac{1}{c^2}\right]}; \qquad (124.1)$$

$$(123.1) \overset{!}{=} (124.1):$$

$$[r_2(H;e^-;n=2)]^2 \cdot \left[\frac{1}{[v_{e2}(H;n=2)]^2} - \frac{1}{c^2}\right] = [r_2(p^+;n=2)]^2 \cdot \left[\frac{1}{[v_{p2}(n=2)]^2} - \frac{1}{c^2}\right];$$

solved for $[v_{e2}(H;n=2)]^2$:

$$[v_{e2}(H;n=2)]^2 = \frac{1}{\left[\left[\dfrac{r_2(p^+;n=2)}{r_2(H;e^-;n=2)}\right]^2 \cdot \left[\dfrac{1}{[v_{p2}(n=2)]^2} - \dfrac{1}{c^2}\right] + \dfrac{1}{c^2}\right]};$$

the root is extracted; the velocity of the electron bears a positive arithmetic sign:

$$v_{e2}(H;n=2) = \frac{1}{\left[\left[\dfrac{r_2(p^+;n=2)}{r_2(H;e^-;n=2)}\right]^2 \cdot \left[\dfrac{1}{[v_{p2}(n=2)]^2} - \dfrac{1}{c^2}\right] + \dfrac{1}{c^2}\right]^{½}};$$

this with (81.1), (107.3) and (125.4):

$$v_{e2}(H;n=2) = \frac{1}{\left[\left[\dfrac{2/11}{1/2}\right]^2 \cdot \left[\dfrac{1}{[5/13]^2\, c^2} - \dfrac{1}{c^2}\right] + \dfrac{1}{c^2}\right]^{½}};$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\left[\dfrac{4}{11}\right]^2 \cdot \left[\dfrac{13^2}{5^2\, c^2} - \dfrac{1}{c^2}\right] + \dfrac{1}{c^2}\right]^{½}};$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\frac{16}{121} \cdot \left[\frac{169}{25\,c^2} - \frac{1}{c^2}\right] + \frac{1}{c^2}\right]^{½}} ;$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\frac{16}{121} \cdot \left[\frac{169 - 25}{25\,c^2}\right] + \frac{1}{c^2}\right]^{½}} ;$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\frac{16}{121} \cdot \left[\frac{144}{25\,c^2}\right] + \frac{1}{c^2}\right]^{½}} ;$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\frac{2304}{3025\,c^2} + \frac{1}{c^2}\right]^{½}} ;$$

$$v_{e2}(H;n=2) = \frac{1}{\left[\frac{2304 + 3025}{3025\,c^2}\right]^{½}} ;$$

$$v_{e2}(H;n=2) = \frac{3025^{½}}{5329^{½}} \cdot c ;$$

$$v_{e2}(H;n=2) = \frac{55}{73} \cdot c ; \qquad (\ 123.2\ )$$

numerically:

$$v_{e2}(H;n=2) = 0.\overline{75342465}\ c . \qquad (\ 123.3\ )$$

So that’s the velocity of the electrons in those hydrogen atoms not containing a test particle at n = 2.

With (84.3) the rest energy of the electron may be calculated as follows:

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - (55/73)^2\right)^{-1/2}\right]^{-1};$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - 3025/5329\right)^{-1/2}\right]^{-1};$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(2304/5329\right)^{-1/2}\right]^{-1};$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[2 - \left(5329/2304\right)^{1/2}\right]^{-1};$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[2 - 73/48\right]^{-1};$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[48/(96-73)\right];$$

$$E_{e2}(v_{e2}=0) = 4\ E_{\varepsilon 2} \cdot \left[48/23\right];$$

$$E_{e2}(v_{e2}=0) = \frac{192}{23} \cdot E_{\varepsilon 2}; \qquad (84.5)$$

numerically:

$$E_{e2}(v_{e2}=0) \approx 8.347826086956521739 1\ E_{\varepsilon 2}; \qquad (84.6)$$

or

$$E_{e2}(v_{e2}=0) = 8\tfrac{8}{23}\ E_{\varepsilon 2}; \qquad (84.7)$$

that’s the mass of an electron at M = 2 if it’s located at the universal antipole of the test particle.

With (84.4), (123.2) yields:

$$v_{e2} = \frac{55}{73} \cdot c; \qquad (123.4)$$

with (84.5), (94.2) is written as follows:

$$6 \cdot E_{\varepsilon 2} = (192/23) \cdot E_{\varepsilon 2} \cdot \left[2 - \left(1 - (v_{e2}(n=2)/c)^2\right)^{-1/2}\right];$$

$$138 = 192 \cdot \left[2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2}\right] ;$$

$$138/192 = 2 - \left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2} ;$$

$$\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2} = 2 - 138/192 ;$$

$$\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{-1/2} = (384–138)/192 ;$$

$$\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{1/2} = 192/246 ;$$

$$\left(1 - \left(v_{e2}(n{=}2)/c\right)^2\right)^{1/2} = 32/41 ; \qquad \text{/squared}$$

$$1 - \left(v_{e2}(n{=}2)/c\right)^2 = 1024/1681 ;$$

$$\left(v_{e2}(n{=}2)/c\right)^2 = (1681–1024)/1681 ;$$

$$\left(v_{e2}(n{=}2)/c\right)^2 = 657/1681 ;$$

$$\left(v_{e2}(n{=}2)/c\right)^2 = (9 \cdot 73)/1681 ;$$

extracting the root:

$$v_{e2}(n{=}2)/c = 3 \cdot 73^{1/2}/41 ; \qquad (94.4)$$

or

$$v_{e2}(n{=}2) = (3/41) \cdot 73^{1/2} \cdot c ; \qquad (94.5)$$

numerically

$$v_{e2}(n{=}2) \approx 0.625171005754941305\ c ; \qquad (94.6)$$

what’s left to combine is (88.3) with (84.5):

$$192/23 \cdot E_{\varepsilon 2} = 3\ E_{\varepsilon 2} \cdot \left[2 - \left(1 - \left(v_{e2}(H;n{=}1)/c\right)^2\right)^{-1/2}\right]^{-1} ;$$

$$64/23 = \left[2 - \left(1 - \left(v_{e2}(H;n{=}1)/c\right)^2\right)^{-1/2}\right]^{-1} ;$$

$$23/64 = 2 - \left(1 - \left(v_{e2}(H;n{=}1)/c\right)^2\right)^{-1/2} ;$$

$$\left(1 - \left(v_{e2}(H;n{=}1)/c\right)^2\right)^{-1/2} = (128–23)/64 ;$$

$$\left(1 - \left(v_{e2}(H;n{=}1)/c\right)^2\right)^{1/2} = 64/105 ; \qquad \text{/squared}$$

$$1 - \left(v_{e2}(H;n=1)/c\right)^2 = 4096/11025\ ;$$

$$\left(v_{e2}(H;n=1)/c\right)^2 = (11025\text{–}4096)/11025\ ;$$

$$\left(v_{e2}(H;n=1)/c\right)^2 = 6929/11025\ ;$$

the root is extracted; now, as a positive value, the electron velocity is

$$v_{e2}(H;n=1)/c = (13/105) \cdot 41^{½}\ ; \tag{88.4}$$

modified:

$$v_{e2}(H;n=1) = (13/105) \cdot 41^{½} \cdot c\ ; \tag{88.5}$$

or, for example:

$$v_{e2}(H;n=1) = [13/(1{\cdot}3{\cdot}5{\cdot}7)] \cdot 41^{½} \cdot c\ ; \tag{88.6}$$

numerically:

$$v_{e2}(H;n=1) \approx 0.79276776272978126592\ c\ ; \tag{88.7}$$

The authors assumption is that, if their main quantum number is equal to 1, the hydrogen atoms without a test particle are at rest, just as they are in their excited state. After all, the momentum conservation argument applies also in this case. And the electrons built of specific rishons are unable to move with any other than their specific speed (though the direction of the velocity vectors may differ); what’s more, they cannot possibly have two different velocities at the same time!

By the way, the author assumes that

$$v_{e2}(H;n=1) \geq\ v_{e1}$$

could be a K.O. criterion for this cosmological model!

Now, what’s left to accomplish is the determination of the kinetic energies of all particles at M = 2. Those of the protons are already known [equation (80.2)]. For the electron on the Bohr radius around the test particle, equation (90) applies; with (84.5) and (88.4):

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - \left((13/105) \cdot 41^{½}\right)^2\right)^{-½} - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - (169/11025) \cdot 41\right)^{-½} - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left((11025 - 6929)/11025\right)^{-½} - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(4096/11025\right)^{-½} - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(11025/4096\right)^{½} - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[105/64 - 1\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[(105\text{–}64)/64\right]\ ;$$

$$E_{kin2}(H;e^-;n=1) = (192/23) \cdot E_{\varepsilon 2} \cdot (41/64) ;$$

$$E_{kin2}(H;e^-;n=1) = (3{\cdot}41/23) \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=1) = (123/23) \cdot E_{\varepsilon 2} ; \qquad (90.1)$$

$$E_{kin2}(H;e^-;n=1) \approx 5.34782608695652173913 \cdot E_{\varepsilon 2} ; \qquad (90.2)$$

or

$$E_{kin2}(H;e^-;n=1) = 5\,{}^{8}/_{23} \cdot E_{\varepsilon 2} ; \qquad (90.3)$$

and for the electron on the outer, 2nd orbit around the test particle, equation (94) applies. With (84.5) and (94.4) one gets

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - \left(3{\cdot}73^{1/2}/41\right)^2\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - 9{\cdot}73/1681\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - 9{\cdot}73/1681\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1 - 657/1681\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left((1681 - 657)/1681\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1024/1681\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1681/1024\right)^{1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1681/1024\right)^{1/2} - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[(41/32) - 1\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[(41-32)/32\right] ;$$

$$E_{kin2}(e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot (9/32) ;$$

$$E_{kin2}(e^-;n=2) = (6/23) \cdot E_{\varepsilon 2} \cdot 9 ;$$

$$E_{kin2}(e^-;n=2) = (54/23) \cdot E_{\varepsilon 2} ; \qquad (94.7)$$

numerically:

$$E_{kin2}(e^-;n=2) \approx 2.34782608695652174\ E_{\varepsilon 2} ; \qquad (94.8)$$

or

$$E_{kin2}(e^-;n=2) = 2\,{}^{8}/_{23} \cdot E_{\varepsilon 2} ; \qquad (94.9)$$

for the electrons of the hydrogen atoms at n = 2 which do not contain protons being test particles, equation (86) yields with (84.5) and (123.2):

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1-(55/73)^2\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot E_{\varepsilon 2} \cdot \left[\left(1-(3025/5329)\right)^{-1/2} - 1\right] ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot \left[\left((5329-3025)/5329\right)^{-1/2} - 1\right] \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot \left[\left(2304/5329\right)^{-1/2} - 1\right] \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot \left[\left(5329/2304\right)^{1/2} - 1\right] \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot \left[\left(5329/2304\right)^{1/2} - 1\right] \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot \left[73/48 - 1\right] \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot ((73-48)/48) \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (192/23) \cdot (25/48) \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (4 \cdot 25)/23 \cdot E_{\varepsilon 2} ;$$

$$E_{kin2}(H;e^-;n=2) = (100/23) \cdot E_{\varepsilon 2} ; \qquad (86.1)$$

numerically:

$$E_{kin2}(H;e^-;n=2) \approx 4.34782608695652173913 \cdot E_{\varepsilon 2} ; \qquad (86.2)$$

or

$$E_{kin2}(H;e^-;n=2) = 4\tfrac{8}{23} \cdot E_{\varepsilon 2} ; \qquad (86.3)$$

By the way, that's also the kinetic energy of the electron orbiting the test particle on the Bohr radius, i.e. $E_{kin2}(e^-)$.

