A Cosmological Model

by Alfred Kühne

(Third and Final Revised Proofred Edition)

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

[This is a translation of the German paper
„Ein kosmologisches Modell –
Dritte überarbeitete und korrigierte Endauflage,
Update 2“]

Summary

Starting from the mathematical definition of a pair in set theory[1], the author describes the get−go of universal expansion as a purely mathematical scenario. This preimage[2] belongs to the Platonic world of ideas[3]. According to the definition of the observer of the world as a set, besides a „null“ assumption of the Platonic world of ideas[3] being a (meta)mathematical continuum, three philosophical assumptions are made; it's assumed that the existence of something requires, that also its complementary equivalent exists (comparable to the yin−and−yang concept from Chinese Daoism[4]), whereby in the context of this assumption it is demanded that in the case of their unification, both cancel each other completely, just as it can be observed in reality with particles and their anti−particles; furthermore it is assumed that the observed world is nothing else than its effect on the observer[5], and furthermore that this observer can only perceive structures if they are congruent to its own structure. From this the solipsistic conclusion could be drawn that only the observer is real. But this solipsistic point of view is then refuted by Russell's antinomy[6]. An observer as a set conditions according to the power set axiom[7] also the existence of its power set. Here, a simplest possible universe is considered; i.e., that in this model of all elements of the power set of the observer only those virtual or real exist, which are absolutely necessary for the existence of an universe. From the two original virtual „particles“ of the model, pure mathematical objects, result two different universes. In one of them, one particle maps onto the other one, and in the other one the other particle maps onto the one. Both mappings are in each case a pair in the set−theoretical sense. And a pair is defined by three elements, of those one being defined by the other two. Therefore, a subset of the subset, or of the element, or of the element of the element, or of the element of the element of the element (etc., etc. – but this is not to be understood in the sense of infinite regress, which will become clear in the further course of this treatise[8]) of the subset of the Platonic world of ideas[3], which is the power set of the observer, has to be the universe, in the simplest case in addition to the set of the pair with still exactly one further subset of this set with the only element to which the mapping was done in the universe in question, just because of the assumption that for every fundamental particle also an anti−particle exists in the universe. Instead of the Zermelo−Fraenkel set theory[9] with its foundation axiom[10] the so−called „basic“ set theory is used, because the author uses Russell's antinomy[6], as already mentioned, which provides a helpful explanatory possibility in the presented model. Then, the common element of the observer and the only other subset contained in this simplest possible universe is subjected to an artifice. Two physical properties are assigned to it, cancelling each other completely, namely mass and electric charge. Masses attract each other, electric charges of the same polarity repel each other. Since the relevant common element must have exactly the same properties both in the observer and in its counterpart, the other existing subset, the introduction of the properties „mass“ and „charge“ does not change the mathematical model. Thus, however, from these two now newly introduced physical conclusions on further physical relations in the model considered here can be drawn. For example, it is concluded that in this mini−universe the Reissner−Nordstrøm metric is valid[11].

Each result of a mapping gets a number M, the „frame number“. The starting situation with the two primordial particles, which are actually only mathematical objects, is marked with M = 0, the result of the first mapping gets the number M = 1. M is a quantum number. The related observable is the mass/energy of the test set (another term for the set called so far „observer“). The author also calls this observer „subject“ and its elements „objects“. Subsequently, the situation at M = 2 is discussed in great detail. Using approaches of Sir Arthur Eddington[12] and the formula for Gaussian error propagation[13] the author shows that also for M >1 and even for M » 1 the Reissner−Nordstrøm metric[11] is valid, but not the Friedmann−Lemaître−Robertson−Walker metric[14]. The situation represented for M = 1 corresponds to the so−called big bang. Finally, the present universe is discussed. Surprising connections between some nature constants (among those the fine structure constant[15]) can be shown, which were not known so far in such a way.

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. Relationship between electromagnetism and gravitation
4. Quarks, subquarks and their structure
5. Properties of particles (especially of those called protons, electrons and neutrinos)
6. Asymmetry between matter and antimatter in the universe
7. Expansion of the universe – why does that happen?
8. Significance of the so–called „Big Cosmic Numbers“
9. Relationship between smallest and biggest possible error of distance measurement
10. The universe – how big is it and its mass?
11. Dependency between the Fine Structure Constant and the ratio of proton to electron mass (which according to this model have changed while the universe expanded)
12. Dark matter – what is it?

And the universal validity of Albert Einstein's theory of *special* relativity[16] (SRT) can be shown, even for the very beginning of cosmic expansion.

The model handles particles 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.

Introduction

In this paper it is assumed that

1. the most elementary and fundamental building blocks of the universe are purely mathematical objects without physical properties, totally in the sense of Max Tegmark, as he writes in his book „Our Mathematical Universe“.[17] These objects appear only as complementary pairs, as one knows it also from physical elementary particles, which arise as particles and antiparticles.

First, the simplest possible case is considered, namely two of these said mathematical objects defining a set in the sense of basic set theory (*not* Zermelo–Fraenkel[9]) – other–wise nothing exists in this theoretically postulated universe. Then it is examined what kind of mathematical relation exists between them. Two further assumptions are included here:

2. 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“: 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. [18]

3. Perception is dependent on the observer, who in the following will be called „subject“, in the sense that his own structure allows only perceptions, whose structures find a correspondence in this own structure – what filters out all perceptions which do not correspond to any structures of the subject. In last consequence, such an approach is the result of a well–known thought experiment: Schrödinger's cat.[19]

From the above three assumptions, the author draws the conclusion that all perceived objects are contained in the subject, which leads him to the mathematical statement that the subject is a set whose elements are objects. He introduces the concepts of positive and negative perception, the latter being simply a perceptual pause associated with perception, or perhaps better, a perceived pause.

The author replaces the term „perception“ by „object“. Thus, it can now be said that the subject is a set whose elements are positive and negative objects.

Because the statement that all perceived objects are contained in the subject can easily lead to the erroneous conclusion that the model presented here postulates the exclusive existence of the subject and thus corresponds to a solipsistic worldview[20], the author shows with the help of Russell's antinomy[6] that this cannot be so.

Since it follows from the 2nd and 3rd assumption that only what acts on a subject is really existent, the components of the subject have to act on each other again and again to maintain their existence. Thus the subject becomes gradually more and more complex. If in the simplest possible case there are still two existent objects, as described above, there are already three objects after their mapping on each other, as the author will show in the first chapter of this treatise. The 1st assumption enforces thereby the real existence of a further subset of the subject, which is defined by only one of the three elements of the subject, namely the one, on which the above mentioned effect took place. This has the consequence that now four elementary objects exist in the universe, of which three define the subject as described, and one of these three defines the only otherwise real existing subset of the subject. The author gives the names epsilons (ε) and anti–epsilons (ε) to the elementary objects, respectively. The number of the epsilons virtually and really existing in the universe is according to the 1st assumption equal to the number of the anti–epsilons virtually and really existing in the universe.

So, here a development of the universe is described in quantum leaps which correspond to the respective imaging process. This happens probably in the direction of the arrow of time perceived by man, but this shall be proved in this paper. The simplest possible case is assigned the quantum number M = 0, the so–called frame number. The first imaging process is followed by the case M = 1, and with each further imaging process M increases by a whole number ($M \in \mathbb{N}_0$). As already mentioned, the observable to this quantum number is the mass or energy of the subject, which the author also calls „test particle“ or „test set“.

At M = 1 now the real trick follows which is definitely a thorn in every mathematicians flesh; arbitrarily, the author introduces two physical properties of the epsilons or anti–epsilons which, however, cancel each other completely. One is mass, the other electric charge. The author considers this to be admissible because he introduces these two properties in a way which does not influence or change the underlying mathematical model in any way. He assigns such a mass to the epsilon or anti–epsilon, to which the mapping is done at M = 0, that their gravitational attraction exactly cancels the electro–magnetic repulsion between two epsilons or anti–epsilons with the same charge sign (see **point 3 of the 12–point–list** at the end of the summary: **Relationship between electromagnetism and gravitation**). Obviously, the electromagnetic charge of the epsilons has the opposite sign to that of the anti–epsilons. It should be referred here to the conclusion of the 10th chapter of Max Tegmark's book „Our Mathematical Universe“[17]; the penultimate point is: A mathematical structure can have many remarkable properties – symmetries, for example – even if neither its units nor its relations have any specific properties. And, by the way, translation and rotation, for example, can be described as breaks of symmetries. This is admissible, because these are properties of the mathe–matical structure as which the universe is described in this treatise, and not properties of the relations of the epsilons between each other.

The physical properties mass and electric charge are phenomena which exist in the present universe. If one introduces them into the model at M = 1 in the way described above and if one can then derive from them a model corresponding to the present universe with an M » 1, then the statement is certainly not inappropriate to call our universe an illusion. This fits very well to Plato's allegory of the cave[21]; for him the shadows on the back wall of the cave, which are seen by the prisoners held in the cave, are also only illusions; they are generated by the events outside the cave, analogous to a film projection on a cinema screen. What happens outside the cave, just like what happens in the projection device of the cinema, is reality, and what is projected is only the image, i.e. the illusion of a reality, depending on the projection surface – which itself, however, is something real. And the model described here says that the subject itself is this projection surface.

Chapter I.

The author defines the Platonic world of ideas[3,21] as the realm of the mathematically possible[22], whereby he, deviating from the original Platonism, also attributes mathematical describability to the good, beautiful and divine[23] (for example, calculation of an optimum, the golden section, cardinal numbers), thus these are also mathematical objects or propositions. In this realm of the mathematically possible, i.e. a mathematical continuum which itself is at least also a set, a set is given, which is defined by two elements ε and ε, complementary in such a way, that the existence of one of the two necessarily causes the existence of the other, and vice versa. The term existence is used here axiomatically at first, but in the course of this paper the author aims at an explanation of this term which follows quasi „en passant“ from parts of the derivation contained there–in.

N.b., with this approach the author imagines himself in consensus with Plato, of whom it is known that mathematics was not only of central importance in his curriculum[24], but was probably also interpreted by him as the sun or fire (at night), respectively, projecting in the cave allegory with emitted light the events in front of the cave on its back wall. Thus, according to the author, what is commonly regarded as physical reality is nothing but a projection of concepts from the realm of the mathematically possible, i.e. the Platonic world of ideas, in such a way that a physically describable universe results from these concepts. The author will show that this can easily be done. By the way, starting from the next but one paragraph, all sets and elements first of all get the index 1, apart from epsilon and anti–epsilon at M = 0, which get the index 0; the index stands for the frame number M.

It makes sense to start axiomatically from the statements[25] that, for every M,

a) between an element x and a set B there ist exactly one of both following relationships:
   $x \in B$,
   $x \notin B$;
b) there is at least one set;
c) for each element x there is at least one set B with $x \in B$.

If M = 1, let B_1 be the test set, i.e. the subject. Is it possible that the subject is the set of all sets? Here the following consideration provides an answer: Assume that for every set B_1 there exists a set A_1 with $A_1 \notin B_1$, so that no set may exist which contains every set as an element; then, the subsets axiom[26] reads as follows:

’Let A_1 be a set and let $\mathcal{A}(x_1)$ be a predicate. Then a subset B_1 of A_1 exists containing exactly those elements $a_1 \in A_1$ for which $\mathcal{A}(a_1)$ is true. For B_1 this is written as follows:

$$B_1 = \{ a_1 \mid a_1 \in A_1 \wedge \mathcal{A}(a_1) \} \text{ .’} \qquad (1)$$

According to this axiom,

$$U_1 := \{ b_1 \mid b_1 \in B_1 \wedge b_1 \text{ is a set} \wedge b_1 \notin b_1 \} \qquad (2)$$

is a subset that exists for each set B_1; because every set is also an element ($B_1 \in \{B_1\}$), the statement $b_1 \notin b_1$ makes sense.

Assertion: $U_1 \notin B_1$.
Proof: Let be $U_1 \in B_1$, then we distinguish two cases.

1st case: $U_1 \notin U_1$, then follows (because $U_1 \in B_1$) $U_1 \in U_1$. Contradiction !
2nd case: $U_1 \in U_1$, then follows (because $U_1 \in B_1$) $U_1 \notin U_1$. Contradiction !

Hence, in each case, the assertion $U_1 \in B_1$ causes a contradiction, therefore the statement $U_1 \notin B_1$ has to be true.[27]

In other words, the subsets of the subject B_1 are not elements of the subject, thus something else than the subject must exist – the assertion that B_1 is the set of all sets is therefore false.

The power set[7] of B_1 , i.e.

$$P(B_1) = \{ U_1 \mid U_1 \subset B_1 \} \,, \qquad (3)$$

is the set of all subsets of the test set B_1 . As epsilon as well as anti–epsilon are given elements here, so a set F_1 with $\varepsilon_1 \in F_1$ and a set G_1 with $\bar{\varepsilon}_1 \in G_1$ must exist, because the author started his line of reasoning with the axioms a), b) and c) on the previous page.[25]

Therefore, the sets

$$\{\varepsilon_1\} = \{ f_1 \mid f_1 \in F_1 \wedge f_1 = \varepsilon_1 \} \,, \qquad (4)$$

and

$$\{\varepsilon_1, \bar{\varepsilon}_1\} = \{ x_1 \mid x_1 \in F_1 \cup G_1 \wedge (x_1 = \varepsilon_1 \vee x_1 = \bar{\varepsilon}_1)\} \qquad (5)$$

must also exist.

Because $\{\varepsilon_1\}$ and $\{\varepsilon_1, \bar{\varepsilon}_1\}$ are sets, there is a set $\{\{\varepsilon_1\},\{\varepsilon_1, \bar{\varepsilon}_1\}\}$. This is an implication of the power set axiom[7], which states that if there is a set B_1 , another set called power set of B_1 has to exist, $P(B_1)$, which is defined by all subsets of B_1 as its elements; see eq. (3).[7]

So, the following applies:

$$P(\{\varepsilon_1, \bar{\varepsilon}_1\}) = \{ \varnothing \,, \{\varepsilon_1\} \,, \{\bar{\varepsilon}_1\} \,, \{\varepsilon_1, \bar{\varepsilon}_1\}\} \,, \qquad (6)$$

where $\varnothing$ is the empty set. And a subset of this power set is the pair, which is defined as follows:

$$(\varepsilon_1, \bar{\varepsilon}_1) = \{\{\varepsilon_1\} \,, \{\varepsilon_1, \bar{\varepsilon}_1\}\} \,. \qquad (7)$$

The author calls W_1 the „smallest possible world“ or „smallest possible universe“, what is in fact the subset of $P(B_1)$ which contains the smallest possible number of elements necessary to equate the quantity of elements $\bar{\varepsilon}_1$ with the quantity of elements ε_1 in the set union of the pair and aforesaid subset of $P(B_1)$:

$$W_1 := \{ \varnothing \,, \{\{\bar{\varepsilon}_1\}\} \,, \{\{\varepsilon_1\} \,, \{\varepsilon_1, \bar{\varepsilon}_1\}\}\} \subset ((\varepsilon_1, \bar{\varepsilon}_1) \cup P(B_1)) \,. \qquad (8)$$

This W_1 is the set representing the necessary minimum of everything virtually and really existent. The author calls

$$Z(B_1) := ((\varepsilon_1,\bar{\varepsilon}_1) \cup P(B_1)) \setminus W_1 \qquad (9)$$

the set of the necessary minimum of everything potentially existent. Thus, he makes a difference between „potentially“ and „virtually“ existent. Something virtually existent may anytime become really existent for the subject, whereas something potentially existent is unable to do so; the latter could eventually act on a differently structured subject in another universe.

The reader can now take from the above explanations that at M = 1 the subject in a matter universe corresponds to the pair $(\varepsilon_1,\bar{\varepsilon}_1)$. At M = 0 this pair does not exist, but only the set $\{\varepsilon_0,\bar{\varepsilon}_0\}$. The transition from M = 0 to M = 1 corresponds to the mapping of the element ε_0 to the element $\bar{\varepsilon}_0$. Thus, at M = 0 there is no subject, because this subject would have to be the result of a previous mapping, and M couldn’t be smaller than zero. The opposite case, i.e. the mapping from $\bar{\varepsilon}_0$ to ε_0 , would correspond to a pair $(\bar{\varepsilon}_1,\varepsilon_1)$; this would be the subject in an antimatter universe, if one would assign the properties „mass“ and „electric charge“ to the elements ε_1 and $\bar{\varepsilon}_1$ in it (see **point 6 of the 12–point list** at the end of the summary: **Asymmetry between matter and antimatter in the universe**).

Here at M = 1 the subject is the pair $(\varepsilon_1,\bar{\varepsilon}_1)$, as already stated above. From eq. (7) one can see that a subset of an element of this pair is the set $\{\{\bar{\varepsilon}_1\}\}$. It is the subset that is at least needed to achieve that at M = 1, there are as many elements ε_1 and $\bar{\varepsilon}_1$ to satisfy assumption 1. Thus, in the subset of the power set $P(B_1)$, which is W_1 , one has to deal with the elements $\{\{\varepsilon_1\}$, $\{\varepsilon_1,\bar{\varepsilon}_1\}\}$ and $\{\{\bar{\varepsilon}_1\}\}$, if one disregards the empty set $\emptyset$. As already repeatedly mentioned before, both ε_1 and $\bar{\varepsilon}_1$ have no physical properties, because they are pure mathematical objects. But it is possible to attribute such properties to them, if one takes care that the latter cancel each other completely; e.g. it is perfectly admissible to claim that epsilons and anti–epsilons are „bommely“ and „quastely“ at the same time, for example, without defining these two strange terms in more detail, but specifying that „bommely“ and „quastely“ cancel each other exactly – something equally „bommely“ and „quastely“ is thus outwardly neither „bommely“ nor „quastely“. If one assigns the properties „mass“ and „electric charge“ to both the elements ε_1 and $\bar{\varepsilon}_1$, the situation at M = 1 must not change by a whit. And this is achieved by the following equation:

$$m_\varepsilon^2 \cdot G = -Q_\varepsilon^2 \qquad \textbf{[4}^{\textbf{th}}\ \textbf{assumption]} \qquad (10)$$

in this equation let m_ε be the mass of an (anti–)epsilon, G the gravitational constant and

Q_ε the electric charge of an (anti–)epsilon; note that the index „1“ is not used here, i.e., the equation is valid for all M. This assumption expresses that the attractive force of the masses of the (anti–)epsilons is exactly equal to the repulsive force between two epsilons or two anti–epsilons. For M = 1 eq. (10) provides a computational entry point to describe the situation in a physical universe containing exactly one hydrogen atom, and nothing else.

So, if we assume that the actually purely mathematical objects ε_1 and $\boxed{\varepsilon_1}$ have the physical properties mass and electric charge as described above, what conclusions can be drawn for the situation at M = 1?

First of all, one has to do with a resting subject – in fact, the subject is at rest in relation to itself – this may sound funny now, and one could write, the subject rests in itself, which sounds almost meditative; but it is so, that the subject in this mini–universe at M = 1 corresponds to the observer, relative to whom everything happens in it. So here the SRT[16] comes into play. And then one can also say something about the common element in the subject as well as in the only further real existing subset of the subject, namely that both elements must always behave exactly the same, because they *are* the same element.

However, before the author turns to these two conclusions, i.e., first, the subject being at rest, and second, the like behavior of the element $\boxed{\varepsilon_1}$ in an element of the subject and the only additionally existing subset of the subject at M = 1, the energy theorem shall become the focus of attention.

$$E_{e1} = E_{e1}(v_{e1}=0) + E_{tot1}(e^-) \; ; \qquad (11)$$

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:

$$E_1(\varepsilon_1) = E_1(\boxed{\varepsilon_1}) \; ; \qquad (12)$$

where $E_1(\boxed{\varepsilon_1})$ is the energy of the element with a negative electric charge and $E_1(\varepsilon_1)$ one such with a positive electric charge.

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:

$$E_{e1} = E_1(\boxed{\varepsilon_1}) \; ; \qquad (13)$$

pursuant SRT[16] the following relation applies:

$$E_{e1} = \left[(p_{e1}c)^2 + \Big[E_{e1}(v_{e1}=0) + E_{pot1}(e^-) \Big]^2 \right]^{1/2} \; ; \qquad (14)$$

where p_{e1} is the momentum of the electron, c is the velocity of light in empty space, $E_{e1}(v_{e1}= 0)$ is the rest energy of the electron and $E_{pot1}(e^-)$ its potential energy.

The technically qualified reader will immediately recognize something unusual here; the mass energy of the electron at rest is combined with its potential energy; the potential energy is thus also subjected to the relativistic effect. This means that the potential energy moves with the electron, and one does not have to deal here with a potential field resting relative to the test particle, which will from now on be called „proton". In the opposite case, one would have a situation like the Aharonov–Bohm effect[28], and eq. (14) would have to read as follows:

$$E_{e1} - E_{pot1}(e^-) = \left[\, [(p_{e1} - q_{e1}) \, c \,]^2 + \Big[E_{e1}(v_{e1}=0) \Big]^2 \right]^{1/2} \; ; \qquad (14.1)$$

However, this would result in a wrong orbital velocity of the electron v_{e1} with a value of 0.8 c, as it unfortunately happened in previous versions of this paper[29,30], and a resulting contradiction to the result of the calculation of $v_{e1} = c$ from Bohr's quantum condition[31] was then falsely legitimized there by the introduction of two–dimensional time. q_{e1}, by the way, stands in eq. (14.1) for the so–called four–momentum[32].

The next important equation is

$$E_{tot1}(e^-) = E_{kin1}(e^-) + E_{pot1}(e^-) \; ; \qquad (15)$$

this means that the total energy of the electron $E_{tot1}(e^-)$ is the sum of the kinetic $E_{kin1}(e^-)$ and the potential energy $E_{pot1}(e^-)$ of the electron. Other energies of the electron are not considered in the model at M = 1, because the electron is only the mathematical object $\{\{\varepsilon_1\}\}$, which has no other properties except mass and electric charge, in particular it has no spin. As can be shown later, the electron at M = 1 is a Reissner–Nordstrøm–hole[11], and as such it does not rotate.

For the potential energy of the electron the following equation is valid, where the first right term results from Newton's law of gravitation[33] and the second right term from Coulomb's law[34]:

$$E_{pot1}(e^-) = - \frac{m_{p1}(v_{p1}=0) \, m_{e1} \, G}{r_1} - \frac{Q_{\varepsilon 1}^{\,2}}{r_1} \; ; \qquad (16)$$

here, $m_{p1}(v_{p1}=0)$ represents the mass of the proton at rest; v_{p1} is the velocity of the proton relative to the subject. m_{e1} is the mass of the orbiting electron acting on the proton, G is the gravitational constant[35], and r_1 symbolizes the so–called Bohr radius[36]. In this smallest possible universe at M = 1, the main quantum number n in the hydrogen atom may only have the value 1 – otherwise, that universe wouldn't be the smallest possible one. With the equation

$$M_{Un1} = m_{p1}(v_{p1}=0) + m_{e1} \qquad (17)$$

the complete universal mass at M = 1 is described.