The kinetic energies of all particles in the universe at M = 2 add up to $E_{kin2}(Un)$; if all three hydrogen atoms show the main quantum number n = 2, one has to deal with two protons bearing a mass energy of $11 \cdot E_{\varepsilon 2}$ and a kinetic energy of $E_{kin2}(p^+;n=2)$, whose two electrons have a mass energy of $4 \cdot E_{\varepsilon 2}$ and a kinetic energy of $E_{kin2}(H;e^-;n=2)$, the electron of the test particle with a mass energy of $6 \cdot E_{\varepsilon 2}$ and a kinetic energy of $E_{kin2}(e^-;n=2)$ as well as all neutrinos/antineutrinos with a total mass energy of $12 \cdot E_{\nu 2}$ and a kinetic energy of all those neutrinos/antneutrinos amounting to $E_{kin2}(\nu^\circ)$. The test proton stays at rest; it has a mass energy of $12 \cdot E_{\varepsilon 2}$, but no kinetic energy.

That may be written as follows:

$$E_{kin2}(Un) = 2 \cdot E_{kin2}(p^+;n=2) + 2 \cdot E_{kin2}(H;e^-;n=2) + E_{kin2}(e^-;n=2) + E_{kin2}(\nu^0) \; ; \quad (128)$$

in contrast to the other ones, the last term hasn't been calculated yet; that shall be done now:

$$E_{kin2}(\nu^0) = E_{kin2}(Un) - 2 \cdot E_{kin2}(p^+;n=2) - 2 \cdot E_{kin2}(H;e^-;n=2) - E_{kin2}(e^-;n=2) \; ; \quad (128.1)$$

with (80.2), (86.1), (97.2) and (94.7) that results in

$$E_{kin2}(\nu^0) = 42 \cdot E_{\varepsilon 2} - 2 \cdot E_{\varepsilon 2} - 2 \cdot (100/23) \cdot E_{\varepsilon 2} - (54/23) \cdot E_{\varepsilon 2} \; ;$$

$$E_{kin2}(\nu^0) = 40 \cdot E_{\varepsilon 2} - (200/23) \cdot E_{\varepsilon 2} - (54/23) \cdot E_{\varepsilon 2} \; ;$$

$$E_{kin2}(\nu^0) = (920/23) \cdot E_{\varepsilon 2} - (200/23) \cdot E_{\varepsilon 2} - (54/23) \cdot E_{\varepsilon 2} \; ;$$

$$E_{kin2}(\nu^0) = (920/23) \cdot E_{\varepsilon 2} - (254/23) \cdot E_{\varepsilon 2} \; ;$$

$$E_{kin2}(\nu^0) = ((920 - 254)/23) \cdot E_{\varepsilon 2} \; ;$$

$$\frac{E_{kin2}(\nu^0)}{E_{\varepsilon 2}} = \frac{\mathbf{666}}{\mathbf{23}} \; ; \quad (128.2)$$

The above, fairly ominous quotient is the kinetic energy of all neutrinos/antineutrinos divided by the energy of a single epsilon at M = 2. Because the mass energy of all these particles is 36 times the epsilon energy and 666/23 ≈ 28.9565217391304347826, the binding energy of all neutrinos/antineutrinos is approximately

$$-28.9565217391304347826 \cdot E_{\varepsilon 2}$$

(negative because of the virial equation), and therefore the energy of the rest mass of all neutrinos/antineutrinos [what sums up to $12 \cdot E_{\nu 2}(v_{\nu 2}=0)$] is

$$36 + 28.9565217391304347826 \approx 64.9565217391304347826$$

epsilon energies (exactly $64\frac{22}{23} \cdot E_{\varepsilon 2}$). The binding energy is negative because the neutrinos/antineutrinos also circle around the test particle; centrifugal force and gravitational attraction are in equilibrium. But it has to be emphasised now that this rest energy is not necessarily portioned out in equal amounts to all neutrinos and antineutrinos [logically true because the kinetic energy $E_{kin2}(\nu^0)$ might also differ between neutrinos/antineutrinos of varicolored, unicolored and mixed colored structure, simply because they could move with different velocities, what would depend on their seperation distance from the test particle]. But the author renounces an investigation in this regard, because in his opinion, this is an aspect of his cosmological model being of less importance; the mathematical investment might possibly be considerable and not at least commensurate.

Now at the latest, a point is reached where the reader should say goodbye to the pet idea that the concept of motion corresponds to something real. Tacitly the author already bade farewell to two of the three properties of epsilons as he traced gravitational and electromagnetic interactions back to the basic laws of set theory; now it becomes obvious that the third property is also obsolete: Velocity. Epsilons don't have speed; aside from the positive object in the test particle and the electron, i.e. the element bearing a negative electric charge, they change their relative positions by performing quantum leaps; this is equally true concerning such changes in translative as well as cyclic time. The terms „energy" (ergo also „mass"), „electric charge" and „velocity" were and will be used for the sole purpose of presenting descriptive terms to the reader, i.e. for the sake of mathematical simplicity. In order to achieve better comprehensibleness, the author mostly tries to avoid a strict quantum mechanical elocution. Perhaps a subsequent paper will deal with this matter again, but then on a mathematically abstract level.

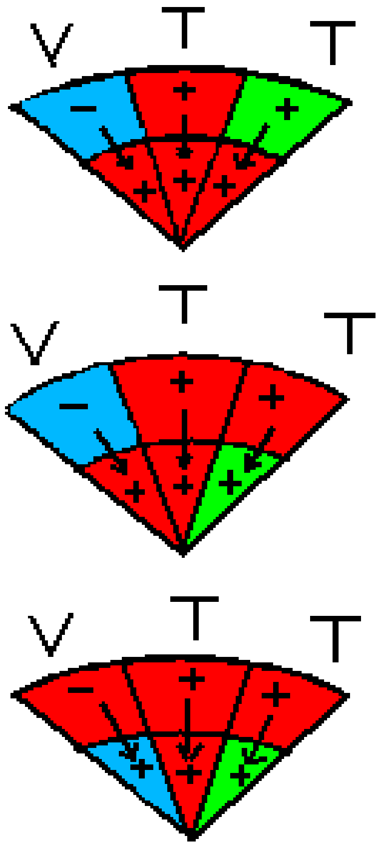

Abb. 9 from top to bottom: u, c and t quark; „+" stands for +1/6th,
„–" for –1/6th of the elementary electric charge

At the end of this chapter, the question shall be discussed how this model could possibly explain the fact that there are three generations of quarks. The author wants to depict this by confronting the reader with the schematic images of the up, charm and top quark in fig. 9 and with those of the down, strange and bottom quark in fig. 10.

The above as well as those „pieces of cake“ shown on the next page are representations of the quarks in fig. 4, 5, 6 and 7 and may be „inserted“ there.

At M = 2 the three possible energy states of the electrons which depend on the main quantum number cannot yet be distinguished from the three generations (electron, muon and tauon); quite in contrast, the neutrinos do indeed exist in three generations (of uni−, vari− and mixed colored composition), but if these states differ energetically from each other so far wasn't investigated in this paper.

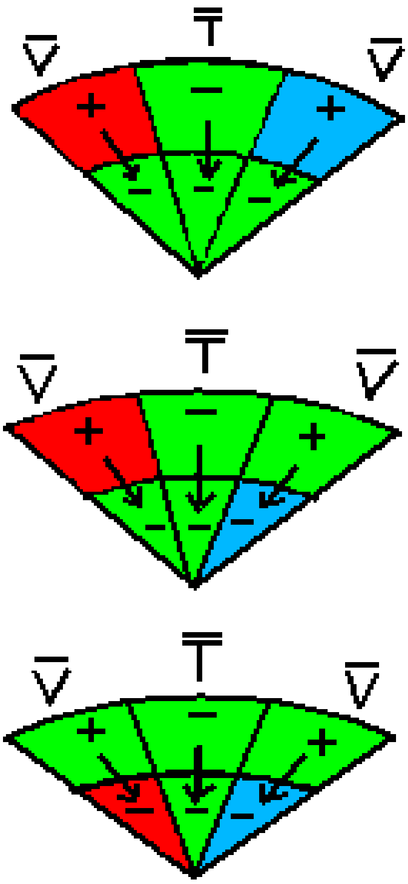

Fig. 10 from top to bottom: d, s and b quark; „+“ stands for +1/6th, „−“ for −1/6th of the elementary electric charge

Chapter III.

In spite of the fact that such an approach is in complete contradiction to the results so far obtained by the previous derivation, the author wants to depict both states of the proton at M =1 as follows: The reader should try to imagine that the electron could also be chosen to be the test particle without becoming an antiproton; under these premises, how would the proton look from the point of view of this electron?

Using this approach, the proton has still a structure defined by its three elements; two of these bear a positive and one a negative electric charge. One could think of this as an isosceles triangle, alternating between lying on one of its sides and standing on one of its tips:

Fig. 11 and 12: Both states of the proton at M =1

If both of these triangles are put one upon another in a way that they get a common barycentre, a Star of David is created; the author found a very nice representation on Wikipedia:

Fig. 13: Star of David

In a strict sense the element with the negative charge in fig. 11 and 12 wouldn't move in relation to the electron, because as the defining element of the electron it is identical with the only element of the proton bearing a negative charge; it must therefore behave exactly like it. This flaw in those three illustrations shown above will be casually ignored here, otherwise the Star of David would not only quiver most unelegantly in three possible directions, and not its barycentre, but the element bearing the negative electric charge would be the reference centre; in consequence, the Star of David would be history here. Well, luckily, not the electron but the proton is able to be a test particle in this universe, therefore nobody has to struggle with such unaesthetic aspects...

As it was already mentioned above, this was only an attempt of the author to explain the issue as vividly as possible.

Back to more serious aspects of the model. One of those is the fact that the model supplies a radius of the universe at M =1 equal to one Planck length, whereas at M = 2, according to equation (121), the universe has already expanded in a way that its radius equals twice the major biggest possible error, i.e. ten Planck lengths [the antipole of the universe at M = 2 is thus 10 Planck lengths away from the test particle; see also (121.1)]. What's really notable: Between both of those extents there are no intermediary states! At M = 2 the world looks as if 10 Planck times would have elapsed since the Big Bang, but actually, in the context of the translative time dimension, the state at M =1 lasted one Planck time and at M = 2 yet one more Planck time, so the experienced age of the universe in translative time sums up to mere two Planck times.

That shows some similarity to the good ole cine film: Between the particular images on the film there's a dark feedthrough, but the spectator doesn't notice that, because the film images are projected on the canvas very rapidly one after another. After the Big Bang, only two Planck times elapse, but the world already looks as if it were 10 Planck times old! Notably in each respect, that's what's the most remarkable fact here.

But at this point, the author wants to lead the reader away from the Big Bang, back into nowadays universe.

As already mentioned earlier, one of both solutions of the Reissner−Nordström equation is

$$r_{-} = [\, M_{Un} - M_{Test}(v_{Test}{=}0) \,] \cdot \frac{G}{c^2} - \left[[\, M_{Un} - M_{Test}(v_{Test}{=}0) \,]^2 \cdot \frac{G^2}{c^4} - (2M-1)^2\, e^{*2} \cdot \frac{G}{c^4} \right]^{½} ; \qquad (129)$$

r_{-} is called the Cauchy horizon.

Choosing the synchronic case, the biggest possible test set is defined by (2M–1) elements (protons). The author deduces this, because at M =1, one single proton is the biggest possible test set, whereas at M = 2, three synchronic protons are defining it, and because the term (2M–1) defines for $M \in IN$ all odd−numbered natural numbers and yields the proton number in the biggest possible test set for both M =1 and M = 2, it follows that for every $M \in IN$, the test is defined by an odd−numbered quantity of protons, i.e. (2M–1).