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."[37] With these sentences he wanted to point up the fact that the positive mass–energy in the universe,

$$E_{Un1} := M_{Un1}\, c^2, \qquad (18)$$

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:

$$E_{pot1}(e^-) = -M_{Un1}\, c^2\ ; \qquad (19)$$

from now on, the elements of the proton will be called „quarks".

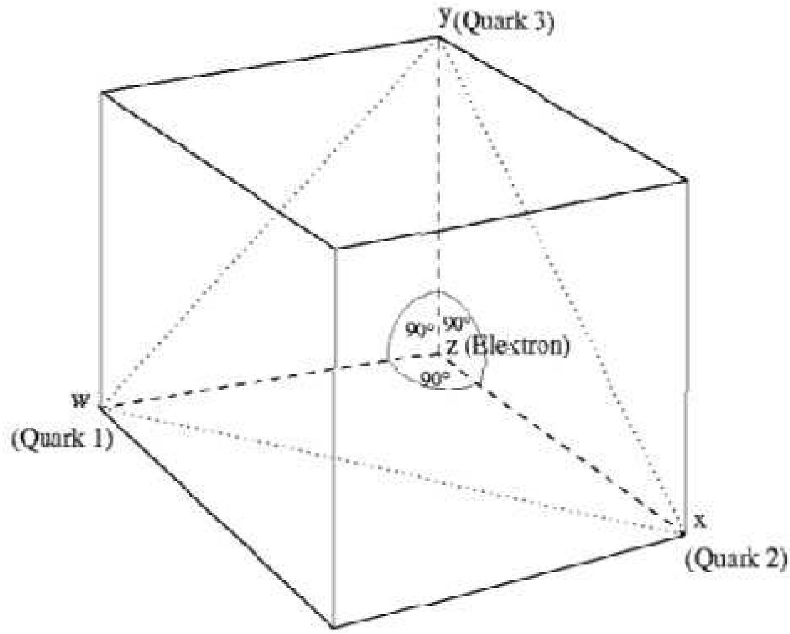

Fig. 1: Lower–dimensional representation of the universe at M =1. The right angles between the connecting lines to the electron are valid in an universe with a positive curvature; in threedimensional, unbent space these angles would amount to 60°

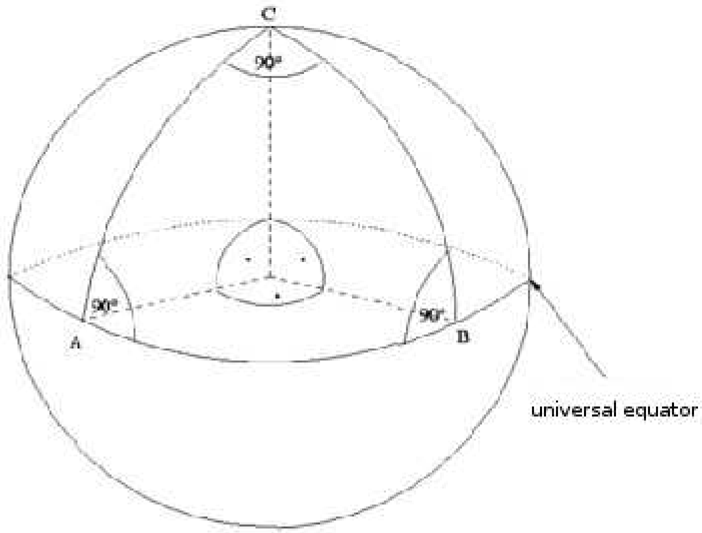

Fig. 2: The above illustration of a 3−sphere is supposed to visualise how the three quarks and the one electron are distributed in the universe at M =1. Aside from the fact one can arrange the three points (A, B and C) in a way so that their radii of curvature are all standing vertically on each other, 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

Eq. (19) in eq. (17) gives

$$E_{pot1}(e^-) = -\big(m_{p1}(v_{p1}=0) + m_{e1}\big)\, c^2 \,;$$

what may be written as follows:

$$m_{p1}(v_{p1}=0)\, c^2 = -E_{pot1}(e^-) - m_{e1}\, c^2 \,; \qquad (17.1)$$

into eq. (16):

$$E_{pot1}(e^-) = -\frac{-\big(E_{pot1}(e^-) + m_{e1}\, c^2\big)\, m_{e1}\, G}{c^2\, r_1} - \frac{Q_{\varepsilon 1}{}^2}{r_1} \,;$$

$$E_{pot1}(e^-) = \frac{\big(E_{pot1}(e^-) + m_{e1}\, c^2\big)\, m_{e1}\, G}{c^2\, r_1} - \frac{Q_{\varepsilon 1}{}^2}{r_1} \,; \quad (16.1)$$

eq. (10) for M = 1:

$$m_{\varepsilon 1}^2 \cdot G = -Q_{\varepsilon 1}^2 \; ; \qquad (10.1)$$

and because of (12) and (13)

$$E_{e1} = E_1(\varepsilon_1)$$

as well as

$$E\varepsilon_1 := E_1(\varepsilon_1) = m_{\varepsilon 1} c^2 \qquad (20)$$

and

$$E_{e1} = m_{e1} c^2 \qquad (21)$$

the following equation applies:

$$m_{e1} = m_{\varepsilon 1} \; , \qquad (12.1)$$

thus, eq. (10.1) changes to

$$m_{e1}^2 \cdot G = -Q_{\varepsilon 1}^2 \; ;$$

the proton has a positive electric charge, the electron a negative one. Therefore, this equation has to be changed as follows:

$$m_{e1}^2 \cdot G = Q_{\varepsilon 1}^2 \; ; \qquad (10.2)$$

into eq. (16.1):

$$E_{pot1}(e^-) = \frac{\left(E_{pot1}(e^-) + m_{e1}c^2 \right) m_{e1} \, G}{c^2 \, r_1} - \frac{m_{e1}^2 \, G}{r_1} \; ;$$

and that gives

$$E_{pot1}(e^-) = \frac{E_{pot1}(e^-) \, m_{e1} \, G}{c^2 \, r_1}$$

potential energy is cut out:

$$r_1 = m_{e1} \frac{G}{c^2} \qquad (16.2)$$

what yields with (10.2)

$$R_{Stat1} := r_1 = m_{e1} \frac{G}{c^2} \pm \left[m_{e1}^2 \cdot \frac{G^2}{c^4} - \frac{Q_{\varepsilon 1}^2 G}{c^4} \right]^{½} ; \qquad (16.3)$$

and that's nothing else than the formula for the static limit[38] of a Reissner–Nordstrøm hole[11] with the mass of an electron and the electric charge of an epsilon or anti–epsilon.

The author already announced previously such a result.

The electric charge of an anti–epsilon has to be equal to that of an electron, because the latter is a set only defined by an anti–epsilon as its sole element, therefore (16.3) gives

$$r_1 = m_{e1} \frac{G}{c^2} \pm \left[m_{e1}^2 \cdot \frac{G^2}{c^4} - \frac{e_1^{*2} G}{c^4} \right]^{½} ; \qquad (16.4)$$

where e_1^{*2} represents the elementary electric charge at M = 1.

With Bohr's quantum condition[31], and $\hbar = (h / 2\pi)$ representing the so–called reduced Planck's constant,

$$\hbar = p_{e1} r_1 \qquad (22)$$

eq. (16.2) yields

$$\hbar = p_{e1} m_{e1} \frac{G}{c^2}$$

and with the definition of momentum[39]

$$p_{e1} = m_{e1} \cdot v_{e1} \qquad (23)$$

one gets

$$c^2 \hbar = m_{e1}^2 \cdot v_{e1} \cdot G$$

what can also be written like that:

$$\frac{v_{e1}}{c} = \frac{c \cdot \hbar}{m_{e1}^2 \cdot G} ; \qquad (23.1)$$

eq. (11) in eq. (14):

$$E_{e1} = \left[(p_{e1}c)^2 + \left[E_{e1} - E_{tot1}(e^-) + E_{pot1}(e^-) \right]^2 \right]^{1/2};$$

with eq. (15):

$$E_{e1} = \left[(p_{e1}c)^2 + \left[E_{e1} - E_{kin1}(e^-) - E_{pot1}(e^-) + E_{pot1}(e^-) \right]^2 \right]^{1/2};$$

$$E_{e1} = \left[(p_{e1}c)^2 + \left[E_{e1} - E_{kin1}(e^-) \right]^2 \right]^{1/2}; \quad \text{/squared}$$

$$[E_{e1}]^2 = (p_{e1}c)^2 + [E_{e1}]^2 - 2 \cdot E_{e1} \cdot E_{kin1}(e^-) + [E_{kin1}(e^-)]^2;$$

$$0 = (p_{e1}c)^2 - 2 \cdot E_{e1} \cdot E_{kin1}(e^-) + [E_{kin1}(e^-)]^2; \qquad / \sqrt{}$$

$$[E_{kin1}(e^-)]_{1,2} = E_{e1} \pm \left[[E_{e1}]^2 - (p_{e1}c)^2 \right]^{1/2}; \qquad (15.1)$$

with (23):

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

with (23.1):

$$[E_{kin1}(e^-)]_{1,2} = E_{e1} \pm \left[[E_{e1}]^2 - \frac{[m_{e1}]^2 \cdot c^3 \cdot c^3 \cdot \hbar^2}{[m_{e1}]^4 \cdot G^2} \right]^{1/2};$$

with (21):

$$[E_{kin1}(e^-)]_{1,2} = m_{e1}c^2 \pm \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2}; \qquad (15.2)$$

but since this is the smallest possible universe, there cannot be two solutions for the kinetic energy of the electron. Therefore, eq. (15.2) gives

$$m_{e1}c^2 + \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2} = m_{e1}c^2 - \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2} ;$$

$$\left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2} = - \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2} ;$$

$$2 \cdot \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right]^{1/2} = 0 ; \qquad \text{/Quadr.}$$

$$4 \cdot \left[[m_{e1}c^2]^2 - \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} \right] = 0 ; \qquad / :4$$

$$[m_{e1}c^2]^2 = \frac{c^6 \cdot \hbar^2}{[m_{e1}]^2 \cdot G^2} ;$$

$$[m_{e1}]^4 = \frac{c^2 \cdot \hbar^2}{G^2} ;$$

extraction with a root of 4th order, assuming positive electron mass:

$$m_{e1} = \left[\frac{c \cdot \hbar}{G} \right]^{1/2} ; \qquad (15.3)$$

and that's nothing else than the Planck mass[40]. With eq. (23.1) one gets

$$v_{e1} = c ; \qquad (15.4)$$

that is the velocity of the electron on its orbit around the proton at rest, i.e., the test particle. For the sake of completeness, eq. (15.2) yields with (15.3) the kinetic energy of the electron:

$$E_{kin1}(e^-) = m_{e1}c^2 \; ; \qquad (15.5)$$

with (14) and (15.4) it follows that the sum of rest energy and potential energy of the electron is zero:

$$E_{e1}(v_{e1}= 0) = -E_{pot1}(e^-) \; ; \qquad (14.2)$$

that combined with eq. (15) gives

$$E_{tot1}(e^-) = E_{kin1}(e^-) - E_{e1}(v_{e1}=0) \; . \qquad (15.6)$$

Finally, one has to realize that in the context of this paper mass was attributed only to the elements ε_1 and ε_1 ; since the proton at M = 1 contains two epsilons and one anti–epsilon, it must have three times the mass of the electron, since the latter contains only one anti–epsilon. Therefore, with

$$m_{p1}(v_{p1}=0) = 3\, m_{e1} \qquad (17.2)$$

and the equations (17) and (19), one gets

$$E_{pot1}(e^-) = -4\, m_{e1}\, c^2 \; ; \qquad (19.1)$$

that into (14.2):

$$E_{e1}(v_{e1}=0) = 4\, m_{e1}\, c^2 \; ; \qquad (14.3)$$

with this and with (15.5), eq. (15.6) yields

$$E_{tot1}(e^-) = -3\, m_{e1}\, c^2 \; ; \qquad (15.7)$$

what’s still left now is the Bohr radius[36]. This can be calculated with the help of the equations (15.3) and (16.2):

$$r_1 = \left[\frac{c \cdot \hbar}{G}\right]^{1/2} \frac{G}{c^2} \; ;$$

that’s nothing else than the Planck length[41]:

$$r_1 = \left[\frac{G \cdot \hbar}{c^3}\right]^{1/2} . \qquad (15.8)$$

Furthermore, the elementary electric charge e_1^* has not been calculated yet. Here (16.4) is a good starting point for the calculation. It yields with (15.8)

$$\left[\frac{G \cdot \hbar}{c^3}\right]^{1/2} = \left[\frac{c \cdot \hbar}{G}\right]^{1/2} \frac{G}{c^2} \pm \left[\frac{c \cdot \hbar}{G} \cdot \frac{G^2}{c^4} - \frac{e_1^{*2} G}{c^4}\right]^{1/2} ;$$

one Planck length[41] substracted on both sides of this equation:

$$0 = \pm \left[\frac{c \cdot \hbar}{G} \cdot \frac{G^2}{c^4} - \frac{e_1^{*2} G}{c^4}\right]^{1/2} ; \qquad / \text{ Quadr.}$$

$$0 = \frac{c \cdot \hbar}{c^3} - \frac{e_1^{*2} G}{c^4} ;$$

$$\frac{e_1^{*2} G}{c^4} = \frac{G \cdot \hbar}{c^3} ;$$

$$\alpha_1 := \frac{e_1^{*2}}{c \cdot \hbar} = 1 ; \qquad (15.9)$$

So the elementary charge at M = 1 is about 11.7 times larger than today, should the author be right with his model. α_1 stands for the fine structure constant at M =1.[15] By the way, the author did not go into the size of the electron until now. What seems to be clear is that in today's universe it should be much smaller than the so–called classical electron radius[43]

$$r_e = e^{*2} / (2\, m_e \cdot c^2) ; \qquad (24)$$

though eq. (24) holds in today's universe, the question cannot be completely dismissed how large this classical electron radius might be at M = 1. In fact, this radius would be that of a set defined by an anti–epsilon, {{ε_1}} – if one assigns mass and electric charge to the epsilons and anti–epsilons in the manner described above, as already explained in detail. However, the calculation of r_{e1} is not quite simple.

The classical model of an electron describes it as a homogeneous sphere with mass m_e, whose electric charge is uniformly distributed on its surface. But at M = 1 the electron is a Reissner–Nordstrøm–hole[11], as it was shown by (16.4), so nothing can legitimately be 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* :

$$g^* := \iota\, m_e\, G^{1/2} \; ; \qquad (25)$$

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 Reissner−Nordstrøm hole[11] 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

$$E_e = e^* /\ 4\pi\varepsilon_0 r^2\ ; \qquad (26)$$

In this paper, he uses the MKS unit system[44], and that's why he sets the dielectric constant as follows:

$$\varepsilon_0 := \frac{1}{4\pi}\ ; \qquad (27)$$

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

$$\rho_e = \frac{1}{8\pi} \cdot E_e^2\ ; \qquad (28)$$

and now to this controversial discussion about gravitational field intensity. The electron at M =1, i.e. its single element, a Reissner–Nordstrøm hole[11], 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; this verb is admissible here because every frame number M is accompanied by a temporal blur in which something happens; thus M does not define a point in time, but a time span, even if only an extremely short one.

First of all, the question has to be asked to what extent Gauß's law[45]

$$-\nabla^2\Phi_e = \vec{\nabla} \cdot \vec{E}_e = 4\pi\ \rho_e \qquad (29)$$

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[46]:

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

There's repulsion between homopolar electric charges, but masses attract each other; so equation (29) 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 (29.1) :

$$-\nabla^2\Phi_g = \vec{\nabla} \cdot \vec{E}_g = -4\pi\ \rho_g\ . \qquad (29.1)$$

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

$$E_{g1} = g_1^* / \ r_{e1}^2 \ ; \qquad (30)$$

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 (29.1), 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)

$$W_{g1}(e^-) = ½ \cdot \int d^3 \vec{r}' \ \ \rho_{g1} \ \Phi_{g1} \ ; \qquad (31)$$

with (29.1) for M =1:

$$-\nabla^2\Phi_{g1} = \vec{\nabla} \cdot \vec{E}_{g1} = -4\pi \ \rho_{g1} \ ; \qquad (29.2)$$

at this point it shall be mentioned that equation (29.2) 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 (29.2), (31) results in

$$W_{g1}(e^-) = 1/8\pi \cdot \int d^3 \vec{r}' \ \ \Phi_{g1}\nabla^2\Phi_{g1} \ ; \qquad (31.1)$$

by applying a three–dimensional equivalent of a partial integration using Green's formula[47] one gets

$$W_{g1}(e^-) = 1/8\pi \cdot \int \vec{\nabla}\Phi_{g1} \ \vec{\nabla}\Phi_{g1} \ d^3r; \qquad (31.2)$$

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

what results in

$$W_{g1}(e^-) = 1/8\pi \cdot \int d^3 \vec{r}' \ \ E_{g1}^2 \ ; \qquad (31.3)$$

at M = 1, the electromagnetic field energy density is

$$\rho_{e1} := \frac{1}{8\pi} \cdot E_{e1}^2 \,; \qquad (28.1)$$

in analogy to the method of deducing equation (31) from (29.1), starting with (29) 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:

$$W_{e1}(e^-) = ½ \cdot \int d^3 \vec{r}' \;\; \rho_{e1}\, \Phi_{e1} \,; \qquad (32)$$

for M =1, equation (29) ends up as

$$-\nabla^2\Phi_{e1} = \vec{\nabla} \cdot \vec{E}_{e1} = 4\pi\; \rho_{e1} \,; \qquad (29.3)$$

together with (32) :

$$W_{e1}(e^-) = -1/8\pi \cdot \int d^3 \vec{r}' \;\; \Phi_{e1}\nabla^2\Phi_{e1} \,; \qquad (32.1)$$

and also here, by applying a three–dimensional equivalent of a partial integration using Green's formula[47], one gets

$$W_{e1}(e^-) = -1/8\pi \cdot \int \vec{\nabla}\Phi_{e1}\, \vec{\nabla}\Phi_{e1}\, d^3r; \qquad (32.2)$$

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

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

hence:

$$W_{e1}(e^-) = -1/8\pi \cdot \int d^3 \vec{r}' \;\; E_{e1}^2 \,; \qquad (32.3)$$

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

$$W_1(e^-) = W_{g1}(e^-) + W_{e1}(e^-) \,; \qquad (33)$$

with (31.3) and (32.3):

$$W_1(e^-) = 1/8\pi \cdot \int d^3 \vec{r}' \left[E_{g1}^2 - E_{e1}^2\right]; \qquad (33.1)$$

What is the author driving at? It is a preliminary adjustment of equation (24) for M =1, as already mentioned above.

(26) with (27):

$$E_{e1} = e_1^* / r_{e1}^2 \; ; \qquad (26.1)$$

this and (30) transform (33.1) into

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

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

$$W_1(e^-) = \tfrac{1}{2} \cdot (g_1^{*2} - e_1^{*2}) \cdot \int_{r_{e1}}^{\infty} 1/r'^2\, dr' \; ; \qquad (33.2)$$

$$W_1(e^-) = \tfrac{1}{2} \cdot (g_1^{*2} - e_1^{*2}) \cdot 1/r_{e1} \; ; \qquad (33.3)$$

equation (25) at M =1:

$$g_1^* = \iota\, m_{e1}\, G^{1/2} \; ; \qquad (25.1)$$

this into (33.3), which makes it clear why the author had chosen to define gravitational charge like that and not to simply equate it with mass:

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

$$W_1(e^-) = -\tfrac{1}{2} \cdot (m_{e1}^2\, G + e_1^{*2}) \cdot 1/r_{e1} \; ; \qquad (33.4)$$

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

$$\left| W_1(e^-) \right| = E_{e1} \; ; \qquad (34)$$

then one gets, starting from (33.4) with (15.3), (15.9) and

$$E_{e1} = \left(c\, \hbar / G\right)^{1/2} \cdot c^2 \, ,$$

what in turn results from (15.3) and (21), to

$$r_{e1} = \tfrac{1}{2} \cdot 2 \cdot c\, \hbar \Big/ ((c\, \hbar / G)^{1/2} \cdot c^2) \; ;$$

and that results in

$$r_{e1} = \left(G\, \hbar / c^3\right)^{1/2} \; ; \qquad (24.1)$$

thus, at M = 1, the classical electron radius is equal to the Planck length[41]; see eq. (15.8).

Later, at the beginning of the next chapter, when the author will come to Eddington[12], this result will acquire a very central importance.

At the end of this chapter, a few remarks on the above results.

Although such a viewpoint is in total contradiction to said results, the author would like to illustrate to the reader the two states that the proton can assume at M = 1 as follows: Imagine that one could choose the electron as a test particle without making it an antiproton, as this model says; from this electron one then looks at the proton.

The latter still has a structure defined by its three elements; two of these elements carry a positive and one a negative electric charge. One can represent the whole as an isosceles triangle, which stands once on one of its sides and once on one of its tips:

Fig. 3 and 4: 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. 5: Star of David

In a strict sense the element with the negative charge in fig. 3 and 4 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.

And it also becomes clear by this way of representation that at the transition from M = 0 to M =1 not only a matter universe as well as an antimatter universe, but in each case two mirror–image variants of both universes standing in symmetrical relation to each other must arise, if the assumptions of the author should be correct, what shall be proved by this paper.

Chapter II.

Sir Arthur Eddington[12] assumes in his model 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 (Eddington[12] assumes after all 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[12] 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[12] 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, perhaps the neutrinos and their anti–particles, for example). 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[12] 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[12] 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:

$$2 \cdot \sigma = \mathbf{R} / N^{1/2} ; \qquad (35)$$

or

$$N^{1/2} = R_{un} : (2 \cdot \pi \cdot \sigma) ; \qquad (36)$$

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. For M = 1 this means

$$\sigma_1 = r_{e1} \; ; \qquad (37)$$

what yields with (24.1)

$$\sigma_1 = \left(G \hbar / c^3\right)^{1/2}. \qquad (24.2)$$

For M = 1, the smallest possible measurement error in the determination of the location and thus the distance is therefore the Planck length[41]!

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

$$r_e \;=\; e^{*2} / (2\, m_e \cdot c^2) \, . \qquad (24)$$

In the first chapter, this formula has already been presented.