For M =1 it was already shown in chapter I. that r_{-1} und R_{Stat1}, i.e. both solutions of the Reissner−Nordström equation, are identical with r_1, and that yields according to (19.2)

$$r_{-1} = \frac{h}{m_{e1}\, c}\,. \qquad (19.4)$$

Equation (14.2) says that $ß_1$, the quotient of $m_{p1}(v_{p1}{=}0)$ and m_{e1}, is equal to 3; thus, equation (19.4) yields:

$$r_{-1} = \frac{3\,h}{m_{p1}(v_{p1}{=}0)\, c}; \qquad (19.5)$$

at M = 2, r_{-2} is half of the smallest possible error, according to (119), what may also be written as

$$r_{-2} = \frac{h}{2\, m_{p2}(v_{p2}{=}0)\, c}, \qquad (119.6)$$

because of (119.3) and (119.5).

How big is r_{-} today? That shall be investigated now.

For this purpose the author refers to equation (119.6) and introduces a variable *k* :

$$r_{-} = \frac{k\,h}{2\, m_p(v_p{=}0)\, c} \qquad (119.7)$$

but as of now, for the sake of simplicity, the rest mass of the proton shall be written as m_p instead of $m_p(v_p{=}0)$. Then, (119.7) is written as follows:

$$2\, r_{-} = \frac{k\,h}{m_p\, c}; \qquad (119.8)$$

k shall be calculated now.

In analogy to (115.2), which yields R_{stat}, the following equation

$$r_{-} = ½\cdot\Delta X - [¼\cdot(\Delta X)^2 - ¼\cdot(\Delta z)^2]^{½} \qquad (115.3)$$

yields the Cauchy horizon.

Into (119.8):

$$\frac{k\,h}{m_p\,c} = \Delta X - [(\Delta X)^2 - (\Delta z)^2]^{½}\ ; \qquad (115.4)$$

the preceding statements reveal that

$$\Delta X = 2 \cdot [\, M_{Un} - M_{Test}(v_{Test}=0)\,] \cdot \frac{G}{c^2}\ ; \qquad (130)$$

and

$$\Delta z = 2 \cdot (2M–1) \cdot e^* \cdot \frac{G^{½}}{c^2}\ ; \qquad (131)$$

both equations into (115.4):

$$\frac{k\,h}{m_p\,c} = 2\,[M_{Un}–M_{Test}(v_{Test}=0)]\cdot \frac{G}{c^2} - \left[4\,[M_{Un}–M_{Test}(v_{Test}=0)]^2 \cdot \frac{G^2}{c^4} – 4\,(2M–1)^2\cdot e^{*2} \cdot \frac{G}{c^4}\right]^{½}\ ;$$

that results in

$$2\,\frac{k\,h}{m_p\,c} \cdot 2\,[M_{Un}–M_{Test}(v_{Test}=0)]\cdot \frac{G}{c^2} - \frac{k^2 h^2}{m_p^2\,c^2} = 4\,(2M–1)^2\cdot e^{*2} \cdot \frac{G}{c^4}\ ;$$

substitution: $k^* := k / \alpha$; $\alpha := e^{*2} / c\,h$:

$$\frac{2\,k^*\,e^{*2}}{m_p\,c^2} \cdot 2\,[M_{Un}–M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} - \frac{k^{*2} e^{*4}}{m_p^2 c^4} = 4\,(2M–1)^2\cdot e^{*2} \cdot \frac{G}{c^4}\ ; \qquad / :e^{*2};$$

$$\frac{2\,k^*}{m_p\,c^2} \cdot 2\,[M_{Un}–M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} - \frac{k^{*2} e^{*2}}{m_p^2 c^4} = 4\,(2M–1)^2\cdot e^{*2} \cdot \frac{G}{c^4}\ ;$$

and further transformations lead to

$$4 \cdot (2M–1)^2 \cdot m_p \cdot \frac{G}{c^2} - 4\,k^* \cdot [M_{Un}–M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} + k^{*2} \cdot \frac{e^{*2}}{m_p\,c^2} = 0\ ; \qquad (115.5)$$

under the premise that $M \gg k^*$ (what shall be proven later), and because it's a case where $M \gg 1$, it has to be true that

$$\Delta X \gg k^* \cdot \frac{e^{*2}}{m_p\, c^2}\ ;$$

$$r_p := \frac{e^{*2}}{2 m_p c^2} \qquad (132)$$

is actually the so−called "classical proton radius", if the proton's electric charge is evenly spreaded over its spherical surface at a radius r_p.[12]

To make this perfectly clear: The author knows without questioning it that this "classical proton radius" lacks even the slightest physical relevance. More or less, it's a mere indication of size; after all, this model assumes that the proton has an inner structure, and consequently, it cannot be an ideal sphere; that implies that the radius of the proton surely isn't equal to r_p.

Starting with equation (115.5) one gets with $M-1 \overset{!}{=} M$ (because $M \gg 1$) :

$$8 \cdot M^2 \cdot m_p \cdot \frac{G}{c^2} - 2\,k^* \cdot [M_{Un} - M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} = 0\ ; \quad / : (-2\,G / c^2)\ ;$$

$$k^* \cdot [M_{Un} - M_{Test}(v_{Test}=0)] = 4\, M^2 \cdot m_p\ ;$$

with $M_{test}(v_{Test}=0) = (2M-1) \cdot m_p$:

$$M_{Un} - (2M-1) \cdot m_p = \frac{4}{k^*} M^2 \cdot m_p\ ;$$

$$\frac{4}{k^*} \cdot M^2 \cdot m_p + 2M \cdot m_p = M_{Un}\ ;$$

$$\left[\frac{4}{k^*} M + 2\right] \cdot M \cdot m_p = M_{Un}\ ;$$

because of $M \gg 1$ and $M \gg k^*$, what still has to be proven:

$$\frac{4}{k^*} \cdot M \cdot M \cdot m_p = M_{Un}\ ;$$

$$\frac{4}{k^*} \cdot M^2 = \frac{M_{Un}}{m_p};$$

$$M^2 = \frac{k^* \cdot M_{Un}}{4 \cdot m_p};$$

extracting the root:

$$M = \frac{1}{2} \cdot \left[\frac{k^* \cdot M_{Un}}{m_p} \right]^{1/2}; \qquad (115.6)$$

and now the statement is certainly correct for all M »1, that

$$2M - 1 = \frac{\Delta X}{2\, r_-};$$

what leads to the simplified form

$$2\,M = \frac{\Delta X}{2\, r_-} \qquad \text{(a statement which also will be proven)}$$

because of M »1. That can be justified in a very ostensive way:
There are (2M–1) protons in the test set, thus, because of M »1, approximately 2M. Each of them has the time

$$2 \cdot \frac{2\, r_-}{c},$$

to "look" at the world, because the particle radius, i.e. its whereabouts uncertainty is equal to 2 r_- [also see the above remarks concerning equation (119.1)], and this doubled is equal to its diameter; thus, the particle can be found in a range of $\pm 2r_-$. And if this is divided by the velocity of light in a vacuum, that yields the above time span.

The time the totality of all protons need to experience the effect of the world is obviously the above time span multiplied by (2M–1), what corresponds approximately to 2M because of M »1, and that's nothing else as the totality of all available time in the universe, in other words, the age of the world, the aeon:

$$2 \cdot (2M–1) \cdot \frac{2\, r_-}{c} = T_{Un};$$

because of M »1 that yields

$$4 \cdot M \cdot \frac{2\, r_{-}}{c} = T_{Un} \qquad (133)$$

If

$$t_{-} := \frac{r_{-}}{c}, \qquad (134)$$

equation (133) yields

$$4M \cdot \frac{2\, c\, t_{-}}{c} = T_{Un};$$

transformed:

$$2M = \frac{T_{Un}}{4t_{-}}; \qquad (133.1)$$

but $T_{Un} \cdot c$ is the distance between the test set and the universal horizon, R_{Un}. That is more or less equal to twice the static boundary of the universe, R_{Stat}.

For M »1 it is true that $R_{stat} \approx \Delta X$, hence approximately the Schwarzschild radius of a Black Hole with the total mass of the universe. Thus, (133.1) yields

$$2M = \frac{R_{Un}}{4r_{-}}; \qquad (133.1)$$

and with $R_{Un} \overset{!}{=} 2 \cdot \Delta X$

$$2M = \frac{\Delta X}{2r_{-}}; \qquad V \qquad \text{q.e.d.} \qquad (133.2)$$

into (115.3) :

$$\frac{\Delta X}{2M} = \Delta X - [(\Delta X)^2 - (\Delta z)^2]^{½}; \qquad (115.7)$$

after various transformations the result is

$$(\Delta z)^2 = (\Delta X)^2 \cdot \frac{4M^2 - 4M^2 + 4M - 1}{4M^2};$$

and with M »1

$$M = \frac{(\Delta X)^2}{(\Delta z)^2} ; \qquad (135)$$

the author finds it interesting that this equation is also valid for M =1, but not for M = 2.

(135) equalised with (115.6) :

$$\frac{(\Delta X)^2}{(\Delta z)^2} = \frac{1}{2} \cdot \left[\frac{k^* \cdot M_{Un}}{m_p} \right]^{1/2} ; \qquad (135)$$

M_{Un} » $M_{Test}(v_{Test}=0)$ at M »1, therefore equation (130) becomes

$$\Delta X = 2 \cdot M_{Un} \cdot \frac{G}{c^2} ; \qquad (130.1)$$

hence

$$M_{Un} = \frac{1}{2} \cdot \Delta X \cdot \frac{c^2}{G} ; \qquad (130.2)$$

and with M »1, (131) yields

$$\Delta z = 4 \cdot M \cdot e^* \cdot \frac{G^{1/2}}{c^2} ; \qquad (131.1)$$

into (135) :

$$\frac{(\Delta X)^2}{\left[4 \cdot M \cdot e^* \cdot \frac{G^{1/2}}{c^2} \right]^2} = \frac{1}{2} \cdot \left[\frac{k^* \cdot M_{Un}}{m_p} \right]^{1/2} ;$$

$$\frac{(\Delta X)^2}{\left[16 \cdot M^2 \cdot e^{*2} \cdot \frac{G}{c^4} \right]} = \frac{1}{2} \cdot \left[\frac{k^* \cdot M_{Un}}{m_p} \right]^{1/2} ;$$

with (115.6) :

$$\frac{(\Delta X)^2}{\left[16 \cdot e^{*2} \cdot \dfrac{G}{c^4}\right]} = {}^1/_8 \cdot \left[\frac{k^* \cdot M_{Un}}{m_p}\right]^{3/2} \quad ;$$

with (130.1) :

$$\frac{(\Delta X)^2}{\left[16 \cdot e^{*2} \cdot \dfrac{G}{c^4}\right]} = {}^1/_8 \cdot \left[\frac{k^* \, \Delta X \, c^2}{2 \cdot m_p \, G}\right]^{3/2} \quad ;$$

$$\frac{(\Delta X)^2}{\left[2 \cdot e^{*2} \cdot \dfrac{G}{c^4}\right]} = \left[\frac{k^* \, \Delta X \, c^2}{2 \cdot m_p \, G}\right]^{3/2} \quad ;$$

solved for k^*:

$$k^* = \left[\frac{8 \cdot m_p^3 \, G^3 \, (\Delta X)^4 \, c^8}{4 \cdot e^{*4} \cdot G^2 \cdot (\Delta X)^3 \cdot c^6}\right]^{1/3} \quad ;$$

$$k^* = \left[\frac{2 \, m_p^3 \, G \, \Delta X \, c^2}{e^{*4}}\right]^{1/3} \quad ;$$

$$k^* = m_p \cdot \left[\frac{2 \, G \, \Delta X \, c^2}{e^{*4}}\right]^{1/3} \quad ;$$

reversing the substitution $k^* := k / \alpha$:

$$k / \alpha = m_p \cdot \left[\frac{2 \, G \, \Delta X \, c^2}{e^{*4}}\right]^{1/3} \quad ;$$

$\alpha := e^{*2} / c\, h$:

$$k = m_p \cdot \left[\frac{2\, \alpha\, \Delta X\, G}{h^{2}} \right]^{1/3} ; \qquad (135.1)$$

and here, the latest, most exactly known values for the variables are used in order to calculate k numerically.

Those are

$G = (6.67384 \pm 0.00080) \cdot 10^{-11} \cdot kg^{-1} \cdot m^3 \cdot s^{-2}$;[13] (136)
$\alpha = (7.29735256980 \pm 0.00000000024) \cdot 10^{-3}$;[13] (137)
$h = (1.054571726 \pm 0.000000047) \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}$;[13] (138)
$m_p = (1.672621777 \pm 0.000000074) \cdot 10^{-27}$ kg ;[13] (139)
$\Delta X = ½ \cdot R_{Un} = ½ \cdot (13.798 \pm 0.037) \cdot 10^{9}$ Ly $= (6.5268 \pm 0.0175) \cdot 10^{25}$ m ;[14] (140)

and that yields with (135.1)

$$k \approx 2.9906859 ; \qquad (135.2)$$

sure enough, that's in the immediate vicinity of 3.

What's left now is to take a closer look at k^*; the above substitution was $k^* := k / \alpha$. With (135.2) and (137) this yields

$$k^* \approx 2.9906859 / (7.29735256980 \cdot 10^{-3}) ;$$

and the solution is

$$k^* \approx 409.83163 . \qquad (135.3)$$

One of the preconditions of these calculations was the statement that the image number M would have to be much bigger than k^*. Because of this very assertion it is also necessary to calculate M. (135.2) yields with (119.8) and (133.2) :

$$2M \approx \frac{\Delta X\, m_p\, c}{2.9906859\, h} ; \qquad (135.4)$$

with (140ff) and $c = 2.99792458 \cdot 10^{8}\ {}^{m}/_{s}$:

$$2M \approx \frac{6.5268 \cdot 10^{25}\ m \cdot 1.672621777 \cdot 10^{-27}\ kg \cdot 2.99792458 \cdot 10^{8}\ {}^{m}/_{s}}{2.9906859 \cdot 1.054571726 \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}} ;$$

that results in

$$M \approx 5.1885 \cdot 10^{40} ; \qquad (135.5)$$

hence it is shown that $M \gg k^*$. *V* q.e.d.

Now *k* shall be calculated by using another approach. To this end, some preceding explanations will hopefully help to clarify things a little bit.

At M =1, aside from the test set, i.e. the proton, there's only one more particle, the electron. In this universe, the latter is merely able to occupy just a single quantum state, i.e. the one defined by a main quantum number n =1. This is so because the quantum state characterised by a main quantum number n = 2, according to some previous statements, corresponds to another universe, where the antiproton serves as a test set, and in consequence, that universe contains mostly antimatter. In order to depict this in a more transparent way, the radius of the universe at M =1 was deliberately set equal to the radius of the sole electron's orbit, whereas at M = 2 and above, the radius of the highest possible electron orbit is somewhat smaller than the so−called universal radius, which is the distance between the test particle and the universal horizon, the location of an electron at rest.

Therefore the method of defining and describing the universe in this paper coincides exclusively for all image numbers bigger than one, hence also for nowadays universe.

Henceforth, the author sets his focus again on the situation at M = 2. He takes a closer look at the following equation:

$$\frac{m_{e2}(n=2)}{2 \cdot m_{min2}} = \frac{c\,h}{[m_{p2}(v_{p2}=0)]^2\,G}\,; \qquad (141)$$

m_{min2} is the mass of a colourless particle with the lowest possible mass energy also having a rest mass bigger than zero, e.g. not a photon. At M = 2 it's identified at once: It is the neutrino; besides, in the case of a main quantum number n =1, there are also electrons in the hydrogen atoms without a test particle having the same mass, i.e. $m_{e2}(H;n=1) = 3 \cdot m_{\varepsilon 2}$; see also equations (70) with (44).

Now the above equation (141) can easily be proven by using the adequate calculated results for its different physical variables; equations (69) and (44) yield $m_{e2}(n=2) = 6 \cdot m_{\varepsilon 2}$, and equation (56.6) yields $m_{p2}(v_{p2}=0) = 12 \cdot m_{\varepsilon 2}$. Thus (141) may be written as follows:

$$\frac{6 \cdot m_{\varepsilon 2}}{2 \cdot 3 \cdot m_{\varepsilon 2}} = \frac{c\,h}{[12 \cdot m_{\varepsilon 2}]^2\,G}\,;$$

and with (119.3) as well as (44) this results in

$$\frac{6 \cdot m_{\varepsilon 2}}{2 \cdot 3 \cdot m_{\varepsilon 2}} = \frac{144 \cdot m_{\varepsilon 2}^2}{[12 \cdot m_{\varepsilon 2}]^2}\,;$$

finally, that gives

$$\frac{6\cdot m_{\varepsilon 2}}{6\cdot m_{\varepsilon 2}} = \frac{144\cdot m_{\varepsilon 2}{}^2}{144\cdot m_{\varepsilon 2}{}^2};$$

$$1 = 1; \qquad\qquad V \qquad \text{q.e.d.}$$

It will now be shown below that (141) is also valid in the contemporary universe, i.e. in this form:

$$\frac{m_e(n_{max})}{2\cdot m_{min}} = \frac{c\,h}{m_p{}^2\,G}. \qquad (141.1)$$

In analogy to m_{min2} (i.e. m_{min} at M = 2), m_{min} is (at M »1) the mass of a colourless particle having the lowest possible mass energy whose rest mass is bigger than zero, i.e. not a photon; $m_e(n_{max})$ is the mass of the electron on its highest possible orbit (whose radius is only negligibly smaller than R_{Un}). But de facto $m_e(n_{max})$ is equal to m_e, because so far out, the negative binding energy is vanishingly small:

$$\frac{m_e}{2\cdot m_{min}} = \frac{c\,h}{m_p{}^2\,G}. \qquad (141.2)$$

The main quantum number n_{max} is calculated as follows:[14]

$$n_{max} = \left[\frac{R_{Un}\cdot m_e\cdot e^{*2}}{h^2}\right]^{1/2}; \qquad (142)$$

numerically with the value for R_{Un} from equation (140) :

$$n_{max} \approx \left[\frac{2\cdot 6.5268\cdot 10^{25}\cdot 9.10938291\cdot 10^{-31}\cdot (1.51890663\cdot 10^{-14})^2}{(1.054571726\cdot 10^{-34})^2}\right]^{1/2};$$

$$n_{max} \approx 1.570596\cdot 10^{18}; \qquad (142.1)$$

and now, m_{min} shall be calculated.

First,

$$E_{min} = m_{min}\,c^2; \qquad (143)$$

and furthermore,

$$E_{min} = h\cdot \nu_{min}; \qquad (144)$$

in addition,

$$\nu_{min} = c / \lambda_{max} \; ; \qquad (145)$$

E_{min} is the lowest possible mass energy of a particle (with zero rest mass); ν_{min} is the frequency of a photon with the energy E_{min} , and λ_{max} is th longest possible wavelength in the universe:

$$\lambda_{max} = 2 \cdot \pi \cdot 2 \cdot \Delta X \; ; \qquad (146)$$

this into (145) :

$$\nu_{min} = c / (4 \cdot \pi \cdot \Delta X) \; ; \qquad (145.1)$$

and that into (144) :

$$E_{min} = h \cdot c / (4 \cdot \pi \cdot \Delta X) \; ;$$

$h = 2\pi \cdot \mathit{h}$:

$$E_{min} = \frac{c\, \mathit{h}}{2 \Delta X} \; ; \qquad (144.1)$$

into (143) :

$$m_{min}\, c^2 = \frac{c\, \mathit{h}}{2 \Delta X} \; ;$$

$$m_{min} = \frac{\mathit{h}}{2 \cdot \Delta X \cdot c} \; ; \qquad (143.1)$$

being an equation only valid for M »1, (135.1) yields

$$\frac{k^3}{m_p^3} = \frac{2 \cdot \alpha \cdot \Delta X \cdot G}{\mathit{h}^2} \; ;$$

$$\Delta X = \frac{h^2 \; k^3}{2 \cdot \alpha \cdot m_p^3 \cdot G} \; ; \qquad (\,135.6\,)$$

this into (143.1) :

$$m_{min} = \frac{h \cdot \alpha \cdot m_p^3 \cdot G}{h^2 \cdot k^3 \cdot c} \; ;$$

$$\frac{m_{min}}{m_p} = \frac{\alpha \cdot m_p^2 \cdot G}{k^3 \cdot h \cdot c} \; ;$$

$$\frac{m_p}{m_{min}} = \frac{k^3}{\alpha} \cdot \frac{c \;\; h}{m_p^2 \; G} \; ; \qquad (\,143.2\,)$$

and this together with (141.2) :

$$\frac{m_p}{m_{min}} = \frac{k^3}{\alpha} \cdot \frac{m_e}{2 \; m_{min}} \; ; \qquad (\,141.3\,)$$

reducing m_{min} and transforming the resulting equation a little bit:

$$\alpha \cdot \frac{m_p}{m_e} = \frac{k^3}{2} \; ;$$

and with the definition ß := m_p / m_e

$$\alpha \, ß = \frac{k^3}{2} \; ; \qquad (\,141.4\,)$$

that yields the cubic root

$$k = \left(2 \, \alpha \, ß \right)^{1/3} \; ; \qquad (\,141.5\,)$$

with

$$\alpha \approx \frac{1}{137.035999074}$$

and $$ß \approx 1{,}836.15267245$$

the result is this numerical value:

$$k \approx 2.99250376016638 \; ; \qquad (\,141.6\,)$$

error estimate:

$$\frac{\Delta k}{k} = \left[\frac{{}^1/_3 \cdot (\Delta\alpha)^2}{\alpha^2} + \frac{{}^1/_3 \cdot (\Delta ß)^2}{ß^2} \right]^{½} ;$$

with the values from appendix A:

$$\frac{\Delta k}{k} \approx \left[\frac{{}^1/_3 \cdot (0.0000000024)^2}{(7.2973525698)^2} + \frac{{}^1/_3 \cdot (0.00000075)^2}{(1{,}836.15267245)^2} \right]^{½} ;$$

$$\frac{\Delta k}{k} \approx (3 \cdot 10^{-20} + 5 \cdot 10^{-20})^{½} ;$$

$$\frac{\Delta k}{k} \approx (8 \cdot 10^{-20})^{½} ;$$

$$\frac{\Delta k}{k} \approx 2.8 \cdot 10^{-10} ;$$

that yields with (141.6)

$$\Delta k \approx 2.992503760166 \cdot 2{,}8 \cdot 10^{-10} ;$$

$$\Delta k \approx 8 \cdot 10^{-10} ;$$

and the result is

$$k = 2.9925037602 \pm 0.0000000008 \qquad (141.7)$$

or, a little bit more clearly represented,

$$k = 2.9925037602(8) ; \qquad (141.8)$$

(135.3) with (141.5) :

$$\Delta X = \frac{h^2 \cdot ß}{m_p{}^3 \cdot G} ;$$

with $ß := m_p / m_e$:

$$\Delta X = \frac{h^2}{m_p{}^2 \cdot m_e \cdot G} ; \qquad (135.7)$$

as ever, the author sets R_{Un} equal to $2\cdot\Delta X$; with the values from appendix A together with (135.7) :

$$R_{Un} \approx \frac{2 \cdot (1.054571726\cdot10^{-34})^2 \cdot m}{(1.672126777\cdot10^{-27})^2 \cdot 9.10938291\cdot10^{-31} \cdot 6.67384\cdot10^{-11}} ;$$

$$R_{Un} \approx 1.30851616 \cdot 10^{26}\ m ; \qquad (135.8)$$

that's also equal to

$$R_{Un} \approx 13.831405 \cdot 10^{9}\ Ly ; \qquad (135.9)$$

error estimate:

$$\frac{\Delta R_{Un}}{R_{Un}} = \left[\frac{2(\Delta h)^2}{h^2} + \frac{2(\Delta m_p)^2}{m_p^2} + \frac{(\Delta m_e)^2}{m_e^2} + \frac{(\Delta G)^2}{G^2} \right]^{½} ;$$

with the values from appendix A :

$$\frac{\Delta R_{Un}}{R_{Un}} = \left[\frac{2\cdot(0.000000047)^2}{1.054571726^2} + \frac{2\cdot(0.000000074)^2}{1.672126777^2} + \frac{0.00000040^2}{9.10938291^2} + \frac{0.00080^2}{6.67384^2} \right]^{½} ;$$

$$\frac{\Delta R_{Un}}{R_{Un}} \approx [\, 4 \cdot 10^{-15} + 4 \cdot 10^{-15} + 2 \cdot 10^{-15} + 1.4 \cdot 10^{-8}\,]^{½} ;$$

$$\frac{\Delta R_{Un}}{R_{Un}} \approx 0.00012 ; \qquad (135.10)$$

together with R_{Un} from (135.9), that yields

$$\Delta R_{Un} \approx 0.00012 \cdot 13.831405 \cdot 10^{9}\ Ly ;$$
$$\Delta R_{Un} \approx 0.0017 \cdot 10^{9}\ Ly ;$$

the size of the universal radius may thus be expressed as follows:

$$R_{Un} = (13.8314 \pm 0.0017) \cdot 10^{9}\ Ly ; \qquad (135.11)$$

or $$R_{Un} = 13.8314(17) \cdot 10^{9}\ Ly ; \qquad (135.12)$$

=> $$½\, R_{Un} = \Delta X = 6.91570(83) \cdot 10^{9}\ Ly ; \qquad (135.12.1)$$

in metric notation:

$$½\, R_{Un} = \Delta X = 6.5426(8) \cdot 10^{25}\ m ; \qquad (135.12.2)$$

and if the latter result is compared with the value in (140), it becomes obvious that it's much more concise; furthermore, the result in (135.12) lies well inside the boundaries of the Planck Mission result for R_{Un} equal to 13.798(37) times 10^9 light years[15]. Thus the value of the age of the universe $T_{Un} := R_{Un} / c$ is in perfect accordance with the error estimates of the „Planck Space Observatory“ project[15]. Therefore, the author declares **the three assumptions underlying this model** herewith **as proven**; it's obvious that the model corresponds to the physical conditions in this universe. Especially the equations (141.4) und (141.5) are now presented here as crucial findings in this paper:

$$\boxed{\alpha\, ß = \frac{k^3}{2}\,; \qquad \text{(für } M \geq 2)} \qquad (141.4)$$

and

$$\boxed{k = \left(2\,\alpha\, ß\right)^{1/3}\,; \qquad \text{(für } M \geq 2)} \qquad (141.5)$$

for M = 2 they confirm the value k =1, if ß is defined as the ratio of the proton rest mass and the electron mass at n_{max2}=2 [and explicitly not the electron rest mass according to equations (84.7) and (44)]; for M = 2, (141.5) yields with (42.2), (44), (62.1) and (69)

$$k_2 = \left(2 \cdot 0.25 \cdot 12/6\right)^{1/3}\,;$$

$$k_2 = \left(4 \cdot 0.25\right)^{1/3}\,;$$

$$k_2 = 1\,;$$

what's left now m_{min} itself. With the halved result for R_{Un} from (135.8) which equals ΔX, (143.1) yields

$$m_{min} \approx \frac{1.054571726 \cdot 10^{-34} \cdot \text{kg}}{2 \cdot ½ \cdot 1.30851616 \cdot 10^{26} \cdot 2.99792458 \cdot 10^{8}}\,;$$

$$m_{min} \approx 2.68829132 \cdot 10^{-69} \cdot \text{kg}\,, \qquad (143.3)$$

a tiny, really minute mass – in the contemporary universe, it's the mass of a colourless particle with the smallest possible mass energy having a rest mass bigger than zero. Because this result doesn't have any pertinence for the following calculations, the author renounces to do an error estimate in this regard, but utters his suspicion that the first five digits of the numerical value of m_{min} could be correct.

However, the author doesn't claim to be able to make further statements concerning this particle, i.e. if m_{min} could be a rest mass etc.

But it's important to emphasise that (135.7) is also one of the most significant results in this paper; nevertheless, the author transforms this equation a little bit using $R_{Un} = 2 \cdot \Delta X$ and the amplitude of the Compton wavelength of the proton, i.e. $A_c := l_c / 2\pi = h / m_p c$:

$$\boxed{\frac{2\pi \cdot R_{Un}}{2 \cdot l_c} = \frac{c h}{m_p \cdot m_e \cdot G} \; ; \qquad (\text{ f. } M \text{ »}1 \text{ })} \qquad (\text{ } 135.7.1 \text{ })$$

or with $M_p := (ch / G)^{½}$:

$$\boxed{\frac{\pi \cdot R_{Un}}{l_c} = \frac{M_p \cdot M_p}{m_p \cdot m_e} \; ; \qquad (\text{ f. } M \text{ »}1 \text{ })} \qquad (\text{ } 135.7.2 \text{ })$$

what may also be written as follows:

$$\boxed{\frac{2\pi \cdot \Delta X}{l_c} = \frac{M_p^2}{m_p \cdot m_e} \; ; \qquad (\text{ f. } M \text{ »}1 \text{ })} \qquad (\text{ } 135.7.3 \text{ })$$

and last but not least, for the sake of completeness, one more main result of the author's work, the equation for the Cauchy horizon of the universe:

$$\boxed{\frac{\boldsymbol{k\,h}}{\mathbf{m_p\,c}} = \mathbf{\Delta X - [(\Delta X)^2 - (\Delta z)^2]^{½}} \; ;} \qquad (\text{ } 115.8 \text{ })$$

What's left now is to deduce the total mass of the universe.

To this behalf equation (130.2) will be used, together with the values for G from equation (136), ΔX from (135.11.2) and $c = 2.99792458 \cdot 10^8 \ ^{m}/_{s}$:

$$M_{Un} \approx ½ \cdot 6.5426 \cdot 10^{25} \cdot \frac{(2.99792458 \cdot 10^8)^2}{6.67384 \cdot 10^{-11}} \cdot \text{kg} \; ;$$

$$M_{Un} \approx 4.40541 \cdot 10^{52} \cdot \text{kg} \; ; \qquad (\text{ } 130.3 \text{ })$$

and the relative error quotient $|\Delta M_{Un}| / M_{Un}$, whose numerator, for the sake of simplicity, will not be written here as an absolute value, but rather as $\Delta M_{Un} / M_{Un}$ (after all, in the context of this paper, all other errors have also been written as positive values), may be calculated by the use of the following equation:

$$\Delta M_{Un} / M_{Un} = \left[\frac{\Delta(\Delta X)^2}{(\Delta X)^2} + \frac{\Delta G^2}{G^2} \right]^{½} \; ; \qquad (147)$$

the numerical value of the velocity of light in vacuum, c, was codified 1983 by the 17^{th} General Conference on Weights and Measures in Sèvres, a suburb of Paris, as being exactly equal to 299792458 meter per second; thus, simply by definition, it doesn't have an error. Numerically from (136) and (136.8) :

$$\Delta M_{Un} / M_{Un} \approx \left[\frac{(0.0017)^2}{(13.8314)^2} + \frac{(0.00080)^2}{(6.67384)^2} \right]^{½} \; ;$$

$$\Delta M_{Un} / M_{Un} \approx 0.00017; \qquad (147.1)$$

thus it can be written

$$M_{Un} = (\, 4.40541 \pm 0.00017 \cdot 4{,}40541 \,) \cdot 10^{52} \cdot kg \; ;$$

$$M_{Un} = (\, 4.40541 \pm 0.00075 \,) \cdot 10^{52} \cdot kg \; ;$$

it also makes sense to round this as follows:

$$M_{Un} = 4.40541(75) \cdot 10^{52} \cdot kg \; ; \qquad (130.4)$$

in relationship to the proton rest mass from (139), this results numerically in

$$\frac{M_{Un}}{m_p} \approx \frac{4.40541 \; \cdot 10^{52} \cdot kg}{1.672621777 \cdot 10^{-27} \; kg} \; ;$$

$$M_{Un} / m_p \approx 2.63384 \cdot 10^{79} \; ; \qquad (130.5)$$

the author finds it irritating that this value corresponds to rough estimates of the proton number in the universe. But since the PSOP mission[14] it is known that the universe contains approximately 4.82±0.05% ordinary baryonic matter, 25.8±0.4% dark matter and 69±1% dark energy.[14,15,16] Since the latter presumably shouldn't be counted to M_{Un}, quite contrary to dark matter, the actual proton number N_p cannot possibly be as big as the value shown in equation (130.5).

So it's crucial to undertake further investigations concerning N_p.

The number of protons in the biggest possible test set, if it is solely defined by protons as its elements, is equal to (2M –1); that's the result of previous considerations. At M =1 as well as at M = 2 the elements of the test set are inexistent for each other, as was already deduced earlier.

At M ≥ 3 it's likely to be different, because under these conditions, $\sigma_{M\geq 3}$ might presumably be even considerably bigger than the Planck time – and that leads to an interesting thought the author would like to present now.

The reader should try to imagine a universe solely containing the (2M –1) protons in the biggest possible test set; in other words, aside from the test set, such a world would be empty (wow! That's really solipsistic!). Now, the following phenomenon may occur: Each of these protons would establish a connection to every other proton by exchanging a photon. This interchange could be realised in two different ways; either, the photon sent by one proton would be coupled by the target, or, the photon wouldn't couple with the other proton. The probability with which the photon couples with the target proton is described by the electromagnetic coupling constant α, the Sommerfeld fine structure constant.[17] In a simplified view, this means that only in approximately one of 137 such encounters the photon is „sucked in" by the proton.

This description isn't really in accordance with the facts, because, more precisely put, the photon doesn't interact with the proton, but the photon field with the atom containing the proton; after all, the photon is only an energy quantum that is exchanged. But here, in order to achieve better clarity, the issue is dumbed down a bit (especially the electron in the hydrogen atom is neglected; in this example, the test set is defined solely by protons and not hydrogen atoms).

The quantity of those exchanges may be expressed by the following term:

$$(2M-1)\cdot(2M-1)\cdot\alpha$$

because there are (2M –1) protons in the biggest possible test set, and each of them receives a photon from all others, (2M –1) photons are exchanged. In nowadays universe that leads in one of approximately 137 cases to a successful coupling.