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[12] 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:

$$\frac{M_{un} \cdot G}{c^2} = \frac{\pi \cdot \mathbf{R}}{2} \; ; \qquad (38)$$

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, $M_{un} = \frac{1}{2} N m_p$, where m_p is the mass of a single proton. Hence, with (38) one gets

$$m_p\, G / (\pi \cdot c^2) \;=\; \mathbf{R} / N \; ; \qquad (39)$$

with equation (35):

$$m_p\, G / (\pi \cdot c^2) \;=\; 2 \cdot \sigma \cdot N^{1/2} / N \; ;$$

converted

$$N^{1/2} / \; \pi \;=\; 2 \cdot \sigma \cdot c^2 / \; m_p\, G \; ; \qquad (40)$$

with equation (24) this is

$$N^{1/2} / \pi = e^{*2} / m_e m_p G ; \qquad (40.1)$$

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[48].

The author fosters his conviction that Eddington's[12] approach is correct; he intends to prove it at the end of this paper.

Now it is possible to start in this respect by looking at the situation at M = 1 from Eddington's point of view[12].

For this the inclined reader may have a look again at the fig. 1 and 2. Without that it was expressed up to now in this treatise, the thought suggests itself to the viewer of these figures that these deliver the reason for the spatial three–dimensionality of this universe. Because one has at M =1 a test particle (other word for test set), which is defined only by the two sets $\{\varepsilon_1\}$ and $\{\varepsilon_1, \varepsilon_1\}$ as its elements, but the number of the epsilons contained in the test particle is equal to three. It was mentioned that in the matter universe, for the two *negative* objects, i.e. the two epsilons with *positive* electric charge, the only *positive* object in the test particle, i.e. the electrically *negative*ly charged anti–epsilon does not exist, but it follows indirectly from their property as perceptual separators or perceived pauses between anti–epsilons that another anti–epsilon must exist. With three fundamental elements in the test set, just the two epsilons and the one anti–epsilon, the epsilons would be indistinguishable from each other if there were not another anti–epsilon in this smallest possible universe to be separated from the anti–epsilon in the test particle. Since the perception corresponds in Boolean algebra[49] to the statement „true", the perception pause to the statement „false", as well as in the realm of digital technology[50], perception corresponds to the state „on", and the perception pause to the state „off", the epsilons are represented here as zeros and the anti–epsilons as ones:

0 1 0

but written in a different order, for example like this

0 0 1

two perception pauses are standing together, side by side. There's nothing in between! This has the bad consequence that the zeros are no longer distinguishable and coincide. This would result in a situation which corresponds exactly to that at M = 0, namely a set defined by only two elements.

Yes, the author literally hears the incredulous outcry of his readers who are invisible to him – they probably know that a computer program ultimately consists of ones and zeros sequencially in a row. And they don't just fall together when they are next to each other!

The explanation is: Computers have clock chips that determine the amount of time available for reading a zero or a one. If this is exceeded and the same number is still there, it is counted as a new zero or one. If this wouldn't be so, the number series

1 0 0 0 1 1 0 1 1 1 0 0 1 0 1 1 1 1 1 0 0 0 1 0 0 1 1 1 0 0 0 0 0 1 1 1 0 1 1 1 0 1 0 0 1 0

would change to 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 – and that surely wouldn't be a computer program any more – only an alternating series of „1" and „0"!

But the test particle at M = 1 does not have a clock like a computer. Its elements exist simultaneously, with a certain temporal fuzziness, which the author will discuss later. And if there are two separators, i.e. two epsilons next to each other, without separating one anti–epsilon from the other anti–epsilon, they become one single epsilon. Then one is again confronted with the state at M = 0, which can show only one epsilon and one anti–epsilon as elements.

Therefore, the existence of two epsilons demands that there must also be two anti–epsilons (corresponding to assumption 1 in this paper), which is the case if the subset $\{\{\varepsilon_1\}\}$ of the test set $\{\{\varepsilon_1\},\{\varepsilon_1,\varepsilon_1\}\}$ also exists – the electron, which together with the test particle, i.e. the proton at M = 1, provides for the electric charge balance in this smallest possible universe. Thus, it is shown that from the existence of two negative objects in the universe follows necessarily the existence of two positive objects. And thus it becomes also permissible to consider the electron at M = 1 as virtually existing for the epsilons in the proton; for its anti–epsilon the electron is real existing, because it is also defined by an anti–epsilon – the anti–epsilon in the proton is in fact of exactly the same nature as the anti–epsilon in the electron, thus the anti–epsilon in the electron exists real according to assumption 3. All three relations, i.e. the one between electron and the two epsilons as well as the one between electron and anti–epsilon, are completely independent of each other; one could also call them orthogonal (in the sense of elementary geometry) to each other; they are perpendicular to each other, thus they are three independent dimensions with 90°–angles between them. **This is the reason for the spatial three–dimensionality** in the universe, which was already mentioned in the summary of this paper (see **point 1 of the 12–point–list** at the end of the summary).

And now the relation to Eddingtons[12] uranoid becomes apparent. This is the 3–surface (the surrounding 4–dimensionally curved space) of a 4–sphere. And from fig. 2 it is clear that it is a low–dimensional image of such a 3–surface of a 4–sphere. From the proton's point of view, the space separating it from the electron is uncurved. But from two epsilons, one anti–epsilon and the electron defined by another anti–epsilon, one obtains a tetrahedron, which in 3–dimensional space would have all 60°–angles between the edges, but in the 3–surface of a 4–sphere these are 90°–angles each.

Also the space curvature of the universe, i.e. the mean space curvature related to the whole universe or the whole uranoid and not only a local curvature of the space caused by masses, is clear from the previous explanations; the connecting lines between the quarks and the electron in fig. 1 are perpendicular to each other, but if one were to tilt the whole and replace one of the quarks by the electron, which of course requires that this quark takes the place of the electron, one would also have three connecting lines with 90° angles in between. Such a thing can work only if the space is curved (**point 2 of the 12–point–list** at the end of the summary of this paper).

It is worthwhile now to examine Eddington's previously reproduced train of thought[12] a little more closely. First of all, his choice of the universal radius of curvature R as the greatest possible error is to be questioned, because this cannot be measured directly at all. Therefore, the author of this paper considers the directly measurable distance to the universal horizon[51] as a basic quantity for determining a greatest possible error; however, he does not equate it with this.

At M = 1 the only distance which exists in reality is the distance between electron and proton. This is, as has been shown in chapter I. with eq. (15.8), the Planck length[41]. Assuming that this has not been calculated up to now, one can nevertheless say something about the largest error of the distance determination at M = 1. Because either the electron is in the greatest possible distance from the proton, thus at the universal antipole of the center of gravity of the proton, or both are not separated at all, or the distance lies somewhere between these two extreme values. So as long as nothing is known about this, one can only say with certainty that the distance between electron and proton is

$$½\cdot R_{Un1} \pm ½\cdot R_{Un1} \ ,$$

where R_{Un1} is the radius of the universe, i.e. the distance between the antipole of the test particle proton and the center of gravity of the latter. Thereby $½\cdot R_{Un1}$ is then the searched greatest possible error of the distance determination. But this latter has also again at least a smallest possible error, because for reasons already well described by Eddington[12] no absolutely exact distance determination can be carried out; the Heisenberg uncertainty relation[52] forbids this. And therefore the above statement that an object is at a distance $½\cdot R_{Un1} \pm ½\cdot R_{Un1}$ to something else is also not quite correct. Thus, in a sense, there is a largest possible error and a smallest possible error. With the smallest possible error there is no such thing, because otherwise there would be an even smaller error than the smallest possible error, which would leave the latter no longer smallest possible; a clear contradiction.

Here, however, the author leaves the case M = 1; in this case r_1 is the distance between the centers of gravity of electron and proton and $2\cdot r_1 = R_{Un1}$ (the electron has the same extension to the back as to the front) is the universal radius (distance between antipole of the test particle and the center of gravity of the test particle itself); then this is symbolized for any M by R_{Un}.

How are the smallest and largest possible error related to each other? The Gaussian formula for the error propagation[13] is helping here:

$$\Delta X = \left[\left[\frac{\partial X}{\partial x}\cdot\Delta x\right]^2 + \left[\frac{\partial X}{\partial z}\cdot\Delta z\right]^2\right]^{½} ; (\Delta X>\Delta x>\Delta z) \quad (41)$$

$\frac{\partial X}{\partial x}$ 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, (41) yields

$$\Delta X = [(\Delta x)^2 + (\Delta z)^2]^{1/2} \, ; \qquad (41.1)$$

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 limit[38] of an (electrically charged) Reissner–Nordstrøm hole[11]:

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

That's the big surprise now: The formula for the static limit[38] of a Reissner–Nordstrøm hole[11] is also obtained from Gaussian error propagation[13]; this works as follows: The author adds the values of largest and smallest possible error calculated with the Gaussian error propagation formula simplified above, and divides the result of this addition by two to calculate R_{Stat} as their arithmetic mean:

$$R_{Stat} = 1/2 \cdot \{ \Delta X + \Delta x \} \, ; \qquad (79)$$

with (41.1):

$$R_{Stat} = 1/2 \cdot \{ [(\Delta x)^2 + (\Delta z)^2]^{1/2} + [(\Delta X)^2 - (\Delta z)^2]^{1/2} \} \, ;$$

and once again with (41.1):

$$R_{Stat} = 1/2 \cdot \{ [(\Delta X)^2]^{1/2} + [(\Delta X)^2 - (\Delta z)^2]^{1/2} \} \, ;$$

$$R_{Stat} = 1/2 \cdot \Delta X + [1/4 \cdot (\Delta X)^2 - 1/4 \cdot (\Delta z)^2]^{1/2} \, ; \qquad (41.2)$$

and if one compares that with the formula for the static limit[38] of Reissner–Nordstrøm–holes[11]

$$R_{Stat} = M \cdot G/c^2 + [M^2 \cdot G^2/c^4 - Q^2 \cdot G/c^4]^{1/2} \, , \qquad (43)$$

a special case of the Kerr–Newman metric[53], it becomes instantly clear that the terms „½·ΔX“ and „M·G/c²“ (as well as their squares) and also „¼·(Δz)²“ and „Q²·G/c⁴“ correspond to each other. For the sake of completeness, the formula for the static limit[38] of a Kerr–Newman hole[53] is also presented here:

$$R_{Stat} = M \cdot G/c^2 + [\, M^2 \cdot G^2/c^4 - Q^2 \cdot G/c^4 - (S^2/M^2 \cdot c^2) \cdot \cos^2\vartheta \,]^{1/2} \;;$$

where M is the mass of the 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 the Kerr–Newman metric[53] does not apply here, because the hole does not rotate. It could rotate relative to the test particle, but this effect is completely compensated by the relativistic frame dragging effect[54] for a test particle directly at the static limit[38] of the hole. But because the test particle is orbiting directly on the static limit 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 – the test particle is located on the static limit[38], i.e. the closest possible proximity to the hole, where it is not yet irretrievably devoured by the hole.

Therefore, S equals zero, and that results in the Reissner–Nordstrøm equation[11]:

$$R_{Stat} = M \cdot G/c^2 + [\, M^2 \cdot G^2/c^4 - Q^2 \cdot G/c^4 \,]^{1/2} \;;$$

but why is the static limit[38] of the same order of magnitude as $\frac{1}{2}R_{Un}$ and not, for instance, twice as large? The attentive reader surely didn't miss that...

The author will try to depict that.

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. $\frac{1}{2}R_{un}$. And that's approximately equal to R_{Stat}.

Hopefully it becomes clear now why the static limit[38] has to be only half as big as the distance between the universal horizon and the test particle.

By the way, from now on it is necessary to be a little more exact; M is here the mass of the universe minus the mass of the test set. The test set, thus the test particle is not a component of the hole and consists at M = 1 only of the proton. Thus, M_1 is

$$M_1 = M_{Un1} - m_{p1}(v_{p1}{=}0) \; ; \qquad (44)$$

and that's why the equation for the static limit[38] in case of a Reissner–Nordstrøm metric[11] reads as follows for M = 1:

$$R_{Stat1} = [\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,] \cdot G/c^2 + \{\, [\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,]^2 \cdot G^2/c^4 - Q_1{}^2 \cdot G/c^4 \,\}^{½} \; ; \qquad (43.1)$$

this equation is actually an old acquaintance by now; however, it looked somewhat different before:

$$r_1 = m_{e1} \frac{G}{c^2} \pm \left[m_{e1}{}^2 \cdot \frac{G^2}{c^4} - \frac{Q_{\varepsilon 1}{}^2 G}{c^4} \right]^{½} \; ; \qquad (16.3)$$

and since at M = 1 the electric charge of an anti–epsilon is equal to that of an electron, the following is of course valid as before:

$$r_1 = m_{e1} \frac{G}{c^2} \pm \left[m_{e1}{}^2 \cdot \frac{G^2}{c^4} - \frac{e_1{}^{*2} G}{c^4} \right]^{½} \; ; \qquad (16.4)$$

at M = 1, the result of the substraction of the test particle mass from the universal mass is the electron mass, in accordance with eq. (17):

$$m_{e1} = M_{Un1} - m_{p1}(v_{p1}{=}0) \; ; \qquad (17.1)$$

eq. (16.4) and (17.1) with eq. (43.1):

$$R_{Stat1} = [\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,] \cdot G/c^2 + \{\, [\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,]^2 \cdot G^2/c^4 - e_1{}^{*2} \cdot G/c^4 \,\}^{½} \; ; \qquad (43.2)$$

well, now, wait a moment... There's something wrong here. Eq. (16.4) as well as (17.1) contain a „±“ instead of a „+“. Did the author omit anything important?

The answer is yes. Namely, the author has completely left out of consideration the 2^{nd} solution for the Reissner–Nordstrøm metric[11]! That one is called „Cauchy horizon“[55]:

$$r_{-1} = [\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,] \cdot \frac{G}{c^2} - \left[[\, M_{Un1} - m_{p1}(v_{p1}{=}0)\,]^2 \cdot \frac{G^2}{c^4} - e_1{}^{*2} \cdot \frac{G}{c^4} \right]^{½} \qquad (43.3)$$

and this equation has later to be further discussed in this paper. However, since the discriminant of the root in (43.3) is zero, i.e, at M = 1, R_{Stat1} and r_{-1} are of course identical, and moreover, Eq. (41) is superfluous, since $\Delta X_1 = \Delta x_1 = \Delta z_1$. So it makes sense here to look at the cases M > 1 before turning again to Eq. (43.3). This will be done below.

Chapter III.

Presently, if one takes a closer look at the results of the considerations in the previous chapter, some interesting conclusions can be made. For this purpose, the author would like to summarize once again what has been described so far.

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 subject chosen by the author, the test particle, is accordingly a set whose three elements carry electric charges, namely two positive and one negative. Since within the subset of the power set of the subject, which was defined in chapter I. with eq. (8) as a world, charge balancing must take place, there has to exist, besides the subject, another set with exactly one element, namely the one with the 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 for a given M in both always keeping the same separation distance between each other. 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; for a given M, 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 is then only a logical consequence of the foregoing, noting what has already been discussed above on pages 29–30.

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 (the author has already explained this, as already mentioned, on pages 29–30). And interactions between the elements of the subject are not definable at M =1, as already explained before.

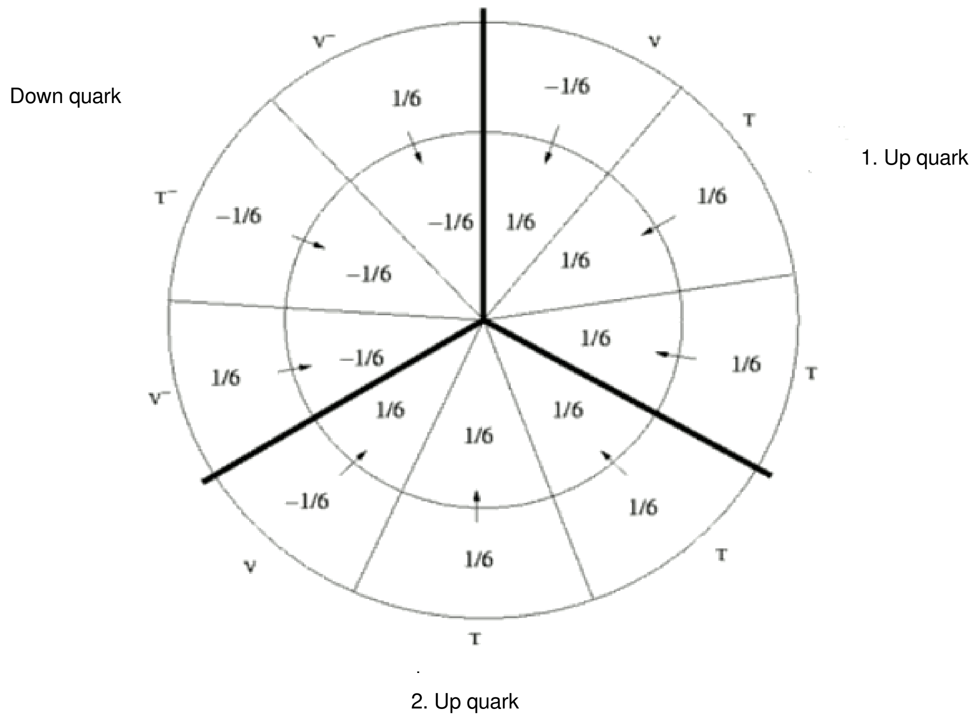

Fig. 6: Here, the result of the reciprocal mapping of the test set's three elements at M =1 is depicted – that's the structure of the test set at M = 2

But what does happen if the frame number gets bigger and bigger? It seems likely that M increases while the universe is getting older.

Let it be that M = 2. The working hypothesis is that the universe expands and gets bigger; therefore, the age of the universe T_{Un2} exceeds T_{Un1}. 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 (strictly speaking, for a given M, the structure of the test set at M–1 becomes a reality).

But exactly *how* do the elements of the test set interact during the transition from M = 1 to M = 2? Does this happen in the same way as in the transition from M = 0 to M = 1?

Of course, in the Platonic world of ideas[3], there exists also a mapping of the elements of the test set at M = 1 on each other of the same type as the mapping of the epsilon on the anti–epsilon at M = 0. This is something purely mathematical; but mass and electric charge were arbitrarily assigned to the elements, thus, their relations were described thereupon with physical equations borrowed from the present. A purely mathematical mapping process is therefore no longer in question if one describes the transition from M = 1 to M = 2 as a process in which time passes – time is, after all, a physical concept. Thus the effect of the elements of the test particle on each other, which is here of interest, can be described from M = 1 only by physical impact processes[56] – the author assumes thus (**5th assumption**) ideally inelastic impacts, with which the collided particles stick to each other.

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. May the reader of this paper now realize that the smallest elements of the test particle all carry an electric charge (either + or –). In the *physical* imaging or impact process described above, the particles which carry the information of the acting, i.e. imaging particle, must accordingly also carry 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. And after complete exchange of this quantized information, the result is as shown in fig. 6.

If by chance the reader knows about the rishon model of Haim Harari[57], 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^- and 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. In the observable universe protons and electrons are obviously in the majority, compared with anti–protons and positrons; therefore it is reasonable to draw the conclusion that the test particle is an original proton with a positive total electric charge. Then, apart from the proton, which, as described, is defined by two electrically positively charged elements and one electrically negatively charged element, there is another element of the power set[7] of the test particle, which is defined by one electrically negatively charged element – the electron.

The rishon properties which were already mentioned above shall now be discussed more thoroughly. Harari[57] 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 momentum vectors of the respective rishon. At M = 1 the total momentum of the three test set elements is zero, because the test particle is at rest. Each momentum has the same scalar value, so the sum of these momentum vectors is nil, what means that the test particle is colorless. If one of those momentum vectors is removed, one „red“ and one „green“ momentum vector is left, for example – and together, those would form an „antiblue“ vector – it's opposed to the „blue“ momentum 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 momentum 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“. Now, the reader may look at the result of this on the following page, when M equals 2.

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

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

1st set:	$\ominus \to \ominus$	(T^-)	(–1/3 e_2^* –blue on blue)
	$\oplus_1 \to \ominus$	(V^-)	(no total electric charge –red on blue)
	$\oplus_2 \to \ominus$	(V^-)	(no total electric charge –green on blue)
2nd set:	$\oplus_1 \to \oplus_1$	(T)	(+1/3 e_2^* –red on red)
	$\oplus_2 \to \oplus_1$	(T)	(+1/3 e_2^* –green on red)
	$\ominus \to \oplus_1$	(V)	(no total electric charge –blue on red)
3rd set:	$\oplus_2 \to \oplus_2$	(T)	(+1/3 e_2^* –green on green)
	$\oplus_1 \to \oplus_2$	(T)	(+1/3 e_2^* –red on green)
	$\ominus \to \oplus_2$	(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 – which ones those are, can be derived from the above list:

$\Theta \rightarrow \Theta$ (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 (including the test particle proton) 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[58] – it might even triple it. So, 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 effectively isochronous. And thus, 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[41] in nowadays universe.