Now it has yet to be taken into consideration that only a single such exchange process may occur per Planck time, though with the probability 1 (because α_1=1), but always only in one of three different ways – the reader may recall that at M =1, the test particle is defined by its three elements called epsilons, and the photon exchange takes always place with one of the elements and not with the proton as a whole. (as depicted at the end of chapter I., in the first place, a photon exchange between the antiproton and the positron is responsible for the creation of the proton and its electron; that applies also the other way round). For consistency reasons the above term has to be divided by three:

$$\frac{(2M-1)\cdot(2M-1)\cdot\alpha}{3}\ .$$

This term will be called N_M :

$$N_M := \frac{(2M-1) \cdot (2M-1) \cdot \alpha}{3} ; \qquad (148)$$

for M »1 the result is

$$N_M = \frac{4 \cdot M^2 \cdot \alpha}{3} ; \qquad (148.1)$$

on the other hand, squaring (115.6) results in

$$4 M^2 = \left[\frac{k^* \cdot M_{Un}}{m_p} \right] ;$$

by substituting $k^* := k / \alpha$ that yields

$$4 M^2 = \left[\frac{k \cdot M_{Un}}{\alpha \cdot m_p} \right] ; \qquad (115.9)$$

and because for M »1 the value $k \approx 2.9925037602$ has been calculated, (115.9) may be written as follows:

$$4 M^2 \approx \frac{2.9925037602 \cdot M_{Un}}{\alpha \cdot m_p} ; \qquad (115.10)$$

or

$$M_{Un} \approx \frac{4 M^2 \cdot \alpha}{2.9925037602} \cdot m_p ; \qquad (115.11)$$

with (148.1)

$$M_{Un} \approx \frac{3}{2.9925037602} \cdot N_M \cdot m_p ; \qquad (115.12)$$

$$M_{Un} \approx 1.0025050060 \cdot N_M \cdot m_p ;$$

thus the conceptual approach depicted above confirms the basic principle that *k* lies very close to 3.

Because N_M is nothing else than the total amount of all protons in the universe, i.e. N_p, it seems that 2.5 per mill of the universal mass never and under no circumstances may consist of protons. The reciprocal value of ß≈1,836.15267245 is equal to more or less 0.000544617. That's the mass fraction to be allotted to all electrons in the universe, if their amount equals that of the protons. Now the difference between those 2.5 per mill of the universal mass and this last−mentioned number is approximately equal to 0.001960389. That's about a fivehundredth of the total proton mass in the universe. The author thinks that this could be the mass fraction that has to be allotted to the neutrinos moving at relativistic speed, thus being nearly massless because of their negative total energy; yet, their overwhelming number is sufficient to account for about two per mill of the total mass of all protons in the universe.

Back to the result of the conceptual approach depicted above. Bewildered, the attentive reader will now ask himself if there are really no other protons (i.e. hydrogen atoms) than those included in the biggest possible test set, because the overwhelming majority of the protons in the universe would only be a kind of „echo“ of those protons being elements of that biggest possible test set!

Asked to solve this riddle most readers will find difficult to accept, the author loconically points to one of the basic assumptions of this paper, i.e. the one stating that the world is a subset of the power set of the test set.

What is still left to be done is to calculate the present−day image number M as accurately as possible. Starting with (115.9), one gets

$$M = \left[\frac{k \cdot M_{Un}}{4 \cdot \alpha \cdot m_p} \right]^{1/2} ; \qquad (115.13)$$

numerically:

$$M \approx \left[\frac{2.9925037602 \cdot 4.40541 \cdot 10^{52}}{4 \cdot 7.29735256980 \cdot 10^{-3} \cdot 1.672621777 \cdot 10^{-27}} \right]^{1/2} ; \qquad (115.14)$$

$$M \approx 5.196357 \cdot 10^{40} ; \qquad (115.15)$$

and here's the respective error estimate:

$$\frac{\Delta M}{M} = \left[\frac{1/2 \cdot (\Delta k)^2}{k^2} + \frac{1/2 \cdot (\Delta M_{Un})^2}{M_{Un}^2} + \frac{1/2 \cdot (\Delta \alpha)^2}{\alpha^2} + \frac{1/2 \cdot (\Delta m_p)^2}{m_p^2} \right]^{1/2} ;$$

with the values of k, M_{Un}, α and m_p [see equations (130.4) and (141.8) as well as appendix A] :

$$\frac{\Delta M}{M} \approx \left[\frac{0.0000000008^2}{2 \cdot 2.9925037602^2} + \frac{0.00025^2}{2 \cdot 4.40541^2} + \frac{0.0000000024^2}{2 \cdot 7.2973525698^2} + \frac{0.000000074^2}{2 \cdot 1.672621777^2} \right]^{1/2} ;$$

$$\frac{\Delta M}{M} \approx 0.00004\ ;$$

with (115.15) that yields

$$\Delta M \approx 0.00004 \cdot 5.196357 \cdot 10^{40}\ ;$$

$$\Delta M \approx 0.0002 \cdot 10^{40}\ ;$$

=> $$M = (5.1964 \pm 0.0002) \cdot 10^{40}\ ; \qquad (115.16)$$

better readable as follows: $$M = 5.1964(2) \cdot 10^{40}\ ; \qquad (115.17)$$

this result differs by $\Delta M = (5.1964–5.1885) \cdot 10^{40} = 0.0079 \cdot 10^{40}$ from equation's (135.5) result. => $\Delta M / M = 0.0079 / 5.1964 = 0.0015$; that's a lot less than the relative error of M based on the Planck mission[15] results.

Here's the error estimate for equation (135.5) :

$$\frac{\Delta M}{M} \approx \left[\frac{[\Delta(\Delta X)]^2}{(\Delta X)^2} + \frac{(\Delta m_p)^2}{m_p^2} + \frac{(\Delta h)^2}{h^2} + \frac{(\Delta k)^2}{k^2}\right]^{½}\ ;$$

$$\frac{\Delta M}{M} \approx \left[\frac{0.037^2}{13.798^2} + \frac{0.000000074^2}{1.672621777^2} + \frac{0.000000047^2}{1.054571726^2} + \frac{0.0000000008^2}{2.9925037602^2}\right]^{½}\ ;$$

$$\frac{\Delta M}{M} \approx 0.0027;$$

with (135.5) :

$$M = (\ 5.1885 \pm 5.1885 \cdot 0.0027\ ) \cdot 10^{40}\ ;$$

$$M = (\ 5.1885 \pm 0.014\ ) \cdot 10^{40}\ ; \qquad (135.13)$$

and if one compares that with the result in equation (135.15)

$$M = (5.1964 \pm 0.0002) \cdot 10^{40},$$

than it becomes instantly obvious that the latter lies well inside the error boundaries of (135.17), and above all, it's much more accurate.

Back to the topic of dark matter.

It was shown in chapter II. that neutrinos have negative binding energy. Each of them can form with baryons something like analogons of atoms, quite comparable to normal atoms consisting of protons and neutrons in the atomic nucleus and electrons in the shell. The only difference is that there is no electromagnetic interaction between the neutrino and the baryon (or rather the atomic nucleus); between them there is, apart of a possible weak interaction, solely gravitational attraction, which in the case of hydrogen atoms is approximately 10^{39} times weaker than the electromagnetic attraction between proton and electron, and that makes these analogons of atoms many times taller than known atoms. By rough estimates of the author, a neutrino on an orbit corresponding to the Bohr radius is 10^{20} times farther away from the proton than an electron in a similar situation.

That provides a plausible explanation for the behaviour of neutrinos, which would otherwise seem fairly queer; them moving extremely fast, nearly with the speed of light, but having an incredibly small mass. This cosmological model simply states that the negative binding energy of the neutrinos has nearly the same absolute value as their rest mass, in case their main quantum number $n \approx 1$; because of the validity of the virial equation the kinetic energy is nearly as big as the rest mass of a neutrino at $n \approx 1$.

Thus, plausible explanations are supplied for sundry unsolved riddles in nowadays physics. The most prominent of them is dark matter; the latter might mainly consist of decelerated neutrinos. Those could be generated if neutrinos are attracted by baryonic matter, thus accumulating in its vicinity. Neutrinos, having half−integral spin, are subject to the Pauli principle[18], and that leads to the fact that they have to adopt higher and higher energy states, the more of them are concentrated in a confined region of space. As it is the case concerning electrons, neutrinos also may at most occupy their respective orbitals in pairs; if such an orbital is „full“, the next neutrino has to jump on a higher orbital. That leads to the situation that huge amounts of slow and high−energy neutrinos accrete in the vicinity of major matter aggregations, and it becomes obvious why those clouds of dark matter do not simply sink into stars or other celestial bodies, because gravitation would normally suck them in; the Pauli principle stands against it.

The graviton is the analogon of the photon; a neutrino coupling a suitable graviton increases its main quantum number accordingly. Of course that applies also to the proton, but the neutrino is the feeblest partner in that couple; in this analogon of an atom the mass difference is so huge that, raising the main quantum number by one, greatly increases the radius of the neutrino orbit, while that of the proton nearly stays unchanged. The consequence of this and the Pauli exclusion principle is that the neutrino is pushed out of the baryonic matter accumulation, while the proton is sinking in.

Another phenomenon easy to explain with this model is the supernova.

An ordinary nova occurs if the respective star is beginning to burn the iron which was created and accumulated by previous fusion processes in its core. Because the fusion of iron to heavier elements is an endothermic reaction, the star looses energy. The radiation pressure which previously opposed itself to the gravitational pull of the stars mass becomes gradually weaker, so that in consequence, the star collapses temporarily, only to become a nova afterwards, as soon as a certain pressure maximum is reached in its core.

The supernova shows a comparable behaviour, only on a larger scale, but for its explosion, neutrinos are responsible in the first place.

Just before exploding as a supernova the extremely high density of matter in the core of the star increases, thus neutrinos are gradually slowed down on their journey through it. It's often quoted that a neutrino is able to cross more than 3,000 light−years of lead with a probability of 50 percent. But in the core of extremely massive stars which eventually become supernovae, matter is very dense, exceeding the density of lead by many orders of magnitude, hence even neutrinos are noteworthy slowed down by it. In extreme cases this process leads to neutrinos reaching their rest energy, which is very much bigger than their mass energy compensated by the negative binding energy in the atom analogons; the authors first estimates hypothesise a neutrino rest mass about 500 to 2,000 times smaller than that of the electron. This slowing down of the neutrinos and the associated raise of neutrino mass energy sucks lots of kinetic energy from the particles in the stars core, hence, comparable to the processes in a nova, gravitational pull wins and causes the star to collapse, and in this case that's happening much more violently than in a nova, in the first place because stars able to become supernovae have a much bigger mass.

Back to equation (115.12). N_M or rather N_p, the total number of protons in the universe, if its whole mass consists of baryonic matter (the electron mass is neglected here, because nowadays, it is approximately 1,836 times smaller than the proton mass), is only valid in this form in the case of an ideal Eddington uranoid. In the real world and right from the start, hydrogen atoms were never evenly distributed throughout the universe. Matter was accumulating in vast regions of space during universal expansion, having consequences for the neutrinos included in this model, as it was already depicted above. So neutrinos were and are still slowed down by the physical effects explained earlier, what leads to the fact that a considerable fraction of mass in the universe turns up as dark matter.

In its present version, this model isn't able to theoretically explain the partitioning of baryonic and dark matter.

At the most the model may be able to bring forward some general statements to the topic of dark energy, but the author wants to leave the necessary calculations to others. He himself is simply much too laizy. After all, he's a cab driver...