At M = 2, the reader may have a look at the subset of the power set[7] 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 particles. 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:

$$[E_{Tu2}]^2 = [E_{Tu2}(v_{Tu2}=0)]^2 + (p_{Tu2} \cdot c)^2 ; \qquad (45)$$

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

$$E_{Tu2} = 2 \cdot E_{\varepsilon 2} ; \qquad (46)$$

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

$$m_{\varepsilon 2}^2 \cdot G = e_2^{*2} : 36 \quad ; \qquad (47)$$

and the momentum is

$$p_{\varepsilon 2} = m_{\varepsilon 2} \cdot v_{\varepsilon 2} ; \qquad (48)$$

(45) and (46) give

$$[2\ E_{\varepsilon 2}]^2 = [E_{Tu2}(v_{Tu2}=0)]^2 + (p_{Tu2} \cdot c)^2 ; \qquad (45.1)$$

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 momentum of each epsilon:

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

$$E_{\varepsilon 2}{}^2 = [E_{\varepsilon 2}(v_{\varepsilon 2}{=}0)]^2 + (\ p_{\varepsilon 2} \cdot c\ )^2\ ; \qquad (\ 45.2\ )$$

with (48):

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

and with

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

one gets

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

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

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

or

$$E_{\varepsilon 2} = E_{\varepsilon 2}(v_{\varepsilon 2}{=}0) \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right)^{-1/2}\ ; \qquad (\ 45.3\ )$$

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

$$E_{Tu2} = 2 \cdot E_{\varepsilon 2}(v_{\varepsilon 2}{=}0) \cdot \left(1 - (v_{\varepsilon 2} / c)^2\right)^{-1/2}\ ; \quad (\ 45.4\ )$$

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

$$v_{Tu2} = v_{\varepsilon 2}\ ; \qquad (\ 50\ )$$

whith (45.4), that results in

$$E_{Tu2} = 2\ E_{\varepsilon 2}(v_{\varepsilon 2}=0) \cdot \left(1 - (v_{Tu2} / c)^2\right)^{-1/2}; \quad (45.5)$$

but now, the varicolored rishons shall be discussed. In their case, the total momentum 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):

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + (\ p_{\varepsilon 2} \cdot c\ )^2\ ; \qquad (51)$$

with the equations (48) and (49), that results in

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + E_{\varepsilon 2}{}^2 \cdot v_{\varepsilon 2}{}^2 / c^2\ ; \qquad (51.1)$$

but this is also correct:

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + (\ p_{Tb2} \cdot c\ )^2\ ; \qquad (52)$$

with

$$p_{Tb2} = m_{Tb2} \cdot v_{Tb2}\ ; \qquad (53)$$

and

$$E_{Tb2} = m_{Tb2} \cdot c^2\ ; \qquad (54)$$

(52) results in

$$[E_{Tb2}]^2 = [E_{Tb2}(v_{Tb2}=0)]^2 + E_{Tb2}{}^2 \cdot v_{Tb2}{}^2 / c^2\ ; \qquad (52.1)$$

$$E_{Tb2} = E_{Tb2}(v_{Tb2}=0) \cdot \left(1 - (v_{Tb2} / c)^2\right)^{-1/2}; \quad (52.2)$$

and (51.1) gives with (52.1)

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

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

$$v_{Tb2} = v_{\varepsilon 2}\ ; \qquad (55)$$

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

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

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

$$E_{Tb2} = E_{\varepsilon 2} \; ; \qquad (55.1)$$

with (46):

$$E_{Tu2} = 2 \cdot E_{Tb2} \; ; \qquad (55.2)$$

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

$$E_{e2} = m_{e2}\, c^2 \qquad (56)$$

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

Let

$$E_{e2}(n{=}2) = m_{e2}\,(n{=}2)\; c^2 \qquad (57)$$

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

$$E_{e2}(H;n{=}1) = m_{e2}\,(H;n{=}1)\; c^2 \qquad (58)$$

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

$$E_{e2}(H;n{=}2) = m_{e2}(H;n{=}2)\; c^2 \qquad (59)$$

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[59] can be used here in order to describe the relationship between those four different electron types. If on the one hand,

$$\tfrac{1}{2} \cdot m_{e2} \leq m_{e2}(H;n{=}1) < m_{e2}$$

applies, 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

$$m_{e2}(H;n=1) = \frac{m_{p2}(v_{p2}=0) \cdot m_{e2}}{[\, m_{p2}(v_{p2}=0) + m_{e2} \,]} ; \qquad (60)$$

$m_{p2}(v_{p2}=0)$ stands for the mass of the (resting) proton. And if on the other hand, the relation

$$\tfrac{1}{2} \cdot m_{e2}(n=2) \leq m_{e2}(H;n=2) < m_{e2}(n=2)$$

applies, 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

$$m_{e2}(H;n=2) = \frac{m_{p2}(v_{p2}=0) \cdot m_{e2}(n=2)}{[\, m_{p2}(v_{p2}=0) + m_{e2}(n=2) \,]} ; \qquad (61)$$

(60) yields

$$m_{p2}(v_{p2}=0) = \frac{m_{e2} \cdot m_{e2}(H;n=1)}{m_{e2} - m_{e2}(H;n=1)} ; \qquad (60.1)$$

and (61) can be converted into

$$m_{p2}(v_{p2}=0) = \frac{m_{e2}(n=2) \cdot m_{e2}(H;n=2)}{m_{e2}(n=2) - m_{e2}(H;n=2)} ; \qquad (61.1)$$

(60.1) equalised with (61.1):

$$\frac{m_{e2} \cdot m_{e2}(H;n=1)}{m_{e2} - m_{e2}(H;n=1)} = \frac{m_{e2}(n=2) \cdot m_{e2}(H;n=2)}{m_{e2}(n=2) - m_{e2}(H;n=2)} ; \qquad (61.2)$$

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 2nd radius of the test particle:

$$m_{e2}(n=2) = m_{eu2} ; \qquad (62)$$

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

$$m_{eu2} = 3 \cdot 2 \cdot m_{\varepsilon 2} ; \qquad (63)$$

(62) and (63):

$$m_{e2}(n=2) = 6 \cdot m_{\varepsilon 2} \; ; \qquad (62.1)$$

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:

$$m_{e2}(H;n=1) = m_{eb2} \; ; \qquad (64)$$

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

$$m_{eb2} = 3 \cdot m_{\varepsilon 2} \; ; \qquad (65)$$

$(64) \overset{!}{=} (65)$:

$$m_{e2}(H;n=1) = 3 \cdot m_{\varepsilon 2} \; ; \qquad (64.1)$$

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

$$m_{em2} = 4 \cdot m_{\varepsilon 2} \qquad (66)$$

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.

(62.1) and (64.1) in (61.2):

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

resultant:

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

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

and now the statement follows that m_{e2} has to be equal to $4 \cdot m_{\varepsilon 2}$ [= m_{em2} , according to equation (66)];

$$\Rightarrow \qquad 4\, m_{\varepsilon 2} \cdot \left[\, 3\, m_{e2}(H;n=2) - 6\, m_{\varepsilon 2} \,\right] = m_{e2}(H;n=2) \cdot 6\, m_{\varepsilon 2} \; ;$$

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

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

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

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

[Confirmation of $\frac{1}{2} \cdot m_{e2}(n=2) \leq m_{e2}(H;n=2) < m_{e2}(n=2)$, because $\frac{1}{2} \cdot 6 \cdot m_{\varepsilon 2} \leq 4 \cdot m_{\varepsilon 2} < 6 \cdot m_{\varepsilon 2}$]

Hence:

$$m_{e2}(n=2) = m_{eu2} = 6\ m_{\varepsilon 2}\ ; \qquad (62),\ (62.1)$$

$$m_{e2} = m_{e2}(H;n=2) = m_{em2} = 4\ m_{\varepsilon 2}\ ; \qquad (61.3),\ (61.4),\ (61.5)$$

$$m_{e2}(H;n=1) = m_{eb2} = 3\ m_{\varepsilon 2}\ ; \qquad (64.1),\ (65)$$

[Confirmation of $\frac{1}{2} \cdot m_{e2} \leq m_{e2}(H;n=1) < m_{e2}$, because $\frac{1}{2} \cdot 4 \cdot m_{\varepsilon 2} \leq 3 \cdot m_{\varepsilon 2} < 4 \cdot m_{\varepsilon 2}$]

(61.5) and (65) in (60.1):

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

$$m_{p2}(v_{p2}=0) = 12\ m_{\varepsilon 2}\ ; \qquad (60.2)$$

in order to check this, (62.1) and (61.5) in (61.1):

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

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

$$m_{p2}(v_{p2}=0) = 12\ m_{\varepsilon 2}\ ; \qquad (61.6)$$

thus, (60.2) and (61.6) are identical. *V* q.e.d.

$$E_{p2}(v_{p2}=0) = m_{p2}(v_{p2}=0)\ c^2\ ; \qquad (67)$$

with this, (61.6) and (49) yield

$$E_{p2}(v_{p2}=0) = 12\ E_{\varepsilon 2}\ ; \qquad (67.1)$$

now, the case in which the electron orbiting around the test particle reaches the 2nd 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 2nd 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 2nd 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

$$E_{p2}(n=2) - E_{p2} = E_{\varepsilon 2} \; ; \qquad (68)$$

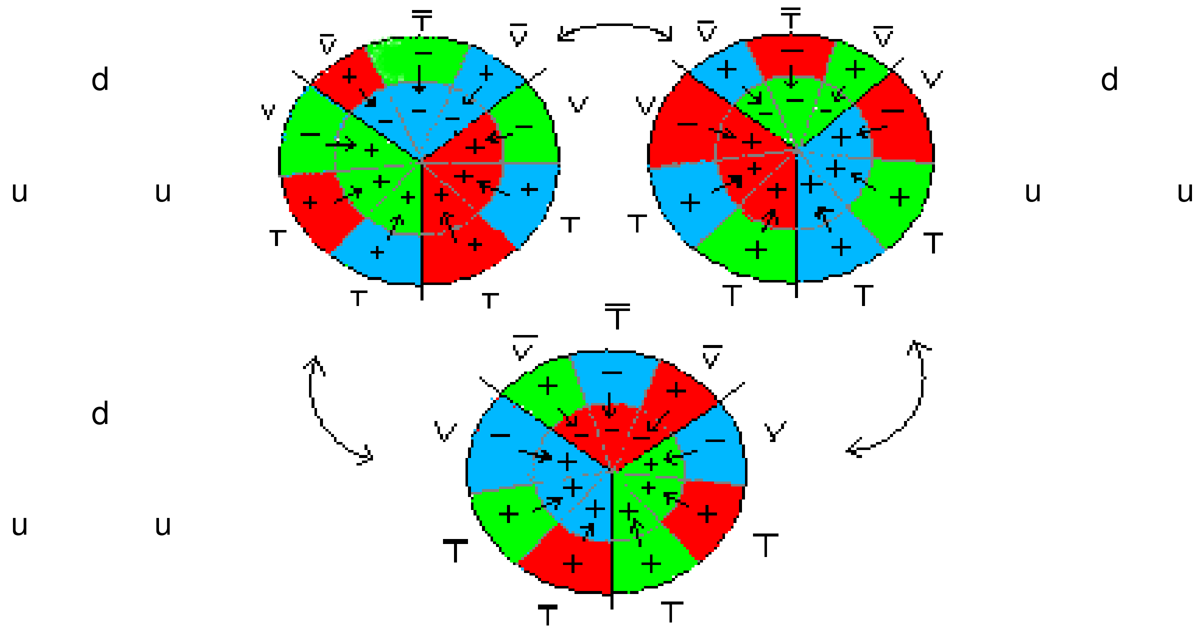

Fig. 7: Each „+“ stands for „+1/6“, each „–“ for „–1/6“ e*

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

$$E_{p2}(n=2) = (E_{Vb2} + E_{Tb2} + E_{Vu2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) \; ; \qquad (69)$$

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 (46) and (55.1):

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

that results in

$$E_{p2}(n{=}2) = 7\,E_{\varepsilon 2} + 3\,E_{Vb2} + E_{Vu2}\ ; \qquad (69.1)$$

something else is yet missing:

$$E_{p2} = (E_{Vb2} + E_{Tb2} + E_{Vu2}) + (E_{Vu2} + 2\,E_{Tb2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2})\ ; \qquad (70)$$

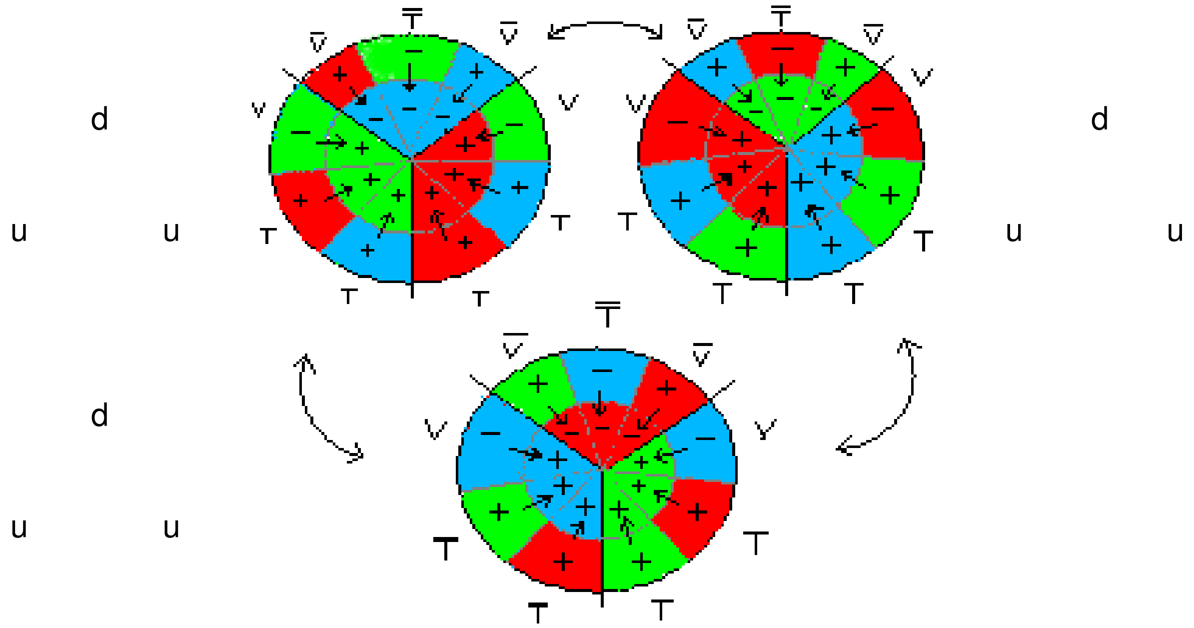

Fig. 8: Wieder steht jedes „+“ für „+1/6“, every „–“ for „–1/6“ e*

with (46) and (55.1):

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

$$E_{p2} = 6\,E_{\varepsilon 2} + 2\,E_{Vb2} + 2\,E_{Vu2}\ ; \qquad (70.1)$$

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. 9 shows this case.

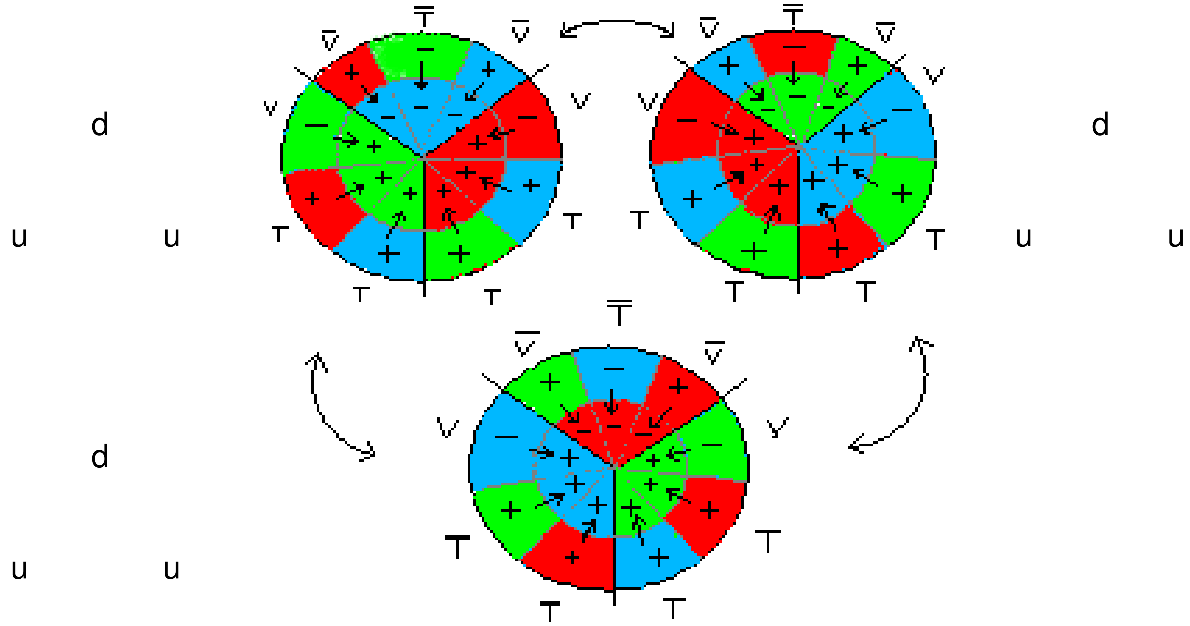

Fig. 9: Each „+“ stands also here for „+1/6“, „–“ for „–1/6“ e*

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. 9 is excluded for the proton.

(69.1) and (70.1) in (68):

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

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

$$E_{Vb2} = E_{Vu2}\;; \qquad (68.1)$$

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

$$E_{p2}(v_{p2}=0) = (2\,E_{Vb2} + E_{Tu2}) + (E_{Vb2} + E_{Tu2} + E_{Tb2}) + (E_{Tb2} + E_{Tu2} + E_{Vb2})\;; \qquad (71)$$

with (46) and (55.1):

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

with (67.1):

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

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

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

$$E_{Vb2} = E_{\varepsilon 2}\;; \qquad (71.1)$$

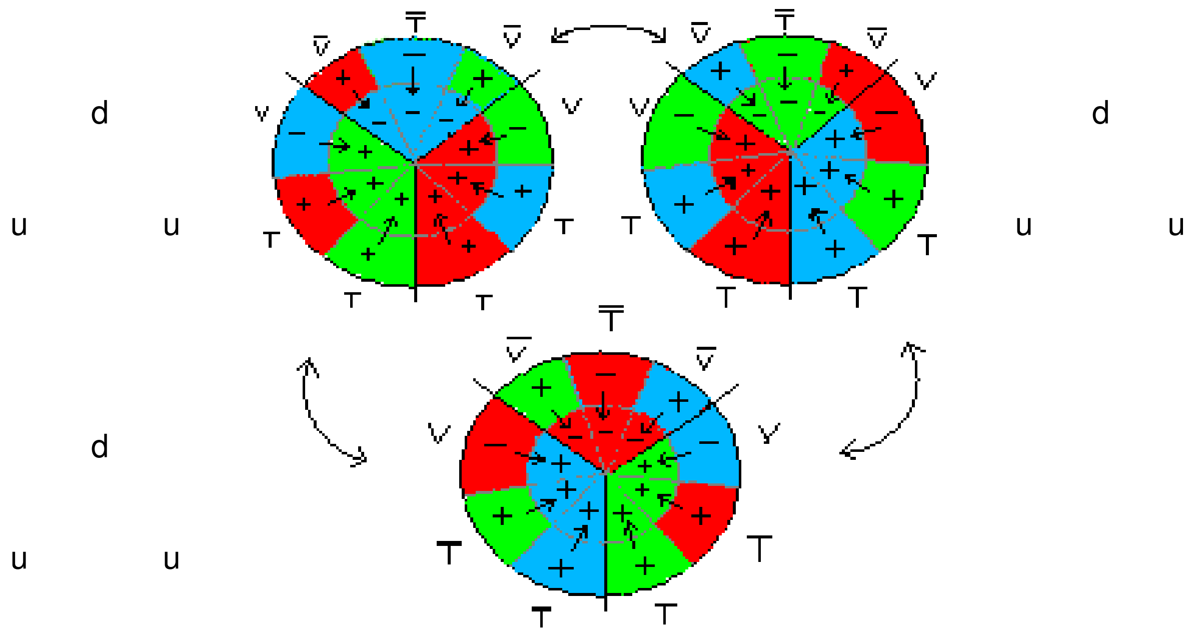

Fig. 10: Again, each „+“ stands for „+1/6“, each „–“ for „–1/6“e*

with (68.1):

$$E_{Vu2} = E_{\varepsilon 2}\;; \qquad (68.2)$$

(70.1) with (68.2) and (71.1):

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

$$E_{p2} = 10\,E_{\varepsilon 2}\;; \qquad (70.2)$$

(69.1) with (68.2) and (71.1):

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

$$E_{p2}\,(n{=}2) = 11\,E_{\varepsilon 2}\;; \qquad (69.2)$$

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

$$E_{\nu 2} = 3\,E_{\varepsilon 2}\;; \qquad (72)$$

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 (56), (61.3), (61.4) and (61.5):

$$E_{e2} = 4\ E_{\varepsilon 2}\ ; \qquad (73)$$

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

$$E_{e2}\,(n{=}2) = 6\ E_{\varepsilon 2}\ ; \qquad (74)$$

resulting from equations (57) and (62.1), this is the energy of the electron with a main quantum number n = 2 orbiting the test particle. At M = 2, because of equations (58) and (65), the energy of an electron on its Bohr radius in one of both hydrogen atoms whose proton is not a test particle is

$$E_{e2}\,(H;n{=}1) = 3\ E_{\varepsilon 2}\ ; \qquad (75)$$

and, last not least, because of equations (59) and (61.4) the energy of an electron orbiting with a main quantum number n = 2 in those hydrogen atoms is

$$E_{e2}\,(H;n{=}2) = 4\ E_{\varepsilon 2}\ ; \qquad (76)$$

the reader may now turn to fig. 11 on page 55.

Apart from three protons, the electrons and neutrinos / antineutrinos shown in the mentioned figure correspond to all particles which can exist under the conditions given above – in them, thus plus the three protons, of which one is the test particle and therefore rests, as well as its electron on the second Bohr orbit and the two other protons, which together with two electrons form two hydrogen atoms with the principal quantum number n = 2, furthermore just the six neutrinos as well as their antiparticles, the six antineutrinos, unite all mass energy existing at M = 2. In exactly this situation, photons are furthermore not possible, since all particles are here already in their highest energy states and said photons can therefore no longer affect any other particle; in such a case, according to the basic assumptions in this paper, they are simply non–existent. However, since the electrons quickly fall back to the Bohr orbits in the hydrogen atoms, three photons are created in this way, which can move freely and subsequently interact with any particle. However, it would simply go beyond the scope of this paper if the author would deal with all situations which can occur at M = 2. Therefore, he restricts himself to the scenario presented here, which from a mathematical point of view can be described very simply.

May the willing reader now redirect his attention to fig. 11. 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:

$$E_{Un2} = E_{p2}(v_{p2}=0) + 2\ E_{p2}(n=2) + 2\ E_{e2}(H;n=2) + E_{e2}(n=2) + 12\ E_{\nu 2}\ ; \quad (77)$$

with (67.1), (69.2), (72), (74) and (76):

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

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

$$E_{Un2} = 84\ E_{\varepsilon 2}\ ; \quad (77.1)$$

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 (19):

$$E_{pot2}(Un) = -84\ E_{\varepsilon 2}\ ; \quad (78)$$

the rest mass of the proton is known; see eq. (67.1).

The electron rest mass is unknown up to now and shall be determined below.

For this purpose, the author would like to illustrate to the reader first of all with fig. 11 on the next page, how the three electrons as well as the 12 neutrinos / antineutrinos are composed at M = 2.

According to (72), the neutrinos all have the same moving mass energy of 3 $E_{\varepsilon 2}$. As with other particles, a neutrino colliding with its antiparticle transform into two photons (the principle of conservation of momentum demands this), which also have three epsilon energies each.