If one looks at the universal mass creation rate C_{Un}, it's obviously not significantly smaller today than at M ≈1. Without perfoming a more thorough derivation here, the author refers to the fact that according to equation (96.5) the universal mass increased by 75% from M =1 to M = 2, what corresponds to three Planck masses, while seemingly 9 translative Planck times elapsed, thus expanding the distance between the test particle and the horizon from 1 (at M =1) to 10 Planck lengths. C_{Un1} equals approximately 1/3 $c^3/G \approx 1.3 \cdot 10^{35}$ kg/s, while, according to equations (130.4) und (140) combined with $cT_{Un} \approx 2 \cdot \Delta X$, the universal mass M_{Un} in relation to the age of the universe, T_{Un}, is nearly exactly equal to 10^{35} kg/s, what allows the deduction that nowadays, the mass creation rate is about 30% smaller than immediately after the Big Bang. The assumption seems likely that this trend finds its continuation in the future. Anyway, the density of matter in the universe in this model lies distinctly above the critical boundary[19] of $5 \cdot 10^{-27}$ kg/m³, thus with (130.2) approximately at

$$\frac{M_{Un}}{V_{Un}} \approx \frac{\frac{1}{2}\,\Delta X\, c^2 / G}{2\,\pi^2\,(2 \cdot \Delta X / \pi)^3}\,, \qquad (149)$$

where V_{Un} is the 3−surface of a 4−sphere with a radius of curvature **R** = $2 \cdot \Delta X / \pi$. The author assumes a hypersphere as uranoid, quite as Eddington did it before.

With (149) that yields

$$\frac{M_{Un}}{V_{Un}} \approx \frac{c^2 / G}{32 (\Delta X)^2 / \pi} ;$$

what results in

$$\frac{M_{Un}}{V_{Un}} \approx \frac{\pi \cdot c^2 / G}{32 (\Delta X)^2} ;$$

numerically with (136), (140) and c = $2.99792458 \cdot 10^{8}$ m/s as well as $\pi \approx 3.141592654$, that results in

$$\frac{M_{Un}}{V_{Un}} \approx 3.10359 \cdot 10^{-26} \text{ kg / m}^3 ; \qquad (149.1)$$

this value lies distinctly above the already mentioned density boundary of $5 \cdot 10^{-27}$ kg/m³, what means according to Einstein that the universe will collapse again after the expansion era.[19]

Because equation (149) comes along with the assumption that the universe is a 3−surface of a 4−sphere, whose radius of curvature is **R** = $2 \cdot \Delta X / \pi$, this model is at odds with cosmic inflation. But on a large scale, the universe is apparently „flat"; apart from regions with bigger mass conglomerations, spatial curvature doesn't show up. Inflationary models explain this fact by postulating an universal extent vastly beyond the horizon, so that the „small" region inside the horizon seems to be unbent. But that is in complete contradiction to the basic assumptions of the cosmological model presented in this paper.

What does the author bring forward in order to explain the obvious lack of evidence for spacial curvature?

For that purpose the reader may redirect his attention to fig. 2 in chapter I.

There, a lower−dimensional image of the universal hypersphere is shown. One can easily see that the points A and B which lie on the equator of the 3−sphere (i.e. its lower−dimensional replica), representing two test particles elements mutually inexistent, are connected to point C by two lines enclosing a right angle. The isosceles triangle which lies in the surface of the sphere has an angular sum of 270°, quite in contrast to a normal triangle in an unbent surface with an angular sum of 180°.

The curvature of the sphere is irrelevant for the elements of the test set represented by the points A and B; it's simply not observable for them. Not before considering, that „seen" from the points B and C the connecting lines B–A and C–A enclose an angle of 90°, as well as „seen" from the points A and C, the connecting lines A–B and C–B form also a right angle, it becomes obvious that this can only work if the surface of the lower−dimensional image is bent.

All that doesn't only apply to an universe at M =1, but is also valid for all others. In order to detect the curvature of spacetime one would need to send a spacecraft very far away from the solar system, so that aside from local perturbations, the curvature of the whole universe would become relevant; this probe should then perform angular measurements related to very distant objects, which afterwards would have to be compared with equivalent measurements on earth. That's simply not realisable.

However, spacial curvature causes another phenomenon. On the 3−sphere in fig. 1 the distance between the points A, B and C is equal. But if the surface is unbent, the distance between A and B is √2 times the distance between A and C as well as B and C according to Pythagoras, and that's nearly one and a half times more. Hence, for the test particle which is defined by the elements A and B, the extent of an object C (if it isn't merely a mathematical dot) seems to be larger than in C's own present.

And that is absolutely compatible with the assertions in this model. For example a proton, which nowadays has a radius r_p , as seen from a distance of, let's say, 6.9 billion light−years, i.e. more or less half−way to the universal horizon, has in its own present a radius which is about √2 times smaller. And that doesn't only apply to the proton, but also to everything else, for example its Compton wavelength. And if the latter is that much smaller, than the protons rest energy has to be that much bigger!

The reason for all this is based on the authors postulate that the test set is the measure of all things. The proton hovering there in a distance of 6.9 billion light−years is a particle defined by elements of the test set. These elements always have the same properties they also have in the current test set; everything seen by a contemporary observer in distant cosmic realms must therefore show all attributes of nowadays matter. If by use of some hypothetical time machine one would have a look at the world as it presented itself to a test particle lying at the universal equator as seen from the present, one would measure a proton radius equal to $r_p/\sqrt{2}$, and the proton rest mass would be √2 times bigger than today; the distance between the test particle and the universal antipole would also be smaller by this factor √2, and the universe itself would be √2 times younger.

The more one would approach the universal horizon, the more extreme this effect would be. The author didn't check that until now, but he suspects that the inflation assumed immediately after the Big Bang by so many cosmologists could be explained by the effect depicted above; though the universal expansion never took place with superluminal velocity, a nowadays observer gets such an impression, simply because at the beginning, the universe seemed to expand extremely fast, until it seemed to have reached a considerable extent after an extremely short time – which, seen from an hypothetical observer at that time, would correspond to the most minute distances and a very young universe. The gravitational waves detected by BICEP [20] are also predicted by the authors model; after the initial state of the universe, as the matter/energy density gradually decreased while translative time went by, it must have happened that the neutrinos which at that time were much more massive than today jumped down from higher orbitals of the atom analogons on lower ones, formerly blocked by the already described Pauli principle, thus emitting high−energy gravitons, i.e. gravitational waves.

And now some last remarks concerning the image number M.

The quantum state defined by M is not that of the universe, what would be complete nonsense in the eyes of the author. But it is a quantum state of the test set.

And alike all decent atoms the latter also tends to reach a low−energy state. If M is a number around 10^{40}, what corresponds to its nowadays value, nothing is to be said against it that the test set is able to instantly change from this state to the lowest−energy ground state, i.e. at M =1. „Instantly“ doesn’t have to do anything with translative time, it’s happening in a kind of meta time. Translative time is only an effect giving the subject having chosen a specific test set the impression of time going by, while the subject actually chooses a sequence of test sets according to an appropriate algorithm with a steadily increasing image number M. The subject could also choose something else, for example a sequence of states in cyclic time.

Something else is notable, concerning the cosmological model presented here; the striking relationship to the periodic table of the elements. While at M =1 only hydrogen atoms may exist, at M = 2 also deuterium is realisable as a test set. A D atom contains a proton and a neutron. The proton has a down quark, the neutron even two of them. And each down quark has an anti−T rishon as an element, while three of them are needed to form an electron. Thus a deuterium nucleus is an absolutely sufficient test set at M = 2; aside from it there would also exist one electron, eleven neutrinos / antineutrinos (because one neutrino is necessary to generate the neutron in the deuterium nucleus) and one electron−positron pair, or an equivalent amount of photons in the remaining universe. This makes it obvious that starting with M = 2 even small amounts of antimatter may be created, but they cannot stay in existence for long, because collisions with matter occur much too frequently.

Tritium is not yet realisable at M = 2, because there are five anti−T rishons in its nucleus, what implies at least an image number of 3. This applies also to helium−3, because four anti−T rishons reside in its nucleus.

Conclusion

The cosmological model presented here leads to results corresponding to observed values confined by tolerable error margins, if an approach based on simple set theory is used, as it was depicted in chapter I. Hence the world cannot only be described with the help of mathematical methods, but it is itself a mathematical structure, and that’s a straightforward explanation for the fact that it obeys mathematical rules.

The author doesn’t entertain the slightest doubt about the fact that most readers of this paper have difficulties with the notion that the world is composed of elements of a test set, and it can be read between the lines that this test set corresponds to the spirit or rather the consciousness of an observer (the so−called "subject"), although this wasn’t yet explicitly claimed in this paper. In other words, the observer structures himself and with it the test set; he chooses, whether knowingly or unconsciously, and thus influences the structure of the universe in an essential extent, because the very fabric of the world depends on the structure of the test set.

It cannot be dismissed that such an approach is not only extremely relevant in physical, but also in metaphysical respect, if it matches reality, as the results well within the fault tolerances suggest in chapter III. Even theologically significant consequences arise, whose discussion would surely go well beyond the scope of this paper.

It shall only be mentioned here in this context that the model leans on Plato’s Cave Allegory; the power set of the test set definitely has some resemblance to Plato’s world of ideas.[21]

Appendix A: Values of Fundamental Physical Constants

Gravitational constant	$G = 6.67384(80) \cdot 10^{-11} \cdot kg^{-1} \cdot m^{3} \cdot s^{-2}$;
Velocity of light in a vacuum	$c = 2.99792458 \cdot 10^{8}$ m/s ;
Planck's constant / 2π	$h = 1.054571726(47) \cdot 10^{-34} \cdot kg \cdot m^{2} \cdot s^{-1}$;
Elementary electric charge	$e^{*} = 1.518906630(33) \cdot 10^{-14} \cdot kg^{½} \cdot m^{3/2} \cdot s^{-1}$;
Proton rest mass	$m_p = 1.672621777(74) \cdot 10^{-27}$ kg ;
Neutron rest mass	$m_n = 1.674927351(74) \cdot 10^{-27}$ kg ;
Electron rest mass	$m_e = 9.10938291(40) \cdot 10^{-31}$ kg ;
Sommerfeld fine structure constant	$\alpha = 7.2973525698(24) \cdot 10^{-3}$;
Ratio of proton to electron rest mass	ß = 1,836.15267245(75) ;

Ratio of electrical to gravitational attraction in the Bohr model of the hydrogen atom

$\gamma = 2.26881(25) \cdot 10^{39}$;

Planck mass	$M_p = 2.17650(17) \cdot 10^{-8}$ kg ;
Planck length	$R_p = 1.61620(1) \cdot 10^{-35}$ m ;
Planck time	$T_p = 1.70480(1) \cdot 10^{-43}$ s ;

Appendix B: Conversion Factors Between Units

1 C = $9.48026993 \cdot 10^{4} \cdot kg^{½} \cdot m^{3/2} \cdot s^{-1}$;

1 A = $9.48026993 \cdot 10^{4} \cdot kg^{½} \cdot m^{3/2} \cdot s^{-2}$;

1 V = $1.05482229 \cdot 10^{-5} \cdot kg^{½} \cdot m^{½} \cdot s^{-1}$;

1 Ly = $9.4604715 \cdot 10^{15}$ m ;

1 a = 31,556,736 s .

Appendix C: Key to Special Terminology

Color: An attribute of epsilons and in consequence of all particles not built of equal amounts of them colored ’red’, ’green’ and ’blue’ each. Of all those, the particles called ’quarks’ are the best−known.

Cyclic: An adjective to characterise a time dimension perpendicular to the time dimension (normally?) perceived by humans which is called ’translative’ in this paper.

Epsilon: The most fundamental (and ’smallest’) particle in this universe. Depending on the ’image number’ M, it carries (and is defined by) a specific electric charge, it moves with a specific velocity and has a specific mass. It may only move into one of three possible directions, and this attribute is called ’color’. Epsilons lack inner structure, hence they may be handled as Black Holes. As translative time goes by, they are getting smaller and smaller.