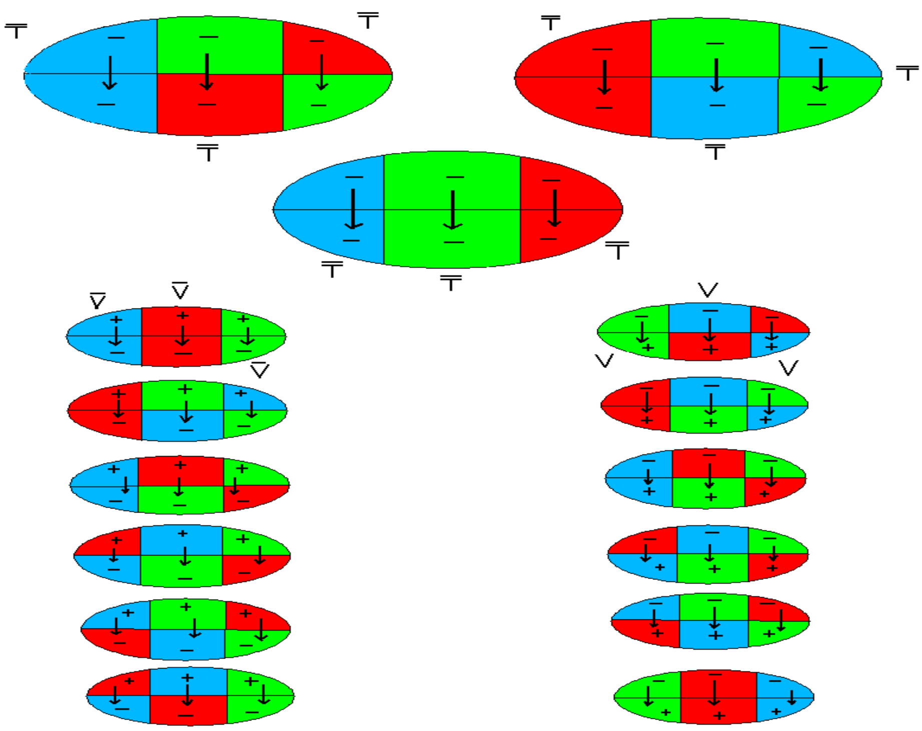

Fig. 11: At the top, 3 electrons are depicted; beneath, on the left side, 6 antineutrinos, and on the right side, 6 neutrinos are shown. „+“ stands for +1/6th, „—“ for —1/6th of the elementary electric charge. In this illustration, neutrinos as well as their antiparticles are arranged in a more or less arbitrary fashion

Up to now, the reader has only been introduced to the photons, admittedly not explicitly, which are swallowed or emitted by the H atoms at M = 2 during the transition of the main quantum number from n = 1 to n = 2 or vice versa, and they have the energy $2 \cdot E_{\varepsilon 2}$, because the mass of the maximum three existing H atoms with a main quantum number n = 1 at M = 2 increases by two epsilon masses at the transition to n = 2; no matter how large the momentum of one of the H atoms without test particle was before the transition from n =1 to n = 2, afterwards the respective atom rests, as already concluded above, and the total momentum of the H atom with n = 1 is cancelled by the momentum of this photon; logically, otherwise the H atom with n = 2 could not rest relative to the test particle.

However, a central question now arises: When, and in particular where, can an electron rest at M = 2? It is permanently exposed to an electric field in a Reissner–Nordstrøm hole[11], which the author thinks the universe must be (still to be proved for M > 1), because the test particle outside the hole carries an electric charge, and since in this model complete charge balance is demanded within the world W, the hole must also carry the corresponding charge, but with opposite sign, thus in the case of a matter universe with a minus, because the test particle is positively charged. And if an electric field acts on an electron, it moves, if it does not stick just somewhere.

There’s a quite simple answer to this central question.

Be it that the distance between the test particle and its antipole in this positively bent model of an universe is defined as $2 \cdot R_{Stat}$. 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, 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. 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.

However, before considering this further, it is important at this point to return to the conclusions at the end of the second chapter. There the author last dealt with the second solution of the Reissner–Nordstrøm metric[11], in the form of eq. (43.3). Since the discriminant in this equation is zero for M = 1, one can kick this second solution into the long grass. But this does not persist for M > 1, as was already stated earlier.

At a first glance, for M = 2, eq. (43.3) should change into

$$r_{-2} = [M_{Un2} - m_{p2}(v_{p2}=0)] \cdot \frac{G}{c^2} - \left[[M_{Un2} - m_{p2}(v_{p2}=0)]^2 \cdot \frac{G^2}{c^4} - e_2^{*2} \cdot \frac{G}{c^4} \right]^{1/2} ; \quad (43.4)$$

and (43.2) should look like this:

$$R_{Stat2} = [M_{Un2} - m_{p2}(v_{p2}=0)] \cdot \frac{G}{c^2} + \left[[M_{Un2} - m_{p2}(v_{p2}=0)]^2 \cdot \frac{G^2}{c^4} - e_2^{*2} \cdot \frac{G}{c^4} \right]^{1/2} ; \quad (43.5)$$

but that's deceptive. As explained on page 41 in the third paragraph, the test set must consist of more than one proton – except for M =1; for M = 2, one already needs a test set consisting of three protons to bring about electric charge balance in the universe. Yet, one can use this test set in different ways; e.g. sequentially, thus from the perspective of a single proton, but this as often as there are protons in the test set, or synchronously from the perspective of all protons of the test set at the same time; this would correspond to the conditions at M = 1: All elements of the test set are quasi simultaneous and non–existent for each other, because only the rest of the universe acts on them, but not the elements of the test set on each other.

From the author's point of view, the most reasonable procedure to determine which physical properties the universe has at M = 2, is to discuss the case of the smallest possible test set and the case of the largest possible test set in detail, but separately. In both cases it makes sense to consider the world synchronously, and this for the reasons already described on page 41.

Let the test set be understood as a set containing the three protons at M = 2; however, this does not mean that this test set also has only three times the mass of the resting proton. On the contrary, it is to be expected that the mass of this test set is clearly larger than 3×12 epsilon masses, although the electric charge of this test set must indeed be equal to three elementary charges. M is then equal to

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

(i.e., the total mass of the universe minus the mass of the test set).

With

$$E_{Un2} = M_{Un2}\,c^2 \qquad (80)$$

(77.1) yields with (49)

$$M_{Un2} = 84\, m_{\varepsilon 2}\,; \qquad (77.2)$$

thus, (43.5) is replaced by

$$R_{Stat2} = [\, M_{Un2} - M_{Test2}\,(v_{Test2}{=}0)\,] \cdot \frac{G}{c^2} + \left[[\, M_{Un2} - M_{Test2}\,(v_{Test2}{=}0)\,]^2 \cdot \frac{G^2}{c^4} - [Q_2]^2 \cdot \frac{G}{c^4} \right]^{1/2}; \qquad (43.6)$$

here, $Q_2 = 3\,e_2^*$, because the test set contains the equivalent of three protons together with their electrical charge.

Well, what is the biggest possible synchronous test set?

At first glance, the answer looks simple. Eq. (43.6) contains a square root on the right side. If the numerical value of the discriminants of this square root would be negative, R_{Stat2} would be a complex number. However, physical distances are to be expressed by real numbers according to experience. That it could be different for Kerr–Newman[53] or Reissner–Nordstrøm holes[11] is an unproven hypothesis. The author therefore excludes negative discriminants in (43.6).

Thus, the largest possible synchronous test set would be the one where the difference of the two terms of the discriminant would be exactly zero. This case shall now be considered, and the value of the corresponding test set mass in relation to the epsilon mass shall be determined.

First, in analogy to eq. (19) for M = 2:

$$E_{pot2}(Un) = -\frac{M_{Test2}(v_{Test2}=0)\cdot[M_{Un2} - M_{Test2}(v_{Test2}=0)]\cdot G}{R_{Stat2}} - \frac{[Q_2]^2}{R_{Stat2}}\ ; \qquad (81)$$

with (78) and $Q_2 = 3\ e_2{}^*$:

$$-84\ E_{\varepsilon 2} = -\frac{M_{Test2}(v_{Test2}=0)\cdot[M_{Un2} - M_{Test2}(v_{Test2}=0)]\cdot G}{R_{Stat2}} - \frac{[3\cdot e_2{}^*]^2}{R_{Stat2}}\ ; \qquad (81.1)$$

(81.1) solved for R_{Stat2} and equalized with (43.6) yields with (47) and (77.1)

$$0 = \left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]^4 - 336\cdot\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]^3 + 34632\cdot\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]^2 -$$

$$- 1076544\cdot\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}} - 2181168\ ; \qquad (81.2)$$

and this equation of 4th degree has four real solutions:

$$\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_1 \approx -1.9069263796581188\ ;$$

$$\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_2 = 66\ ;$$

$$\left[\frac{M_{Test2}\,(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_3 = 102\ ;$$

$$\left[\frac{M_{Test2}\,(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_4 \approx 169.9069263796581188\ ;$$

of these four solutions only the second one may come into closer consideration, because the number of epsilons available for the formation of a test set at M = 2 is 84. The mass ratio between the mass of the test set and the epsilon mass is taken as a positive quantity here, which excludes solution 1.

So here's what's finally written:

$$\frac{M_{Test2}\,(v_{Test2}=0)}{m_{\varepsilon 2}} = 66\ ; \qquad (81.3)$$

$$M_{Test2}\,(v_{Test2}=0) = 66 \cdot m_{\varepsilon 2}\ ; \qquad (81.4)$$

thus, in the synchronous case, the largest possible test set, bearing three elementary electric charges, consists of 66 epsilons. In order to create a balance worldwide with the latter, the rest of the world, i.e. the hole, must have three elementary charges of opposite sign. Together with (77.2), (80) and $Q_2 = 3\ e_2^*$, (43.6) yields

$$R_{Stat2} = [\,84 - 66\,] \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[\,[\,84 - 66\,]^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 3^2 \cdot e_2^{*2} \cdot \frac{G}{c^4}\right]^{1/2}\ ; \qquad (43.7)$$

$$R_{Stat2} = 18 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[\,18^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 9 \cdot e_2^{*2} \cdot \frac{G}{c^4}\right]^{1/2}\ ;$$

with (47):

$$R_{Stat2} = 18 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[324 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 9 \cdot 36 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} \right]^{1/2} ; \qquad (43.8)$$

9 times 36 is equal to 324, so the diskriminant is zero:

$$R_{Stat2} = 18 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.9)$$

as already explained above, this is half the distance between the test set and its universal antipole, in case of the largest possible test set with 66 epsilon masses. $2 \cdot R_{Stat2}$ is the average universal radius, i.e. the arithmetic mean between twice the largest possible error and twice the smallest possible error:

$$2 \cdot R_{Stat2} = 36 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.10)$$

(41.2) with (43.8) for M = 2 :

$$\tfrac{1}{2} \cdot \Delta X_2 = 18 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ;$$

$$\Delta X_2 = 36 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.11)$$

with (49):

$$\Delta X_2 = 36 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} ; \qquad (43.12)$$

and, also a result of (41.2) together with (43.8) 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 positive errors:)

$$\Delta z_2 = 36 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (43.13)$$

whether this error is equal to the smallest possible error of electromagnetic measure–ments is left open for the moment. This will be investigated later. However, the author introduces already here an equation, which shall be examined more exactly in the 6th chapter for M » 1. It is

$$\frac{k_2 \hbar}{m_{p2}\,(v_{p2}=0)c} = \Delta z_2 \;; \qquad (82)$$

the test set has a certain extension. In the worst case, its center of gravity is in the minor biggest possible distance to the universal equator, and in the best case in the major biggest possible distance to it. In the worst case, the test set is just barely not sucked irretrievably into the hole; in the best case, it just barely touches its static limit[38]. Both cases represent the largest possible deviations from the mean orbit of the test particle around the Reissner–Nordstrøm hole[11], an orbit which corresponds to the static limit[38], and these largest possible deviations are described by the second solution of the Reissner–Nordstrøm equation[11]; this result is also called the Cauchy horizon[55] of the electrically charged hole.

Eq. (43.4), altered in the same way as (43.6):

$$r_{-2} = [\, M_{Un2} - M_{Test2}\,(v_{Test2}=0)\,] \cdot \frac{G}{c^2} - \left[[\, M_{Un2} - M_{Test2}\,(v_{Test2}=0)\,]^2 \cdot \frac{G^2}{c^4} - [Q_2]^2 \cdot \frac{G}{c^4} \right]^{1/2} ; \qquad (43.14)$$

yields together with (77.2), (81.3) and $Q_2 = 3\ e_2^*$

$$r_{-2} = [\, 84 - 66\,] \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} - \left[[\, 84 - 66\,]^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 3^2 \cdot e_2^{*2} \cdot \frac{G}{c^4} \right]^{1/2} .$$

.

With (47) and (49):

$$r_{-2} = 18 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \; ; \qquad (47.1)$$

by the way, the static limit[38] is a statistical mean value from which r_{-2} is the maximum possible deviation; in fact, the location of the test particle can only be given by $\pm r_{-2}$, because the Heisenberg uncertainty relation[52] does not allow a more precise location. So the test particle is somewhere in a distance between ΔX_2 and Δx_2 from the equator of the black hole. The distance R_{Stat2} represents a purely statistically meant statement (whereby this has nothing to do with the static in the designation static boundary), in the sense that the test particle is at this average distance from the equator.

The attentive reader will have noticed it; the case distinction between (43.6) and (43.14) is unnecessary, because the discriminant in it is equal to zero. That the author has nevertheless made it, has its reason in the fact that he wanted to clarify the difference between static limit[38] and Cauchy horizon[55].

The discriminant in question must now come more precisely into focus.

It results quite generally, i.e. independently of M, from the definition of the fine structure constant[15]:

$$\alpha := \frac{e^{*2}}{c \cdot \hbar} \; ; \qquad (83)$$

please compare with eq. (15.9). (83) may also be written like that:

$$\alpha \cdot c \cdot \hbar = e^{*2} \; ;$$

$$\alpha \cdot \frac{c \cdot \hbar}{G} \cdot G = e^{*2} \; ; \qquad / \cdot G$$

$$\alpha \cdot \frac{c \cdot \hbar}{G} \cdot G^2 = e^{*2} \cdot G \; ; \qquad / \cdot (2M-1)^2$$

$$(2M-1)^2 \cdot \alpha \cdot \frac{c \cdot \hbar}{G} \cdot G^2 = (2M-1)^2 \cdot e^{*2} \cdot G \; ; \qquad / :c^4$$

$$0 = (2M-1)^2 \cdot \alpha \cdot \frac{c \cdot \hbar}{G} \cdot G^2 \cdot c^{-4} - (2M-1)^2 \cdot e^{*2} \cdot G \cdot c^{-4} \; ; \qquad (83.1)$$

with the definition of the Planck mass[40]

$$M_P := \left[\frac{c \cdot \hbar}{G} \right]^{1/2} \qquad (84)$$

(83.1) yields

$$0 = (2M - 1)^2 \cdot \alpha \cdot M_P{}^2 \cdot G^2 \cdot c^{-4} - (2M - 1)^2 \cdot e^{*2} \cdot G \cdot c^{-4} \; ; \qquad (83.2)$$

that's the discriminant in (16.4), (43.6) or (43.14), the last both equations with $Q_2 = 3\,e_2{}^*$. Because for M = 1, (83.2) yields with (15.9)

$$0 = M_P{}^2 \cdot G^2 \cdot c^{-4} - e_1{}^{*2} \cdot G \cdot c^{-4} \; ;$$

once again with (15.9):

$$0 = M_P{}^2 \cdot G^2 \cdot c^{-4} - c \cdot \hbar \cdot G \cdot c^{-4} \; ;$$

and with (84):

$$0 = M_P{}^2 \cdot G^2 \cdot c^{-4} - M_P{}^2 \cdot G^2 \cdot c^{-4} \; ;$$

V q.e.d.

And for M = 2, eq. (83.2) yields with (43.6) and $Q_2 = 3\,e_2{}^*$

$$0 = (2 \cdot 2 - 1)^2 \cdot \alpha_2 \cdot M_P{}^2 \cdot G^2 \cdot c^{-4} - (2 \cdot 2 - 1)^2 \cdot e_2{}^{*2} \cdot G \cdot c^{-4} \; ;$$

$$0 = 3^2 \cdot \alpha_2 \cdot M_P{}^2 \cdot G^2 \cdot c^{-4} - 3^2 \cdot e_2{}^{*2} \cdot G \cdot c^{-4} \; ; \qquad (83.3)$$

where the negative term in the discriminant of eq. (43.7) is identical to the negative term in (83.3). Because the discriminant is in both cases equal to zero, one may also substitute the positive term in the discriminant of eq. (43.7) with the one in (83.3):

$$3^2 \cdot \alpha_2 \cdot M_P{}^2 \cdot G^2 \cdot c^{-4} = [\, 84 - 66 \,]^2 \cdot (m_{\varepsilon 2})^2 \cdot G \cdot c^{-4} \; ;$$

what yields with (43.6), (77.2) and (81.3)

$$3^2 \cdot \alpha_2 \cdot M_P{}^2 \cdot G^2 \cdot c^{-4} = [\, M_{Un2} - M_{Test2}(v_{Test2}=0) \,]^2 \cdot G \cdot c^{-4} \,.$$

And that results in

$$9 \cdot \alpha_2 \cdot M_P{}^2 = [\, M_{Un2} - M_{Test2}(v_{Test2}=0) \,]^2 \; ;$$

$$\alpha_2 = \frac{[\, M_{Un2} - M_{Test2}(v_{Test2}=0) \,]^2}{9 \cdot M_P{}^2} \; ; \qquad (83.4)$$

with (77.2) and (81.3):

$$\alpha_2 = \frac{[18\cdot m_{\varepsilon 2}]^2}{9\cdot M_P{}^2} \; ; \qquad (83.4)$$

[notice: This is simply another way of writing eq. (47).]

further down it will be investigated in which relation M_P and $m_{\varepsilon 2}$ are standing to each other.

Now, however, after discussing the largest possible test set, it's time to discuss the smallest possible synchronous test set when M = 2.

So: what is the smallest possible synchronous test set?

At M = 2, the three protons, already discussed in detail above, are virtually broken down into their individual parts (without affecting the set–theoretic structure of the test set defined by its three elements, the protons). Synchronous means that all elements of the test set are quasi simultaneous and therefore non–existent for each other, because only the rest of the universe acts on them, but not the elements of the test set on each other. This corresponds to the situation at M = 1; there the three epsilons, of which the proton consists, are also non–existent for each other, because they are at the same time on the bottom of the potential well, which is represented by this cosmolo–gical model. Then, in all elements of the test set as well as again the elements of these elements etc., in the minimum case of a synchronous representation way, altogether 3 times 18 elements, i.e. epsilons are contained, what together results in 54 epsilons:

$$M_{Test2}(v_{Test2}=0) = 54\ m_{\varepsilon 2}\ . \qquad (85)$$

(43.6) with (77.2), (85) and $Q_2 = 3\ e_2{}^*$, because the test set contains the equivalent of three protons together with their electrical charge – in order to reach a worldwide compensation concerning the latter, the rest of the world, i.e. the hole, has to come with three elementary electric charges of opposite sign:

$$R_{Stat2} = [\ 84 - 54\ ] \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[[\ 84 - 54\ ]^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 3^2 \cdot e_2{}^{*2} \cdot \frac{G}{c^4} \right]^{1/2} \; ;$$

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[30^2 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 9 \cdot e_2{}^{*2} \cdot \frac{G}{c^4} \right]^{1/2} \; ;$$

with (47):

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

$$R_{Stat2} = 30 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} + \left[900 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4} - 324 \cdot (m_{\varepsilon 2})^2 \cdot \frac{G^2}{c^4}\right]^{½} ; \qquad (43.15)$$

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

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

$$R_{Stat2} = 54 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.16)$$

as the author explained already several times before, this is half the distance between the test particle and its antipole. $2 \cdot R_{Stat2}$ is the medial universal radius, i.e. the arithmetic mean of the doubled major and the doubled minor biggest possible error:

$$2 \cdot R_{Stat2} = 108 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.17)$$

(41.2) mit (43.15) für M = 2 :

$$½ \cdot \Delta X_2 = 54 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ;$$

$$\Delta X_2 = 108 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} ; \qquad (43.18)$$

with (49):

$$\Delta X_2 = 108 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \;; \qquad (43.19)$$

and also with (41.2) as well as (43.15) for M = 2 :

$$¼\cdot(\Delta z_2)^2 = 324 \cdot [E_{\varepsilon 2}]^2 \cdot \frac{G^2}{c^8} \;;$$

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

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

(only positive errors:)

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

this is once again the confirmation of equation (43.13). And one recognizes here that the smallest possible error is the same, no matter whether one chooses the largest possible or the smallest possible test set at M = 2.

Starting from (43.14), one gets with $Q_2 = 3\, e_2^*$ and (85) the„Cauchy horizon[55] of the electric charged Reissner–Nordstrøm hole[11] in the case of the smallest possible test set at M = 2 :

$$r_{-2} = [\, M_{Un2} - M_{Test2}(v_{Test2}{=}0)\,] \cdot \frac{G}{c^2} - \left[[M_{Un2} - M_{Test2}(v_{Test2}{=}0)]^2 \cdot \frac{G^2}{c^4} - 9\, e_2^{*2} \cdot \frac{G}{c^4} \right]^{½} \;;$$

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

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

$$r_{-2} = 6 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \; ; \qquad (47.2)$$

the result differs from that of eq. (47.1); there it is three times as large. But both times we have to do with the synchronous case. What is the difference?

As already indicated by (82), r_{-2} has something to do with the Compton wavelength of the proton[60]. And this is particularly small with a large proton mass, because the latter is in its denominator in the formula concerning this. Also a test set, which consists of several particles, can be assigned a corresponding wavelength; however, this has no fundamental physical meaning, but only a wavelength, which can be assigned to a single particle. In the smallest possible synchronous case examined here, the test set is composed of three protons. So r_{-2} has to be tripled, because for this purpose only a reference to one of the three protons each can be made; again for reminding: In the formula for the Compton wavelength of the proton[60] the proton mass is in the denominator. If it is to be inserted there instead of the mass of the entire test set, the said wavelength is tripled, of course. (47.2) must therefore be corrected accordingly:

$$r_{-2} = 3 \cdot 6 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \; ;$$

$$r_{-2} = 18 \cdot E_{\varepsilon 2} \cdot \frac{G}{c^4} \; ; \qquad (47.3)$$

Now, the energy of the epsilon shall be calculated in MKS units[44].

If $E_{tot2}(Un)$ is the total energy of all masses contained in the universe excluding that of the test set, $E_{kin2}(Un)$ is the corresponding kinetic energy, and $E_{pot2}(Un)$ is the corresponding potential energy, this equation applies:

$$E_{tot2}(Un) = E_{kin2}(Un) + E_{pot2}(Un) \; ; \qquad (86)$$

here, according to SRT[16] [please compare with eq. (14)]

$$E_{Un2}(Rest) := [E_{Un2} - M_{Test2}(v_{Test2}=0)c^2] = \left[[p_{Un2}(Rest) \cdot c]^2 + \left[E_{Un2}(Rest; v_{Un2}=0) + E_{pot2}(Un) \right]^2 \right]^{½} ,$$

(the equation to the right is eq. 87)

where $p_{Un2}(Rest)$ is the momentum of the mass of the universe without the mass of the test set; furthermore, this trivial relationship applies:

$$E_{Un2}(Rest) = E_{Un2}(Rest;v_{Un2}=0) + E_{tot2}(Un) \; ; \qquad (88)$$

(87) squared:

$$[E_{Un2}(Rest)]^2 = [p_{Un2}(Rest)\cdot c]^2 + \Big[E_{Un2}(Rest;v_{Un2}=0) + E_{pot2}(Un)\Big]^2 ; \qquad (87.1)$$

with the momentum of the whole mass of the universe minus the mass of the test particle

$$p_{Un2}(Rest) = [M_{Un2} - M_{Test2}(v_{Test2}=0)]\cdot v_{Un2}(Rest) \, , \qquad (89)$$

and

$$E_{Un2}(Rest) = [M_{Un2} - M_{Test2}(v_{Test2}=0)]\cdot c^2 \qquad (90)$$

(87.1) yields

$$[E_{Un2}(Rest)]^2 = [E_{Un2}(Rest)]^2\cdot(v_{Un2}(Rest)/c)^2 + \\ + \Big[E_{Un2}(Rest;v_{Un2}=0)+E_{pot2}(Un)\Big]^2 ;$$

$$[E_{Un2}(Rest)]^2\cdot\{1-[v_{Un2}(Rest)/c]^2\} = \Big[E_{Un2}(Rest;v_{Un2}=0) + E_{pot2}(Un)\Big]^2 ; \qquad (87.2)$$

with (86) and (88):

$$[E_{Un2}(Rest)]^2\cdot\{1-[v_{Un2}(Rest)/c]^2\} = \Big[E_{Un2}(Rest) - E_{kin2}(Un)\Big]^2 ;$$

$$[E_{Un2}(Rest)]^2 = [E_{Un2}(Rest)]^2\cdot(v_{Un2}(Rest)/c)^2 + [E_{Un2}(Rest)]^2 - \\ - 2\cdot E_{Un2}(Rest)\cdot E_{kin2}(Un) + [E_{kin2}(Un)]^2 ;$$

$$0 = [E_{Un2}(Rest)]^2\cdot(v_{Un2}(Rest)/c)^2 - \\ -2\cdot E_{Un2}(Rest)\cdot E_{kin2}(Un)) + [E_{kin2}(Un)]^2 ; \qquad /\sqrt{}$$

$$[E_{kin2}(Rest)]_{1,2} = E_{Un2}(Rest) \pm \Big[[E_{Un2}(Rest)]^2 - \\ - [E_{Un2}(Rest)]^2\cdot[v_{Un2}(Rest)/c]^2 \Big]^{1/2} ; \qquad (87.3)$$

the first solution is

$$[E_{kin2}(Rest)]_1 = E_{Un2}(Rest)\cdot\left[1+\left(1-[v_{Un2}(Rest)/c]^2\right)^{1/2}\right] ; \qquad (87.4)$$

and the second one:

$$[E_{kin2}(Rest)]_2 = E_{Un2}(Rest)\cdot\left[1-\left(1-[v_{Un2}(Rest)/c]^2\right)^{1/2}\right] ; \qquad (87.5)$$

if $v_{Un2}(Rest)$ equals zero, (86.4) yields

$$[E_{kin2}(Rest)]_1 = 2\cdot E_{Un2}(Rest) ; \qquad (87.6)$$

what's definitely wrong, because kinetic energy is energy of movement – if nothing moves, there's no kinetic energy. Thus, only eq. (87.5) is correct:

$$E_{kin2}(Rest) = E_{Un2}(Rest)\cdot\left[1-\left(1-[v_{Un2}(Rest)/c]^2\right)^{1/2}\right] ; \qquad (86.7)$$

conservation of momentum is valid at the transition from M = 1 to M = 2; the test set has the momentum zero, so the universal total momentum is that of the remaining mass m_{Un2}(Rest); because of this, the following equation is valid:

$$E_{Un2}(Rest) = m_{Un2}(Rest)\cdot c^2 ; \qquad (91)$$

and said conservation of momentum may be expressed as follows:

$$m_{e1}\cdot v_{e1} = m_{Un2}(Rest)\cdot v_{Un2}(Rest) ; \qquad (92)$$

with (15.3) and (15.4):

$$\left(c^3\hbar / G\right)^{1/2} = m_{Un2}(Rest)\cdot v_{Un2}(Rest) ; \qquad (92.1)$$

with (91):

$$\left(c^7\hbar / G\right)^{1/2} = E_{Un2}(Rest)\cdot v_{Un2}(Rest) ;$$

resolved to v_{Un2}(Rest):

$$v_{Un2}(Rest) = \frac{\left(c^7\hbar / G\right)^{1/2}}{E_{Un2}(Rest)} ; \qquad (92.2)$$

into (87.7):

$$E_{kin2}(Rest) = E_{Un2}(Rest)\cdot\Big[1-\Big(1-\big(c^5\hbar / G\big) / [E_{Un2}(Rest)]^2\Big)\Big]\ ; \qquad (87.8)$$

$$E_{Un2}(Rest) - E_{kin2}(Rest) = E_{Un2}(Rest)\cdot\Big(1-\big(c^5\hbar / G\big) / [E_{Un2}(Rest)]^2\Big)\ ; \qquad / \cdot[E_{Un2}(Rest)]^2$$

assuming positive mass energy:

$$E_{kin2}(Rest)\cdot E_{Un2}(Rest) = \big(c^5\hbar / G\big)\ ; \qquad (87.9)$$

(86), (87.1) and (88) yield with (89), (90) and (91):

$$[E_{Un2}(Rest)]^2 = \big(c^5\hbar / G\big) + \Big[E_{Un2}(Rest) - E_{kin2}(Un)\Big]^2; \qquad (87.10)$$

this with (87.9):

$$[E_{Un2}(Rest)]^2 = \big(c^5\hbar / G\big) + \Big[E_{Un2}(Rest) - \big(c^5\hbar / G\big) / E_{Un2}(Rest)\Big]^2;$$

multiplied by $[E_{Un2}(Rest)]^2$:

$$[E_{Un2}(Rest)]^4 = [E_{Un2}(Rest)]^2\cdot\big(c^5\hbar / G\big) + \Big[[E_{Un2}(Rest)]^2 - \big(c^5\hbar / G\big)\Big]^2;$$

$$[E_{Un2}(Rest)]^4 =$$
$$= [E_{Un2}(Rest)]^2\cdot\big(c^5\hbar / G\big) + [E_{Un2}(Rest)]^4 - 2\cdot[E_{Un2}(Rest)]^2\cdot\big(c^5\hbar / G\big) + \big(c^5\hbar / G\big)^2;$$

$$0 = [E_{Un2}(Rest)]^2\cdot\big(c^5\hbar / G\big) - 2\cdot[E_{Un2}(Rest)]^2\cdot\big(c^5\hbar / G\big) + \big(c^5\hbar / G\big)^2;$$

divided by $\big(c^5\hbar / G\big)$:

$$0 = [E_{Un2}(Rest)]^2 - 2\cdot[E_{Un2}(Rest)]^2 + \big(c^5\hbar / G\big);$$

$$[E_{Un2}(Rest)]^2 = \big(c^5\hbar / G\big); \qquad / \sqrt{\ }$$

$$E_{Un2}(Rest) = \big(c\hbar / G\big)^{1/2}\cdot c^2\ ; \qquad (87.11)$$

with (77.2), (80) and (81.3) that yields

$$18\cdot E_{\varepsilon 2} = \big(c\hbar / G\big)^{1/2}\cdot c^2\ ;$$

$$E_{\varepsilon 2} = {}^{1}/_{18}\cdot\big(c\hbar / G\big)^{1/2}\cdot c^2\ ; \qquad (87.12)$$

(87.11) into (87.9):

$$E_{kin2}(\text{Rest})\cdot\left(c\hbar / G\right)^{½}\cdot c^2 = \left(c^5\hbar / G\right) ;$$

$$E_{kin2}(\text{Rest}) = \left(c\hbar / G\right)^{½}\cdot c^2 ; \qquad (87.13)$$

this and (87.11) into (87.7):

$$\left(c\hbar / G\right)^{½}\cdot c^2 = \left(c\hbar / G\right)^{½}\cdot c^2\cdot\left[1-\left(1-[v_{Un2}(\text{Rest})/c]^2\right)^{½}\right] ;$$

$$1 = 1-\left(1-[v_{Un2}(\text{Rest})/c]^2\right)^{½} ;$$

$$0 = -\left(1-[v_{Un2}(\text{Rest})/c]^2\right)^{½} ; \qquad \text{/ squared}$$

$$0 = 1-[v_{Un2}(\text{Rest})/c]^2 ;$$

$$[v_{Un2}(\text{Rest})/c]^2 = 1 ; \qquad /\sqrt{\ }$$

assuming a positive velocity:

$$v_{Un2}(\text{Rest}) = c ; \qquad (87.14)$$

(87.12) with (77.1):

$$E_{Un2} = 84\cdot{}^{1}/_{18}\cdot\left(c\hbar / G\right)^{½}\cdot c^2 ;$$

$$E_{Un2} = {}^{14}/_{3}\cdot\left(c\hbar / G\right)^{½}\cdot c^2 ;$$

$$E_{Un2} = 4^{2}/_{3}\cdot\left(c\hbar / G\right)^{½}\cdot c^2 ; \qquad (77.3)$$

(87.12) with (85):

$$M_{Test2}(v_{Test2}{=}0) = 54\cdot{}^{1}/_{18}\cdot\left(c\hbar / G\right)^{½}\cdot c^2 ;$$

$$M_{Test2}(v_{Test2}{=}0) = 3\cdot\left(c\hbar / G\right)^{½}\cdot c^2 ; \qquad (85.1)$$

(87.12) with (49), (83.4) and (84):

$$\alpha_2 = \frac{324\cdot{}^{1}/_{324}\cdot\left(c\hbar / G\right)}{9\cdot\left(c\hbar / G\right)} ;$$

$$\alpha_2 = {}^1/_9 \; ; \qquad (83.5)$$

that is the fine structure constant[15] at M = 2.

(87.12) with (67) and (67.1):

$$m_{p2}\,(v_{p2}{=}0) = 12 \cdot {}^1/_{18} \cdot \left(c\hbar / G\right)^{½} \; ;$$

$$m_{p2}\,(v_{p2}{=}0) = {}^2/_3 \cdot \left(c\hbar / G\right)^{½} \; ; \qquad (67.2)$$

[author's note: Since in the previous versions of this paper a proton rest mass of one Planck mass[40] was obtained, which would mean that the proton at M = 2 would be a Reissner–Nordstrøm hole[11] , in comparison with that, this result here is obviously much less problematic!]

Starting from (43.16), one gets with (49) and (87.12)

$$R_{Stat2} = 54 \cdot {}^1/_{18} \cdot \left(c\hbar / G\right)^{½} \cdot \frac{G}{c^2} \; ;$$

$$R_{Stat2} = 3 \cdot \left(G\hbar / c^3\right)^{½} \; ; \qquad (43.20)$$

with

$$R_P := \left[\frac{G \cdot \hbar}{c^3}\right]^{½} , \qquad (93)$$

the definition of the Planck length[41], one can write (43.20) as follows:

$$R_{Stat2} = 3 \cdot R_P \; ; \qquad (43.21)$$

Thus, the average universal radius, i.e. the arithmetic mean between double major largest possible error and double minor largest possible error, is exactly equal to 6 Planck lengths[41] in case of the smallest possible synchronous test set.

Back to the considerations of the author on page 41. There he asks the question whether with a frame number M = 2 the shortest electromagnetically measurable time $\tau_2 := \sigma_2/c$ could be probably clearly longer than the Planck time[58]. Nowadays this is the case; τ is at present approx. 10^{20} times larger than the Planck time[58] T_P .

The latter is defined as follows:

$$T_P := \left[\frac{G \cdot \hbar}{c^3} \right]^{½} ; \qquad (94)$$

the question of the author can now be answered quite easily. The wavelength of the shortest wavelength radiation at M = 2 corresponds to the Compton wavelength of the resting proton, l_{c2}, which is the test particle in the sequential view of the world:

$$\frac{l_{c2}}{2\pi} = \frac{\hbar}{m_{p2}(v_{p2}=0) \cdot c} ; \qquad (95)$$

with (49) and (61.6):

$$\frac{l_{c2}}{2\pi} = \frac{c\,\hbar}{12\,E_{\varepsilon 2}} ; \qquad (95.1)$$

At M = 2, no particle exists whose mass exceeds that of the proton at rest. Thus it is justified to set Eddington's[12] smallest possible error of distance measurement as follows:

$$\sigma_2 := \frac{l_{c2}}{2\pi} . \qquad (96)$$

(95.1) with (87.12):

$$\frac{l_{c2}}{2\pi} = \frac{c\,\hbar}{12 \cdot {}^{1}/_{18} \cdot \left(c\hbar / G\right)^{½} \cdot c^2} ;$$

$$\frac{l_{c2}}{2\pi} = \frac{3\,\hbar}{2 \cdot \left(c\hbar / G\right)^{½} \cdot c} ;$$

$$\frac{l_{c2}}{2\pi} = {}^{3}/_{2} \cdot \left(G\hbar / c^3\right)^{½} ; \qquad (95.2)$$

with (93):

$$l_{c2} = 3\pi R_P . \qquad (95.3)$$

Conclusion: The shortest possible wavelength of a photon at M = 2 equals 2π times 1½ Planck length[41].

For the sake of completeness, however, the author would like to deal with the sequential look at the cosmological model. For this now the next question:

What is the largest possible sequential test set?

Apart from eq. (43.21) a final answer to the question about the extent of the universe at a frame number M = 2 is missing. In order to clarify this, the author switches from the synchronous to the sequential view.

With (43.5), (78), (81) and Q2 = e_2^*, since the proton has only one elementary charge, and the exchange of R_{Stat2} by r_{Stat2}, which seems strange at first, one gets the following:

$$84\ E_{\varepsilon 2} = \frac{M_{Test2}\,(v_{Test2}{=}0)\cdot[M_{un2} - M_{Test2}\,(v_{Test2}{=}0)]\cdot G}{r_{Stat2}} + \frac{e_2^{*2}}{r_{Stat2}}\,, \qquad (81.5)$$

one gets in analogy to eq. (81.2) a fourth grade equation.

$$0 = \left[\frac{M_{Test2}\,(v_{Test2}{=}0)}{m_{\varepsilon 2}}\right]^4 - 336\cdot\left[\frac{M_{Test2}\,(v_{Test2}{=}0)}{m_{\varepsilon 2}}\right]^3 + 35208\cdot\left[\frac{M_{Test2}\,(v_{Test2}{=}0)}{m_{\varepsilon 2}}\right]^2 -$$

$$- 1173312\cdot\frac{M_{Test2}\,(v_{Test2}{=}0)}{m_{\varepsilon 2}} - 252270\ ; \qquad (81.6)$$

and this equation has the following four solutions:

$$\left[\frac{M_{Test2}(v_{Test2}{=}0)}{m_{\varepsilon 2}}\right]_1 \approx -0{,}21401308570919778\ ;$$

$$\left[\frac{M_{Test2}(v_{Test2}{=}0)}{m_{\varepsilon 2}}\right]_2 = 78\ ;$$

$$\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_3 = 90 \;;$$

$$\left[\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}}\right]_4 \approx 168{,}2140130857091978 \;;$$

84 – 78 = 6, i.e. 84 minus 78 epsilon masses result in the mass of an excited electron of the test particle, i.e. one on the 2nd Bohr orbit, and of course, this electron carries an elementary charge, which is why inserting the only plausible result number 2

$$\frac{M_{Test2}(v_{Test2}=0)}{m_{\varepsilon 2}} = 78 \;; \qquad (81.7)$$

into eq. (81.5) yields the following:

$$84\,E_{\varepsilon 2} = \frac{78\cdot m_{\varepsilon 2}\cdot[M_{Un2} - 78\cdot m_{\varepsilon 2}]\cdot G}{r_{Stat2}} + \frac{e_2^{*2}}{r_{Stat2}} \;;$$

$$r_{Stat2} = \frac{78\cdot m_{\varepsilon 2}\cdot[M_{Un2} - 78\cdot m_{\varepsilon 2}]\cdot G}{84\,E_{\varepsilon 2}} + \frac{e_2^{*2}}{84\,E_{\varepsilon 2}} \;;$$

with (77.2) and (47):

$$r_{Stat2} = \frac{78\cdot m_{\varepsilon 2}\cdot[84\cdot m_{\varepsilon 2} - 78\cdot m_{\varepsilon 2}]\cdot G}{84\,E_{\varepsilon 2}} + \frac{36\cdot m_{\varepsilon 2}{}^2\cdot G}{84\,E_{\varepsilon 2}} \;;$$

$$r_{Stat2} = \frac{78 \cdot m_{\varepsilon 2} \cdot 6 \cdot m_{\varepsilon 2} \cdot G}{84\ E_{\varepsilon 2}} + \frac{36 \cdot m_{\varepsilon 2}{}^{2} \cdot G}{84\ E_{\varepsilon 2}}\ ;$$

with (49):

$$r_{Stat2} = \frac{78 \cdot m_{\varepsilon 2} \cdot 6 \cdot G}{84 \cdot c^2} + \frac{36 \cdot m_{\varepsilon 2} \cdot G}{84 \cdot c^2}\ ;$$

$$r_{Stat2} = \frac{468 \cdot m_{\varepsilon 2}\, G}{84 \cdot c^2} + \frac{36 \cdot m_{\varepsilon 2} \cdot G}{84 \cdot c^2}\ ;$$

$$r_{Stat2} = \frac{504 \cdot m_{\varepsilon 2}\, G}{84 \cdot c^2}\ ;$$

$$r_{Stat2} = 6\ m_{\varepsilon 2} \cdot \frac{G}{c^2}\ ; \qquad (81.8)$$

with (49) and (87.12):

$$r_{Stat2} = {}^{1}/_{3} \cdot \left(G\hbar / c^3\right)^{1/2}\ ; \qquad (81.9)$$

and that makes it now evident why the author has written r_{Stat2} instead of R_{Stat2} ; a distance r_{Stat2} according to equations (81.8) and (81.9) is impossible, because there's no distance shorter than the Planck length[41]. But the reader may remember it; here, the sequential case is discussed, and, to put it bluntly, the word „sequential" stands for „one step after the other". Because in this case, three protons in turn play the role of a test particle, r_{Stat2} must be multiplied by three, and only then, one gets R_{Stat2} :

$$R_{Stat2} = 3 \cdot r_{Stat2}\ ;$$

with (81.9):

$$R_{Stat2} = \left(G\hbar / c^3\right)^{1/2}\ ; \qquad (81.10)$$

thus, one Planck length[41]. This is the half of the extent of the electron on the 2. Bohr orbit around the test particle; the diameter of the test particle is according to (81.8) and (87.12) in connection with (81.9) and (81.10) two Planck lengths[41].

But there's still one case missing; what's the smallest possible sequential test set?

The question was already answered by the previous explanations. It is the resting proton. Times three taken one after the other, as just demonstrated.

But there is a decisive difference to the immediately before discussed case of the largest possible sequential test set; with the latter, the same contains namely all three protons existing at M = 2, of which per Planck time[58] always only one acts as subject, but in case of the largest possible sequential test set, the other two are either part of that test set, as well as also two electrons and every existing neutrino / anti–neutrino. With the smallest possible sequential test set, however, this is not at all so; here always only one of the three protons is the test set, and this then runs through two more times until all three protons have exercised the role of the test set. A very important consequence of this is that for each of these protons only those particles exist in the rest of the universe whose structure can be derived from the structure of the respective proton (according to assumptions 2 and 3 of this cosmological model; see p. 4 of this paper). For the respec–tive proton, the rest simply does not exist! Thus, also only one third of the mass in the universe exists for the respective test particle, but also only one third of the elementary charge of the electron, and only one third of the universal radius, because for Reissner–Nordstrøm holes[11] their radius as well as their static limit[38] is proportional to their mass and to their charge, which here are each one third of what they would be in case of the smallest possible synchronous universe. Therefore eq. (81.5) as well as also (43.14) must be adapted to these conditions. If one starts from eq. (81.5) and sets there as mass of the test set the mass of a resting proton $m_{p2}\,(v_{p2}=0)$, then one receives the following equation with consideration of the just described:

$$^{1}/_{3}\cdot 84\ E_{\varepsilon 2} = \frac{m_{p2}\,(v_{p2}=0)\cdot[^{1}/_{3}\cdot M_{un2} - m_{p2}\,(v_{p2}=0)]\cdot G}{^{1}/_{3}\cdot r_{Stat2}} + \frac{^{1}/_{9}\cdot e_2^{*2}}{^{1}/_{3}\cdot r_{Stat2}}\,, \qquad (81.11)$$

with (66.1) and (77.2):

$$^{1}/_{3}\cdot 84\ E_{\varepsilon 2} = \frac{12\cdot m_{\varepsilon 2}\cdot[^{1}/_{3}\cdot 84\cdot m_{\varepsilon 2} - 12\cdot m_{\varepsilon 2}]\cdot G}{^{1}/_{3}\cdot r_{Stat2}} + \frac{^{1}/_{9}\cdot e_2^{*2}}{^{1}/_{3}\cdot r_{Stat2}}\,;$$

$$28\ E_{\varepsilon 2} = \frac{12\cdot m_{\varepsilon 2}\cdot[28\cdot m_{\varepsilon 2} - 12\cdot m_{\varepsilon 2}]\cdot G}{^{1}/_{3}\cdot r_{Stat2}} + \frac{^{1}/_{9}\cdot e_2^{*2}}{^{1}/_{3}\cdot r_{Stat2}}\,;$$

with (47):

$$28\ E_{\varepsilon 2} = \frac{12\cdot m_{\varepsilon 2}\cdot 16\cdot m_{\varepsilon 2}\cdot G}{^{1}/_{3}\cdot r_{Stat2}} + \frac{4\cdot m_{\varepsilon 2}^{\,2}\cdot G}{^{1}/_{3}\cdot r_{Stat2}}\,;$$

and with (49):

$$r_{Stat2} = 21 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} \; ; \qquad (81.12)$$

as in the former case of the biggest possible sequential test set, r_{Stat2} has to be tripled in order to get R_{Stat2} :

$$R_{Stat2} = 3 \cdot 21 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} \; ;$$

$$R_{Stat2} = 63 \cdot m_{\varepsilon 2} \cdot \frac{G}{c^2} \; ; \qquad (81.13)$$

that makes with (49) and (87.12):

$$R_{Stat2} = 63 \cdot {}^{1}/_{18} \cdot \left(c\hbar / G\right)^{1/2} \cdot \frac{G}{c^2} \; ;$$

$$R_{Stat2} = {}^{7}/_{2} \cdot \left(c\hbar / G\right)^{1/2} \cdot \frac{G}{c^2} \; ;$$

$$R_{Stat2} = {}^{7}/_{2} \cdot \left(G\hbar / c^3\right)^{1/2} \; ; \qquad (81.14)$$

duplicated, that is the medial distance between the test particle (i.e., the proton as smallest possible sequential test set at M = 2) and its universal antipole:

$$2 \cdot R_{Stat2} = 7 \cdot \left(G\hbar / c^3\right)^{1/2} \; ; \qquad (81.15)$$

the corresponding total mass of the universe is according to (49) and (77.3)

$$M_{Un2} = 4\,{}^{2}/_{3} \cdot \left(c\hbar / G\right)^{1/2} \; ; \qquad (81.16)$$

Thus one would now have calculated all relevant physical properties of a universe with a frame number M = 2, apart from the rest mass (−energy) of the electron. The author dedicates the whole following chapter to the latter, because the calculations concerning this are rather extensive.