Image: The subject’s quantum state. It is characterised by an ’image number’ M, the latter obviously becoming bigger and bigger while translative time goes by. M stays constant if only cyclic time elapses.

Mixed: An adjective used to describe particles themselves built of a mixture of uni− and varicolored particles.

Object: An observed event. The set−theoretical approach is that an object is an element of a subject. ’Positive’ objects correspond to observations, ’negative’ objects are so−called ’non−observations’.

Rishon: Fundamental particle proposed by Haim Harari.[10] Here in this paper, a rishon always consists of pairs of epsilons and is thus colored.

Subject: A perceiving observer. Here in this paper, the approach is that a subject is a set defined by its elements called ’objects’. A subject is at rest by definition.

Test set: A set chosen by the subject by adapting his structure to that of the test set. It has to be congruent with the subject’s structure (or perhaps with a part of it). The smallest possible test set is a particle, also called ’test particle’, which in this universe is a proton.

Translative: Here, in this paper, ’translative’ is an adjective used to characterise the time dimension (normally?) perceived by humans.

Unicolored: Particles consisting of epsilons all having the same color.

Uranoid: Model of the world in which uniformly distributed particles exist (i.e. protons and electrons) whose temperature is 0°Kelvin, so that al l particles are at rest relative to each other.

Varicolored: Particles consisting of epsilons having different colors.

World: A set defined by elements which are subsets of the subject, and therefore at least a subset of the power set of the subject.

Appendix D: Bibliography

1: Singh, Jagjit: Modern Cosmology. Penguin Books Ltd., England, 1970. A summary of Eddingtons considerations can be found on pages 248−250.

2: Sartre, Jean−Paul: Being and Nothingness. Translation by Hazel E. Barnes, University of Colorado, 2nd revised edition, original french publication 1953 (1st edition of the french publication 1943). Page xlvi.

3: Andrade e Silva, J. und Lochak, G.: Quanta. World University Library, 1969. Pages 179ff.

4: Kasch, F., Pareigis, B.: Grundbegriffe der Mathematik (translated title: 'Fundamental Terms in Mathematics'). 2nd revised and extended edition. Verlag Uni−Druck, München, Germany, 1978. ISBN 3−87821−057−4.

Translation of pages 38−39 and page 31 (the definition of the subset axiom):
„During the first development phase of set theory no restrictions concerning set formation were made. The general belief was that any condition (predicate) would define the 'performance quantity of this predicate', i.e. the set of all objects satisfying this condition. Thus it would make sense to talk of the 'set of all sets'. B. Russell (1872−1970) was the first to notice that this approach leads to contradictions (Russell's Antinomy).

We will consider that for each set A there exists a set $B \notin A$, so that no set may exist which contains every set as an element; [the] subset axiom [reads as follows] :

'Let B be a set and let $\mathrm{A}(x)$ be a predicate. Then a subset A of B exists containing exactly those elements $b \in B$ for which $\mathrm{A}(b)$ is true. For A we write

$$A = \{ b \mid b \in B \wedge \mathrm{A}(b) \} .'$$

[According to this axiom,]

$$U := \{ a \mid a \in A \wedge a \text{ is a set} \wedge a \notin a \}$$

is a subset that exists for each set A; because every set is also an element ($A \in \{A\}$), the statement $a \notin a$ makes sense.

Assertion: $U \notin A$.
Proof: Let be $U \in A$, then we distinguish two cases.
1st case: $U \notin U$, then follows (because $U \in A$) $U \in U$. Contradiction !
2nd case: $U \in U$, then follows (because $U \in A$) $U \notin U$. Contradiction !

Hence, in each case, the assertion $U \in A$ causes a contradiction, therefore the statement $U \notin A$ has to be true."

5: Einstein, Albert: The Meaning of Relativity. Fifth Edition. Including the Relativistic Theory of the Non−Symmetric Field. Princeton University Press, Princeton, New Jersey, U.S.A., 2nd Princeton Paperback Printing, 1970. ISBN 0−691−02352−2.

6: Hawking, Stephen W.: A Brief History of Time. Updated and expanded tenth anniversary edition. Bantam Books, New York, New York 10036, U.S.A., 1998. ISBN 0−553−10953−7 — ISBN 0−553−38016−8. Page 134.

7: Gerthsen/Kneser/Vogel: Physik. Springer−Verlag, Berlin/Heidelberg/New York, 1977 (13th edition). ISBN 3−540−07876−2. Pages 29−30.

8: Misner, C., Thorne, K. S., Wheeler, J. A.: Gravitation. W. H. Freeman, San Francisco, U.S.A., 1973. ISBN 0−7167−0344−0. Pages 878−883, Box 33.2 (Kerr−Newman Geometry and Electromagnetic Field).

9: Zeidler, E. (publisher): Taschenbuch der Mathematik, Teil I. B. G. Teubner, Stuttgart, Leipzig, 1996. ISBN 3−8154−2001−6. Page 353. There’s also a British edition: Oxford Users’ Guide to Mathematics (corresponds to ’Teil I.’/part I.). Same publisher as for the german edition, Oxford University Press. ISBN 978−0198507635.

10: Harari, Haim: The Structure of Quarks and Leptons. Scientific American, Volume 248, New York, U.S.A., April 1983. ISSN 0036−8733. Pages 48−60.

11: Adams, Douglas: The Hitchhiker’s Guide to the Galaxy. Pan Books, London, UK, 1979. ISBN 0−330−25864−8.

12: http://wwwex.physik.uni−ulm.de/lehre/ap−2012/ap−2012se11.html :

A „classical proton radius“ may be deduced exactly like a classical electron radius.

Let the electric charge density of a homogeneously charged sphere with the radius r_p be ρ_{el}; then the charge of this sphere is

$$Q(r_p) = \frac{4 \cdot \pi}{3} \cdot \rho_{el} \cdot r_p^3 \,; \qquad (150)$$

assuming the charge density is kept constant, and if a spherical shell with the thickness dr_p is added, its charge is

$$dQ(r_p) = 4 \cdot \pi \cdot \rho_{el} \cdot r_p^2 \, dr_p \,; \qquad (151)$$

The charge Q works on a test charge dQ in the distance r_p from the centre of Q with the force

$$F(r_p) = \frac{Q \, dQ}{r_p^2} \,;$$

Now, if Q is locked in place and a dQ infinitely far away is brought into the distance r_p from it, the following energy is needed to perform this:

$$dE_{pot}(r_p) = -\int_{\infty}^{r_p} F(r_p)\, dr_p = -Q\, dQ \int_{\infty}^{r_p} r_p^{-2}\, \mathbf{d}r_p = Q\, dQ\, r_p^{-1}\ ;$$

the total energy contained in the uniformely charged sphere is with (150) und (151)

$$E_{pot.tot} = \int_0^{r_p} dE_{pot} = \int_0^{r_p} Q\, dQ\, r_p^{-1} = \int_0^{r_p} 1/3 \cdot 4 \cdot \pi \cdot \rho_{el} \cdot r_p^3 \cdot 4 \cdot \pi \cdot \rho_{el} \cdot r_p^2 \cdot r_p^{-1}\, dr_p = \frac{(4\pi)^2 \cdot \rho_{el}^2 \cdot r_p^5}{15}\ ;$$

the charge density can be replaced by

$$e^* = \frac{4\pi\rho_{el} r_p^3}{3}$$

thus the result for an uniformely charged sphere is

$$E_{self.homogen}(e^*, r_p) = \frac{3\, e^{*2}}{5\, r_p}.$$

This energy is set equal to the relativistic rest energy of the mass m_p:

$$m_p c^2 = \frac{3\, e^{*2}}{5\, r_p}\ ;$$

and that yields

$$r_p = \frac{3\, e^{*2}}{5\, m_p c^2}\ ;$$

that’s what one might call a „classical proton radius“, if the electric charge is evenly spread inside the proton’s spherical interior.

On the other hand, in order to calculate the classical proton radius there’s also the option to assume that the whole electric charge is spread evenly over the surface. For this purpose, the electric field of a charge e* is examined:

$$\mathit{E}(r_p) = -\frac{e^*}{r_p^2}$$

and the energy density on the outside of this charge is

$$w(r) = \frac{1}{8\pi} \cdot \left[-\frac{e^*}{r^2} \right]^2 = \frac{e^{*2}}{8\pi \cdot r^4} \; ; \qquad (152)$$

the energy content of the electric field outside of the sperical coordinates is

$$E_{Feld} = \int_{r_p}^{\infty} \int_{0}^{\pi} \int_{0}^{2\pi} w(r) \cdot r^2 \cdot \sin(\vartheta) \cdot dr \cdot d\vartheta \cdot d\phi \; ;$$

$$E_{Feld} = 4\pi \cdot \int_{r_p}^{\infty} w(r) \cdot r^2 \cdot dr \; ;$$

with (152) :

$$E_{Feld} = 4\pi \cdot \int_{r_p}^{\infty} e^{*2} \cdot 1/8\pi \cdot r^{-4} \cdot r^2 \cdot dr \; ;$$

$$E_{Feld} = ½ \cdot \int_{r_p}^{\infty} e^{*2} \cdot r^{-2} \cdot dr \; ;$$

$$E_{Feld} = e^{*2}/2 \cdot \int_{r_p}^{\infty} r^{-2} \cdot dr \; ;$$

$$E_{Feld} = \frac{e^{*2}}{2} \cdot \frac{1}{r} \Bigg|_{r_p}^{\infty} \; ;$$

$$E_{Feld} = \frac{e^{*2}}{2r_p} \; ;$$

and by equalising with the relativistic rest mass m_p the result is

$$m_p c^2 = \frac{e^{*2}}{2r_p} \; ;$$

transformed:

$$r_p = \frac{e^{*2}}{2m_pc^2}.$$

13: http://www.nist.gov/pml/index.cfm, Status May 2015.

14: Planck Collaboration (2013) – Ade, P.A.R. et al. (275 other authors): Planck 2013 results. I. Overview of products and scientific results, Table 9. Astronomy & Astrophysics, 2013. arXiv:1303.5062 [astro−ph.CO].

15: Planck 2013 Results Papers, European Space Agency, 2013.

16: Planck Collaboration (2013) – Ade, P.A.R. et al. (275 other authors): Planck 2013 results. XVI. Cosmological Parameters. Astronomy & Astrophysics, 2013. arXiv:1303.5076 [astro−ph.CO].

17: http://de.academic.ru/dic.nsf/dewiki/1302654

18: Gerthsen/Kneser/Vogel: Physik. Springer−Verlag, Berlin/Heidelberg/New York, 1977 (13th edition). ISBN 3−540−07876−2. Pages 728−729.

19: Misner, C., Thorne, K. S., Wheeler, J. A.: Gravitation. W. H. Freeman, San Francisco, U.S.A., 1973. ISBN 0−7167−0344−0. Page 782.

20: http://www.seti.org/weeky−lecture/inflationary−cosmology−biceps

21: Rehn, Rudolf (Hrsg.): Platons Höhlengleichnis. Das siebte Buch der Politeia (translated title: 'Plato's Cave Allegory. The Seventh Book of the Politeia'). Dieterich'sche Verlagsbuchhandlung, Mainz 2005, ISBN 3−87162−062−9 (greek text with added translation and annotations but without body of criticism; introduction by Burkhard Mojsisch).

22: Evans, Lawrence C.: Partial Differential Equations. American Mathematical Society, Providence (RI), U.S.A., 1998. ISBN 0−8218−0772−2.

© Alfred Kühne, Teufelsgrabenweg 2A, 83626 Grub/Valley, Bavaria, Germany
Tel.: +49(0)8095−35.83.862
E−Mail: alfred@snake.de

[The translation of the original german text was achieved by the author himself on March 3rd, 2016]