The author now returns to eq. (82). This contains a number k_2 which is to be determined for the case of a smallest possible synchronous test set. Why, will become clear in chapter VI. With (43.13), (67.2) and (87.12), eq. (82) changes into

$$\frac{k_2\hbar}{{}^2/_3\cdot\left(c\hbar\,/\,G\right)^{1/2}\cdot c} = 36\cdot{}^1/_{18}\cdot\left(c\hbar\,/\,G\right)^{1/2}\cdot c^2\cdot\frac{G}{c^4}\;;$$

$$k_2 = {}^4/_3\,. \qquad (82.1)$$

At the end of this chapter, the question shall be discussed how the model explains the three generations of quarks. The author would like to illustrate this with two graphical representations; in figure 12 one sees the schematic images of up–, charm– and top–quark, in figure 13 those of down–, strange– and bottom–quark.

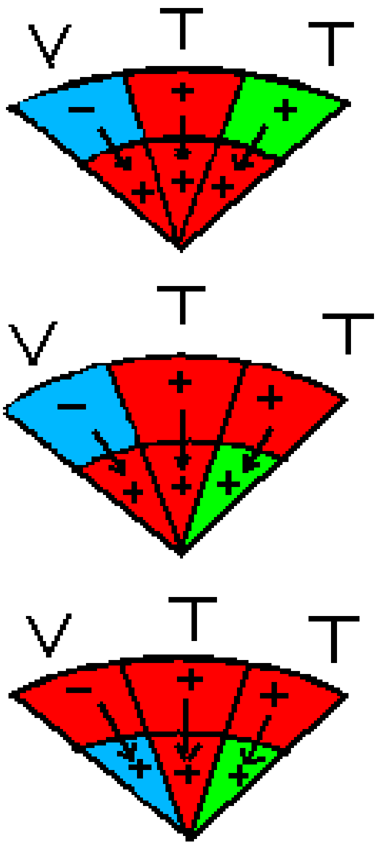

Fig. 12 from top to bottom: u, c and t quark; „+“ stands for +1/6th, „–“ for –1/6th of the elementary electric charge

Above as well as on the next page shown „cake slices“ are modeled on the representation of the quarks in figures 7 to 10 and can be inserted there, in a way.

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.

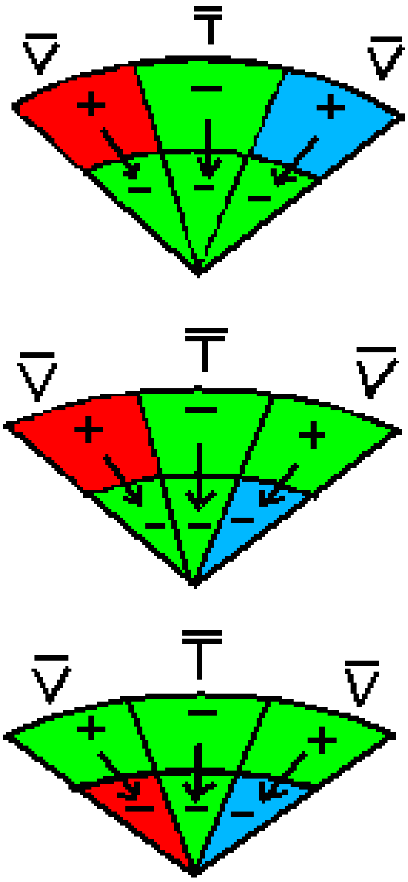

Fig. 13 from top to bottom: d, s and b quark; „+" stands for +1/6th, „–" for –1/6th of the elementary electric charge

Chapter IV.

In this chapter the author wants to calculate the rest mass(–energy) of the electron at M = 2. Some considerations are purposeful here.

The procedure is as follows. The constituents of the hydrogen atoms (already before from time to time simply called H atoms) are examined for their properties, i.e. the protons and electrons contained in them. In addition, the electron of the test particle is examined on its Bohr basic orbit and the 2nd Bohr orbit; other Bohr orbits are not possible in a universe with the frame number M = 2. Finally, when both kinetic and potential energies of the individual particles are known and the rest mass of the electron will be calculated, a short look at the neutrinos will be taken; the author plans to make a detailed treatment of the neutrinos the subject of another, future paper.

Both the kinetic and the potential energy of the proton in the H atoms, which do not contain the test particle, are composed of two components. First, it is the kinetic energy of the proton on its Bohr orbit, and second, it is the fraction of the kinetic energy of the whole H atom which is allotted to the proton, if the latter moves relative to the test particle. And for the potential energy the same is valid, so, on the one hand there is the potential energy of the proton inside the H atom (i.e. relative to the common center of gravity with the electron), and on the other hand the part of the potential energy of the whole H atom relative to the test particle, which is allotted to the proton. The kinetic energy $E_{kin2}(H;e^-;n=1)$ and the potential energy E_{pot2} (p+) of the protons in the H atoms without test particle at a main quantum number n = 1 are sums of the kinetic and potential energies inside and outside the respective H atom, by the way, as well as the corresponding energies of the accompanying electrons, i.e. E_{kin2} $(H;e^-;n=1)$ and also E_{pot2} $(H;e^-;n=1)$.

If the author would use the uranoid model of Eddington[12] already presented above, he wouldn't have to struggle very much; in Eddingtons model, atoms don't move. But here a realistic picture of the universe at M = 2 is to be presented, and in such a picture atoms move (however not if they are observed, as physicists know since some time[61]).

First, the energies of those H atoms which do not contain the test particle shall be calculated. This equation

$$E_{tot2}\,(p^+) = E_{kin2}(p^+) + E_{pot2}(p^+)\ ; \qquad (97)$$

says that the total energy E_{tot2} (p^+) of each of the protons which are no test particles is the sum of the kinetic energy $E_{kin2}(p^+)$ and the potential energy $E_{pot2}(p^+)$ of each of them. According to SRT[16] [see also eq. (14)] this equation applies:

$$E_{p2} = \left[[p_{p2} \cdot c]^2 + \Big[E_{p2}\,(v_{p2}{=}0) + E_{pot2} \Big]^2 \right]^{1/2} \ ; \qquad (98)$$

p_{p2} is the momentum of each of these protons relative to the test particle (all this is valid for a main quantum number n = 1).

And whatsmore, there's also this equation:

$$E_{p2} = E_{p2}(v_{p2}=0) + E_{tot2}(p^+) \; ; \qquad (99)$$

and one gets with (67.1) and (70.2)

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

$$E_{tot2}(p^+) = -2\, E_{\varepsilon 2} \; ; \qquad (99.1)$$

(98) squared:

$$[E_{p2}]^2 = [p_{p2} \cdot c]^2 + \Big[E_{p2}(v_{p2}=0) + E_{pot2}(p^+) \Big]^2 ; \qquad (98.1)$$

with the proton's momentum on its own Bohr base orbit

$$p_{p2} = m_{p2} \cdot v_{p2} \, , \qquad (100)$$

where v_{p2} is the velocity of this proton. Its energy

$$E_{p2} = m_{p2}\, c^2 \qquad (101)$$

results from eq. (98.1)

$$[E_{p2}]^2 = [E_{p2}]^2 \cdot [v_{p2}/c]^2 + \Big[E_{p2}(v_{p2}=0) + E_{pot2}(p^+) \Big]^2 ;$$

$$[E_{p2}]^2 \cdot \Big(1 - [v_{p2}/c]^2 \Big) = \Big[E_{p2}(v_{p2}=0) + E_{pot2}(p^+) \Big]^2 ; \qquad (98.2)$$

with (97) and (99):

$$[E_{p2}]^2 \cdot \Big(1 - [v_{p2}/c]^2 \Big) = \Big[E_{p2} - E_{kin2}(p^+) \Big]^2 ;$$

$$[E_{p2}]^2 = [E_{p2}]^2 \cdot [v_{p2}/ c]^2 + [E_{p2}]^2 - 2 \cdot E_{p2} \cdot E_{kin2}(p^+) + [E_{kin2}(p^+)]^2 ;$$

$$0 = [E_{p2}]^2 \cdot [v_{p2}/ c]^2 - 2 \cdot E_{p2} \cdot E_{kin2}(p^+) + [E_{kin2}(p^+)]^2 ; \, / \sqrt{}$$

$$[E_{kin2}(p^+)]_{1,2} = E_{p2} \pm \Big[[E_{p2}]^2 - [E_{p2}]^2 \cdot [v_{p2} / c]^2 \Big]^{1/2} ; \qquad (98.3)$$

the first solution is

$$[E_{kin2}(p^+)]_1 = E_{p2} \cdot \left[1 + \left(1 - (v_{p2}/c)^2\right)^{1/2}\right] ; \qquad (98.4)$$

and the second one:

$$[E_{kin2}(p^+)]_2 = E_{p2} \cdot \left[1 - \left(1 - (v_{p2}/c)^2\right)^{1/2}\right] ; \qquad (98.5)$$

Both solutions yield with (70.2):

$$[E_{kin2}(p^+)]_1 = 10 \cdot E_{\varepsilon 2} \cdot \left[1 + \left(1 - (v_{p2}/c)^2\right)^{1/2}\right] ; \qquad (98.6)$$

and

$$[E_{kin2}(p^+)]_2 = 10 \cdot E_{\varepsilon 2} \cdot \left[1 - \left(1 - (v_{p2}/c)^2\right)^{1/2}\right] ; \qquad (98.7)$$

v_{p2} is the velocity of these protons relative to the test particle if the main quantum number n equals one. If this velocity in eq. (98.6) equals zero, one gets

$$[E_{kin2}(p^+)]_1 = 10 \cdot E_{\varepsilon 2} \cdot \left[1 + 1\right] ;$$

$$[E_{kin2}(p^+)]_1 = 20 \cdot E_{\varepsilon 2} ;$$

that's definitely wrong. In plain english, kinetic energy is the energy of movement, and if there's no movement, there's also no kinetic energy. And the reader knows since his confrontation with eq. (87.12) that the energy of an epsilon is not zero.

Thus, only eq. (98.7) applies:

$$E_{kin2}(p^+) = 10 \cdot E_{\varepsilon 2} \cdot \left[1 - \left(1 - (v_{p2}/c)^2\right)^{1/2}\right] ; \qquad (98.9)$$

(100) resolved to v_{p2}:

$$v_{p2} = \frac{p_{p2}}{m_{p2}} ;$$

with (70.2) and (101):

$$v_{p2} = \frac{p_{p2}}{10 \cdot E_{\varepsilon 2}} ; \qquad (100.1)$$

From this point, further discussion of the protons in the H atoms that do not contain the test particle and whose principal quantum number equals one is deferred. It will be continued from page 104. Instead, the author now turns to the protons in these atoms if the principal quantum number has increased to n = 2.

For the proton on the 2nd Bohr orbit in those hydrogen atoms without test particle, the following equation applies:

$$E_{tot2}(p^+;n{=}2) = E_{kin2}(p^+;n{=}2) + E_{pot2}(p^+;n{=}2)\ ; \qquad (102)$$

$E_{tot2}(p^+;n{=}2)$ is the total energy of each of both protons at M = 2 which are not test particles; $E_{kin2}(p^+;n{=}2)$ is their kinetic and $E_{pot2}(p^+;n{=}2)$ their potential energy. According to SRT[16] the following equation applies [please compare with eq. (14)]:

$$E_{p2}(n{=}2) = \left[[p_{p2}(n{=}2)\cdot c]^2 + \Big[E_{p2}(v_{p2}{=}0) + E_{pot2}(p^+;n{=}2)\Big]^2 \right]^{1/2};\qquad (103)$$

starting with

$$E_{p2}(n{=}2) = E_{p2}(v_{p2}{=}0) + E_{tot2}(p^+;n{=}2) \qquad (104)$$

one gets with (67.1) and (69.2)

$$11\cdot E_{\varepsilon 2} = 12\cdot E_{\varepsilon 2} + E_{tot2}(p^+;n{=}2)\ ;$$
$$E_{tot2}(p^+;n{=}2) = -E_{\varepsilon 2}\ ; \qquad (104.1)$$

(103) squared:

$$[E_{p2}(n{=}2)]^2 = [p_{p2}(n{=}2)\cdot c]^2 + \Big[E_{p2}(v_{p2}{=}0) + E_{pot2}(p^+;n{=}2)\Big]^2;\qquad (103.1)$$

with the momentum of the proton on its 2nd Bohr orbit

$$p_{p2}(n{=}2) = m_{p2}(n{=}2)\cdot v_{p2}(n{=}2)\ , \qquad (105)$$

whereat the energy of this proton is

$$E_{p2}(n{=}2) = m_{p2}(n{=}2)\ c^2\ , \qquad (106)$$

and then, (103.1) results in

$$[E_{p2}(n{=}2)]^2 = [E_{p2}(n{=}2)]^2\cdot[v_{p2}(n{=}2)/c]^2 + \Big[E_{p2}(v_{p2}{=}0) + E_{pot2}(p^+;n{=}2)\Big]^2;$$

$$[1-[v_{p2}(n{=}2)/c]^2 = 1/[E_{p2}(n{=}2)]^2\cdot\Big[E_{p2}(v_{p2}{=}0) + E_{pot2}(p^+;n{=}2)\Big]^2;\qquad (103.2)$$

with (102) and (104):

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

$$[E_{p2}(n{=}2)]^2 = [E_{p2}(n{=}2)]^2\cdot[v_{p2}(n{=}2)/c]^2 + $$
$$+ [E_{p2}(n{=}2)]^2 - 2\cdot E_{p2}(n{=}2)\cdot E_{kin2}(p^+;n{=}2) + [E_{kin2}(p^+;n{=}2)]^2 ;$$

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

$$[E_{kin2}(p^+;n{=}2)]_{1,2} = E_{p2}(n{=}2) \pm \left[[E_{p2}(n{=}2)]^2 - [E_{p2}(n{=}2)]^2 \cdot [v_{p2}(n{=}2)/c]^2 \right]^{½} ; \qquad (103.3)$$

the first solution is

$$[E_{kin2}(p^+;n{=}2)]_1 = E_{p2}(n{=}2)\cdot\left[1 + \left(1 - (v_{p2}(n{=}2)/c)^2\right)^{½}\right] ; \qquad (103.4)$$

and the second one:

$$[E_{kin2}(p^+;n{=}2)]_2 = E_{p2}(n{=}2)\cdot\left[1 - \left(1 - (v_{p2}(n{=}2)/c)^2\right)^{½}\right] ; \qquad (103.5)$$

with (69.2), the first solution yields

$$[E_{kin2}(p^+;n{=}2)]_1 = 11\cdot E_{\varepsilon 2}\cdot\left[1 + \left(1 - (v_{p2}(n{=}2)/c)^2\right)^{½}\right] ; \qquad (103.6)$$

and the second one:

$$[E_{kin2}(p^+;n{=}2)]_2 = 11\cdot E_{\varepsilon 2}\cdot\left[1 - \left(1 - (v_{p2}(n{=}2)/c)^2\right)^{½}\right] ; \qquad (103.7)$$

$v_{p2}(n{=}2)$ is the velocity of these protons relative to the test particle, in the case that the main quantum number is n = 2. But it is also the velocity with which the proton is traveling on the 2nd Bohr orbit in one of those H atoms which do not contain the test particle.

Solution (103.6) can be discarded, because the kinetic energy at a velocity $v_{p2}(n{=}2) = 0$ must be zero; the epsilon energy is non–zero, as already stated before [see eq. 87.12)]. Thus, only eq. (103.7) is correct:

$$E_{kin2}(p^+;n{=}2) = 11\cdot E_{\varepsilon 2}\cdot\left[1 - \left(1 - (v_{p2}(n{=}2)/c)^2\right)^{½}\right] ; \qquad (103.8)$$

next, the following formula is introduced:

$$m_{p2}(n{=}2) \cdot v_{p2}(n{=}2) = m_{e2}(H;n{=}2) \cdot v_{e2}(H;n{=}2) \; ; \quad (107)$$

it says nothing else than that the momentum of the proton must be equal to the momentum of the electron. This assertion is based on the assumption of a resting H atom. This must now be substantiated more exactly.

The following applies: According to eq. (65) together with (49), electrons composed of varicolored rishons have a mass energy of $3 \cdot E_{\varepsilon 2}$, and, according to eq. (61.5) also together with (49), electrons 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, according to eq. (62.1) together with (49), 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 specific velocity bigger than zero. In the excited state, the total momentum 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 momentum 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!

According to the previous remarks, the proton and electron of the H atoms which do not contain the test particle, are described in the sequential case treated here (see the remarks on p. 56 below) as particles orbiting on circular paths around a common center of mass at rest relative to the test particle.

According to[62]

$$m_{p2}(n{=}2) \cdot r_2(p^+;n{=}2) = m_{e2}(H;n{=}2) \cdot r_2(H;e^-;n{=}2) \quad (108)$$

the ratio of both involved masses is inversely proportional to the ratio of their distances to their common center of gravity, i.e. in this case the H atom that is resting relative to the test particle.

For the electron which orbits on the basic Bohr orbit around the test particle and which according to (73) and (76) has the same mass energy as the first mentioned electron, and, because they are both composed of one unicolored and two varicolored rishons and therefore according to this cosmological model must move with the same velocity relative to the test particle, Bohr's quantum condition[31] is valid in the following form [notice: m_{e2} is already replaced here by $m_{e2}(H;n=2)$ and v_{e2} by $v_{e2}(H;n=2)$]:

$$\hbar = m_{e2}(H;n=2) \cdot v_{e2}(H;n=2) \cdot r_2 \; ; \qquad (109)$$

on the other hand, for the electron in those H atoms not containing the test particle,

$$E_{e2}(H;n=2) = h \cdot \nu_{e2}(H;n=2) \; , \qquad (110)$$

if the main quantum number n = 2. This with

$$\nu_{e2}(H;n=2) = \frac{v_{e2}(H;n=2)}{\lambda_{e2}(H;n=2)} \; ; \qquad (111)$$

where

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

in this context it must be emphasized here that there is an important difference between $r_2(H;e^-;n=2)$ and r_2; the former distance is that of the electron to the common center of mass with the proton in one of the H atoms which do not contain the test particle, while r_2 is the total distance between the electron of the test particle and the latter if this electron has the main quantum number n = 1. So, in the latter case one can use Bohr's quantum condition[31] according to eq. (109), while one cannot do so in the former case, because the proton moves at M = 2 also with considerable velocity, and at this frame number the mass difference between the proton and the electron is not very pronounced, contrary to today.

For the sake of completeness, we must still present the equations corresponding to the above equations (110) to (112), they don't apply to the electron in the H atoms without test particles, but to the corresponding protons:

First, it's

$$E_{p2}(n=2) = h \cdot \nu_{p2}(n=2) \; ; \qquad (113)$$

where $\nu_{p2}(n=2)$ is the frequency of the proton orbiting the same center of gravity as its electron in the H atoms not containing the test particle

$$\nu_{p2}(n=2) = \frac{v_{p2}(n=2)}{\lambda_{p2}(n=2)} \; ; \qquad (114)$$

λ_{p2}(n=2) is the wavelength of the proton on said 2nd Bohr orbit. In an H atom with the principal quantum number n = 2, the 2nd Bohr orbit has a circumference of two wave–lengths of the proton:

$$2 \cdot \lambda_{p2}(n{=}2) = 2\pi \cdot r_2(p^+;n{=}2)\ . \qquad (115)$$

Eq. (108) yields with (49), (61.3), (61.4), (61.5) and (69.2):

$$\frac{r_2(H;e^-;n{=}2)}{r_2(p^+;n{=}2)} = \frac{11 \cdot m_{\varepsilon 2}}{4 \cdot m_{\varepsilon 2}}\ ;$$

$$r_2(p^+;n{=}2) = {}^4/_{11} \cdot r_2(H;e^-;n{=}2)\ ; \qquad (108.1)$$

with (113), (114), (115) and $h{=}2\pi\hbar$:

$$E_{p2}(n{=}2) = \frac{2 \cdot v_{p2}(n{=}2) \cdot \hbar}{{}^4/_{11} \cdot r_2(H;e^-;n{=}2)}\ ; \qquad (113.1)$$

due to the fact that the orbital circumference of the electron of the test particle on the Bohr basic orbit corresponds to a wavelength λ_{e2}, and the further fact that the electron in the H atoms without test particle, which is on the 2nd Bohr orbit, has the same mass energy and the same velocity as the first–mentioned electron and therefore its wavelength is also equal to λ_{e2},

$$\lambda_{e2} = \lambda_{e2}(H;n{=}2)\ , \qquad (116)$$

it must be logical that also the radius of the orbit of the electron in the H–atom without test particle with a principal quantum number n = 2 must be twice as large as that of the electron in the H–atom of the test particle:

$$r_2(H;e^-;n{=}2) = 2 \cdot r_2\ ; \qquad (117)$$

into (113.1):

$$E_{p2}(n{=}2) = \frac{2 \cdot v_{p2}(n{=}2) \cdot \hbar}{{}^4/_{11} \cdot 2 \cdot r_2}\ ;$$

with (109):

$$E_{p2}(n{=}2) = \frac{22 \cdot m_{e2}(H;n{=}2) \cdot v_{e2}(H;n{=}2) \cdot v_{p2}(n{=}2)}{4}\ ;$$

with (61.5) and (69.2):

$$11 \cdot E_{\varepsilon 2} = \frac{22 \cdot 4 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n=2) \cdot v_{p2}(n=2)}{4} ;$$

$$E_{\varepsilon 2} = 2 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n=2) \cdot v_{p2}(n=2) ;$$

with (49):

$$2 \cdot v_{e2}(H;n=2) \cdot v_{p2}(n=2) = c^2 ; \qquad (113.2)$$

as already explained in detail on page 86, the H atoms are at rest at a principal quantum number n = 2 relative to the test particle. The author may therefore perform a simple approach: In both hydrogen atoms at rest relative to the test particle, both the proton and the electron rotate around a common center of mass with the same angular velocity ω_{H2} as seen from the test particle.

The simple approach the author just mentioned reads as follows[63]:

$$v_{p2}(n=2) = \frac{r_2(p^+;n=2) \cdot \omega_{H2}}{\left[1 + \dfrac{(r_2(p^+;n=2) \cdot \omega_{H2})^2}{c^2} \right]^{1/2}} ; \qquad (118)$$

as well as

$$v_{e2}(H;n=2) = \frac{r_2(H;e^-;n=2) \cdot \omega_{H2}}{\left[1 + \dfrac{(r_2(H;e^-;n=2) \cdot \omega_{H2})^2}{c^2} \right]^{1/2}} ; \qquad (119)$$

eq. (118) yields:

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

$$(\omega_{H2})^2 = \frac{1}{[r_2(p^+;n=2)]^2 \cdot \left[\dfrac{1}{[v_{p2}(n=2)]^2} - \dfrac{1}{c^2} \right]} ; \qquad (118.1)$$

and likewise, (119) yields

$$(\omega_{H2})^2 = \frac{1}{[r_2(H;e^-;n=2)]^2 \cdot \left[\dfrac{1}{[v_{e2}(H;n=2)]^2} - \dfrac{1}{c^2} \right]} ; \quad (119.1)$$

$$(118.1) \overset{!}{=} (119.1):$$

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

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

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

from this the root is now drawn; the electron velocity is then presented as a positive quantity:

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

this with (113.2):

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

with (49), (61.4), (69.2) and (108):

$$\frac{c^2}{2\cdot v_{p2}(n=2)} = \frac{1}{\left[\left[\frac{4}{11}\right]^{\mathbf{2}}\cdot\left[\frac{1}{[v_{p2}(n=2)]^2} - \frac{1}{c^2}\right] + \frac{1}{c^2}\right]^{½}} ;$$

$$1 = \left[\left[\frac{4}{11}\right]^{\mathbf{2}}\cdot\left[\frac{1}{[v_{p2}(n=2)]^2} - \frac{1}{c^2}\right] + \frac{1}{c^2}\right]^{½} \cdot \frac{c^2}{2\cdot v_{p2}(n=2)} ;$$

/ Quadr.

$$1 = \left[{}^{16}/_{121} \cdot \left[\frac{1}{[v_{p2}(n=2)]^2} - \frac{1}{c^2}\right] + \frac{1}{c^2}\right] \cdot \left[\frac{c^2}{2\cdot v_{p2}(n=2)}\right]^{\mathbf{2}} ;$$

and this results in the following quadratic equation:

$$0 = \frac{[v_{p2}(n=2)]^4}{c^4} - \frac{105\cdot[v_{p2}(n=2)]^2}{484\cdot c^2} - \frac{4}{121} \qquad (118.2)$$

having the real solution (the 2nd solution would be a negative number, and imaginary numbers will be excluded here):

$$\frac{[v_{p2}(n=2)]^2}{c^2} = \frac{105 + [97\cdot 433]^{½}}{968} ; \qquad (118.3)$$

this has the following quadratic root:

$$\frac{v_{p2}(n=2)}{c} = \frac{\{105 + [97\cdot 433]^{½}\}^{½}}{22\cdot 2^{½}} ; \qquad (118.3)$$

$$\frac{v_{p2}(n=2)}{c} \approx 0.56585108780408134785 ; \qquad (118.4)$$

that's a result that is one and a half times bigger than that presented in the 2nd revised and completed edition of this paper[64]. It's becoming obvious now that the use of Clausius's virial theorem[65] at that time was erroneous.

Eq. (118.3) results with (113.2) in

$$v_{e2}(H;n=2) = c \cdot \frac{11 \cdot 2^{1/2}}{\{105 + [97 \cdot 433]^{1/2}\}^{1/2}} ; \qquad (119.2)$$

$$\frac{v_{e2}(H;n=2)}{c} \approx 0.88362470405485649788 ; \qquad (119.3)$$

this result also differs from the one in the 2nd revised and completed edition of this paper[66], but not as much as $v_{p2}(n=2)$; only by about 17%.

But because $v_{e2}(H;n=2) = v_{e2}$, the following also applies:

$$v_{e2} = c \cdot \frac{11 \cdot 2^{1/2}}{\{105 + [97 \cdot 433]^{1/2}\}^{1/2}} ; \qquad (119.4)$$

(119.2) with (61.4) and (105.3) inserted into (109):

$$\hbar = 4 \cdot m_{\varepsilon 2} \cdot \frac{11 \cdot 2^{1/2}}{\{105 + [97 \cdot 433]^{1/2}\}^{1/2}} \cdot c \cdot r_2 ;$$

$$r_2 = \frac{\hbar \cdot \{105 + [97 \cdot 433]^{1/2}\}^{1/2}}{44 \cdot 2^{1/2} \cdot m_{\varepsilon 2} \cdot c} ; \qquad (109.1)$$

$$r_2 \approx \frac{\hbar}{m_{\varepsilon 2} c} \cdot 0.28292554390204067392 ; \qquad (109.2)$$

with (87.12) that results in

$$r_2 \approx 5.09265979023673213056 \cdot \left(G\hbar / c^3\right)^{1/2} ; \qquad (109.3)$$

i.e., a little bit more than five Planck lengths[41], and this result is compatible with the extent of the world at M = 2 according to eq. (81.15).

Eq. (109.1), (49) and (87.12) yield

$$r_2 = \frac{\hbar \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{44 \cdot 2^{½} \cdot {}^1/_{18} \cdot (c\hbar / G)^{½} \cdot c} ;$$

$$r_2 = \frac{9 \cdot \hbar \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{22 \cdot 2^{½} \cdot (c\hbar / G)^{½} \cdot c} ;$$

$$r_2 = \frac{9 \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{22 \cdot 2^{½}} \cdot (G\hbar / c^3)^{½} ; \qquad (109.4)$$

with (108.1) and with $r_2(H;e^-;n{=}2) = 2 \cdot r_2$ one gets the following:

$$r_2(p^+;n{=}2) = \frac{{}^8/_{11} \cdot 9 \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{22 \cdot 2^{½}} \cdot (G\hbar / c^3)^{½} ;$$

$$r_2(p^+;n{=}2) = \frac{72 \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{242 \cdot 2^{½}} \cdot (G\hbar / c^3)^{½} ;$$

$$r_2(p^+;n{=}2) = \frac{36 \cdot \{105 + [97 \cdot 433]^{½}\}^{½}}{121 \cdot 2^{½}} \cdot (G\hbar / c^3)^{½} ; \qquad (109.5)$$

$$r_2(p^+;n{=}2) \approx 3.7037525747176233677 \cdot (G\hbar / c^3)^{½} ; \qquad (109.6)$$

now it makes sense to calculate the kinetic energy of the proton considered here. Starting from eq. (103.8) one gets with (87.12) and (118.3):

$$E_{kin2}(p^+;n{=}2) = 11 \cdot {}^1/_{18} \cdot (c\hbar / G)^{½} \cdot c^2 \cdot \Big\{1 - \Big[1 - \Big(\{{}^1/_{22} \cdot 2^{-½} \cdot \{105 + [97 \cdot 433]^{½}\}^{½}\Big)^2\Big]^{½}\Big\} ;$$

$$E_{kin2}(p^+;n=2) = {}^{11}/_{18} \cdot \left\{1 - \left[1 - {}^{1}/_{968} \cdot \{105 + [97 \cdot 433]^{1/2}\}\right]^{1/2}\right\} \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ; \qquad (103.9)$$

numerically:

$$E_{kin2}(p^+;n=2) \approx 0.10724544302511076238 \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ; \qquad (103.10)$$

or again with (87.12):

$$E_{kin2}(p^+;n=2) \approx 1.93041797445199372296 \cdot E_{\varepsilon 2} \, . \qquad (103.11)$$

with (102), (103.9) and (104.1):

$$E_{pot2}(p^+;n=2) = -E_{\varepsilon 2} - {}^{11}/_{18} \cdot \left\{1 - \left[1 - {}^{1}/_{968} \cdot \{105 + [97 \cdot 433]^{1/2}\}\right]^{1/2}\right\} \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ; \qquad (103.12)$$

with (87.12):

$$E_{pot2}(p^+;n=2) = -E_{\varepsilon 2} - 11 \cdot \left\{1 - \left[1 - {}^{1}/_{968} \cdot \{105 + [97 \cdot 433]^{1/2}\}\right]^{1/2}\right\} \cdot E_{\varepsilon 2} \, ;$$

numerically:

$$E_{pot2}(p^+;n=2) = -E_{\varepsilon 2} - 1.93041797445199372296 \cdot E_{\varepsilon 2} \, ;$$

$$E_{pot2}(p^+;n=2) = -2.93041797445199372296 \cdot E_{\varepsilon 2} \, ; \qquad (103.13)$$

by comparing (103.11) and (103.13) one sees that Clausius's virial theorem[65], according to which the kinetic energy should be equal to half the negative potential energy, is no longer valid already at approx. 57 % of the light velocity, due to the relativistic effect [see equation (118.4)].

$$E_{pot2}(p^+;n=2) = -{}^{1}/_{18} \cdot (c\hbar / G)^{1/2} \cdot c^2 - {}^{11}/_{18} \cdot \left\{1 - \left[1 - {}^{1}/_{968} \cdot \{105 + [97 \cdot 433]^{1/2}\}\right]^{1/2}\right\} \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ;$$

$$E_{pot2}(p^+;n=2) = -{}^{1}/_{18} \cdot \left\{1 - 11 \cdot \left[1 - \left(1 - {}^{1}/_{968} \cdot \{105 + [97 \cdot 433]^{1/2}\}\right)^{1/2}\right]\right\} \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ; \qquad (103.14)$$

numerically:

$$E_{pot2}(p^+;n=2) \approx -0.16280099858066631792 \cdot (c\hbar / G)^{1/2} \cdot c^2 \, ; \qquad (103.15)$$

but now the electron of this proton must come into focus.

In analogy to (102), where $E_{tot2}(H;e^-;n=2)$ is the total energy of the electron in one of these said H atoms, $E_{kin2}(H;e^-;n=2)$ is the corresponding kinetic energy, and $E_{pot2}(H;e^-;n=2)$ is the corresponding potential energy.

$E_{tot2}(H;e^-;n=2) = E_{kin2}(H;e^-;n=2) + E_{pot2}(H;e^-;n=2)$; (120)

according to SRT[16], the following applies [please compare with (14) and (98)]:

$$E_{e2}(H;n=2) = \left[[p_{e2}(H;n=2) \cdot c]^2 + \Big[E_{e2}(v_{e2}=0) + E_{pot2}(H;e^-;n=2) \Big]^2 \right]^{1/2} , \qquad (121)$$

where $p_{e2}(H;n=2)$ is the momentum of the electron on its 2nd Bohr orbit; furthermore, the following applies:

$$E_{e2}(H;n=2) = E_{e2}(v_{e2}=0) + E_{tot2}(H;e^-;n=2) ; \qquad (122)$$

(121) squared:

$$[E_{e2}(H;n=2)]^2 = [p_{e2}(H;n=2) \cdot c]^2 + \Big[E_{e2}(v_{e2}=0) + E_{pot2}(H;e^-;n=2) \Big]^2 ; \qquad (121.1)$$

with the momentum of the electron on its 2nd Bohr orbit

$$p_{e2}(H;n=2) = m_{e2}(H;n=2) \cdot v_{e2}(H;n=2) , \qquad (123)$$

and

$$E_{e2}(H;n=2) = m_{e2}(H;n=2)\, c^2 , \qquad (124)$$

eq. (121.1) changes into

$$[E_{e2}(H;n=2)]^2 = [E_{e2}(H;n=2)]^2 \cdot (v_{e2}(H;n=2)/c)^2 + \Big[E_{e2}(v_{e2}=0) + E_{pot2}(H;e^-;n=2) \Big]^2 ;$$

$$[E_{e2}(H;n=2)]^2 \cdot \{1 - [v_{e2}(H;n=2)/c]^2\} = \Big[E_{e2}(v_{p2}=0) + E_{pot2}(H;e^-;n=2) \Big]^2 ; \qquad (121.2)$$

with (120) and (122):

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

$$[E_{e2}(H;n=2)]^2 = [E_{e2}(H;n=2)]^2 \cdot (v_{e2}(H;n=2)/c)^2 + [E_{e2}(H;n=2)]^2 - 2 \cdot E_{e2}(H;n=2) \cdot E_{kin2}(H;e^-;n=2) + [E_{kin2}(H;e^-;n=2)]^2 ;$$

$$0 = [E_{e2}(H;n=2)]^2 \cdot (v_{e2}(H;n=2)/c)^2 - 2 \cdot E_{e2}(H;n=2) \cdot E_{kin2}(H;e^-;n=2)) + [E_{kin2}(H;e^-;n=2))]^2 ; \quad / \sqrt{\ }$$

$$[E_{kin2}(H;e^-;n=2)]_{1,2} = E_{e2}(H;n=2) \pm \left[[E_{e2}(H;n=2)]^2 - [E_{e2}(H;n=2)]^2 \cdot [v_{e2}(H;n=2) / c]^2 \right]^{1/2} \quad ; \qquad (121.3)$$

the first solution is

$$[E_{kin2}(H;e^-;n=2)]_1 = E_{e2}(H;n=2) \cdot \left[1 + \left(1 - [v_{e2}(H;n=2)/c]^2 \right)^{1/2} \right] \; ; \qquad (121.4)$$

and the second one

$$[E_{kin2}(H;e^-;n=2)]_2 = E_{e2}(H;n=2) \cdot \left[1 - \left(1 - [v_{e2}(H;n=2)/c]^2 \right)^{1/2} \right] \; ; \qquad (121.5)$$

(121.4) yields with (76) and (119.2):

$$[E_{kin2}(H;e^-;n=2)]_1 = 4 \cdot E_{\varepsilon 2} \cdot \left[1 + \left[1 - \left[\frac{242}{\left[105 + (97 \cdot 433)^{1/2}\right]} \right] \right]^{1/2} \right] \quad ; \qquad (121.6)$$

numerically:

$$[E_{kin2}(H;e^-;n=2)]_1 \approx 5.872783521430994525 \cdot E_{\varepsilon 2} \; ; \qquad (121.7)$$

$$[E_{kin2}(H;e^-;n=2)]_1 \approx 0.3262657511906108069 4 \cdot \left(c\hbar / G \right)^{1/2} \cdot c^2 \qquad (121.8)$$

As in the case of eq. (103.6) before, inserting a velocity $v_{e2}(H;n=2) = 0$ in (121.4), that a kinetic energy $E_{kin2}(H;e^-;n=2) > 0$ results, because the epsilon energy according to (87.12) is also greater than zero; (121.4) can therefore not be correct, because kinetic energy is the energy of movement, and if there is no motion, this energy must of course be zero. Therefore the author decides also here for the second solution, i.e. eq. (121.5) and rejects (121.4), (121.6), (121.7) and (121.8) likewise.

(121.5) yields

$$[E_{kin2}(H;e^-;n=2)]_2 = 4 \cdot E_{\varepsilon 2} \cdot \left[1 - \left[1 - \left[\frac{242}{\left[105 + (97 \cdot 433)^{1/2}\right]} \right] \right]^{1/2} \right] \quad ; \qquad (121.9)$$

numerically:

$$[E_{kin2}(H;e^-;n=2)]_2 \approx 2.127216478569005475 \cdot E_{\varepsilon 2} \; ; \qquad (121.10)$$

(121.9) with (87.12):

$$[E_{kin2}(H;e^-;n=2)]_2 \approx 0.11817869325383363748 \cdot \left(c\hbar / G\right)^{1/2} \cdot c^2 \; ; \qquad (121.11)$$

analogous to (121.11), this is the correct solution for the kinetic energy, here that of the electron on the 2nd Bohr orbit of the H atoms without test particle, but also that of the electron of the test particle on its Bohr fundamental orbit. So this equation applies:

$$E_{kin2}(H;e^-;n=2) = 4 \cdot E_{\varepsilon 2} \cdot \left[1 - \left[1 - \left[\frac{242}{\left[105 + \left(97 \cdot 433\right)^{1/2}\right]}\right]\right]^{1/2}\right] \; ; \qquad (121.12)$$

respectively

$$E_{kin2}(H;e^-;n=2) \approx 2.127216478569005475 \cdot E_{\varepsilon 2} \; ; \qquad (121.13)$$

and

$$E_{kin2}(H;e^-;n=2) \approx 0.11817869325383363748 \cdot \left(c\hbar / G\right)^{1/2} \cdot c^2 \, . \qquad (121.14)$$

But now the potential energy is still of interest. Since here only the second solution is considered as correct, (121.5) together with (120) is assumed here:

$$E_{pot2}(H;e^-;n=2) = E_{tot2}(H;e^-;n=2) - 4 \cdot E_{\varepsilon 2} \cdot \left[1 - \left(1 - [v_{e2}(H;n=2)/c]^2\right)^{1/2}\right] \; ; \qquad (121.15)$$

with (122):

$$E_{pot2}(H;e^-;n=2) = E_{e2}(H;n=2) - E_{e2}(v_{e2}=0) - 4 \cdot E_{\varepsilon 2} \cdot \left[1 - \left(1 - [v_{e2}(H;n=2)/c]^2\right)^{1/2}\right] \; ; \qquad (121.16)$$

(121.1) resolved to $p_{e2}(H;n=2)$:

$$p_{e2}(H;n=2) = \left[\left[E_{e2}(v_{e2}=0) / c\right]^2 - \left[[E_{e2}(v_{e2}=0) / c] + [E_{pot2}(H;e^-;n=2) / c]\right]^2\right]^{1/2} ;$$

with (105), (108) and (123):

$$m_{p2}(n=2)\cdot v_{p2}(n=2) = \left[\left[E_{e2}(v_{e2}=0)/c\right]^2 - \left[[E_{e2}(v_{e2}=0)/c] + [E_{pot2}(H;e^-;n=2)/c]\right]^2 \right]^{1/2} \quad ; \qquad (121.17)$$

with (69.2) and (106):

$$11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2) = \left[\left[E_{e2}(v_{e2}=0)/c\right]^2 - \left[[E_{e2}(v_{e2}=0)/c] + [E_{pot2}(H;e^-;n=2)/c]\right]^2 \right]^{1/2} \quad ;$$

with (120) and (122):

$$11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2) = \left[\left[E_{e2}(v_{e2}=0)/c\right]^2 - \left[[E_{e2}(H;n=2)/c] - [E_{kin2}(H;e^-;n=2)/c]\right]^2 \right]^{1/2} \quad ;$$

and again with (122):

$$11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2) = \left[\left[[E_{e2}(H;n=2) - E_{tot2}(H;e^-;n=2)]/c\right]^2 - \left[[E_{e2}(H;n=2)/c] - [E_{kin2}(H;e^-;n=2)/c]\right]^2 \right]^{1/2} \quad ;$$

/ squared

$$[11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2)]^2 = \left[[E_{e2}(H;n=2) - E_{tot2}(H;e^-;n=2)]/c\right]^2 - \left[[E_{e2}(H;n=2)/c] - [E_{kin2}(H;e^-;n=2)/c]\right]^2 \quad ;$$

/ $\cdot c^2$

$$[11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2)c]^2 = \left[E_{e2}(H;n=2) - E_{tot2}(H;e^-;n=2)\right]^2 - \left[E_{e2}(H;n=2) - E_{kin2}(H;e^-;n=2)\right]^2 \quad ;$$

with (76):

$$[11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2)c]^2 = \left[4\cdot E_{\varepsilon 2} - E_{tot2}(H;e^-;n=2)\right]^2 - \left[4\cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n=2)\right]^2 \quad ;$$

$$\left[4\cdot E_{\varepsilon 2} - E_{tot2}(H;e^-;n=2)\right]^2 = [11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2)c]^2 + \left[4\cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n=2)\right]^2 ; \quad / \sqrt{\ }$$

$$E_{tot2}(H;e^-;n=2) = 4\cdot E_{\varepsilon 2} - \left[[11\cdot m_{\varepsilon 2}\cdot v_{p2}(n=2)c]^2 + \left[4\cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n=2)\right]^2\right]^{1/2} ;$$

with (118.3) and (121.12):

$$E_{tot2}(H;e^-;n=2) = 4\cdot E_{\varepsilon 2} - \left[\left[11\cdot E_{\varepsilon 2}\cdot \frac{\{105 + [97\cdot 433]^{1/2}\}^{1/2}}{22\cdot 2^{1/2}}\right]^2 + \right.$$

$$\left. + \left[4\cdot E_{\varepsilon 2} - 4\cdot E_{\varepsilon 2}\cdot\left[1 - \left[1 - \frac{242}{[105 + (97\cdot 433)^{1/2}]}\right]^{1/2}\right]\right]^2\right]^{1/2} ;$$

$$E_{tot2}(H;e^-;n=2) = -2{,}5\cdot E_{\varepsilon 2} ; \qquad (121.18)$$

with (120) and (121.12):

$$E_{pot2}(H;e^-;n=2) = -2{,}5\cdot E_{\varepsilon 2} - 4\cdot E_{\varepsilon 2}\cdot\left[1 + \left[1 - \left[\frac{242}{[105 + (97\cdot 433)^{1/2}]}\right]\right]^{1/2}\right] ;$$

numerically:

$$E_{pot2}(H;e^-;n=2) \approx -2.5\cdot E_{\varepsilon 2} - 2.127216478569005475\cdot E_{\varepsilon 2} ;$$

$$E_{pot2}(H;e^-;n=2) \approx -4.627216478569005475\cdot E_{\varepsilon 2} ; \qquad (121.19)$$

with (87.12):

$$E_{pot2}(H;e^-;n=2) \approx -0.25706758214272252638\cdot\left(c\hbar / G\right)^{1/2}\cdot c^2 \qquad (121.20)$$

(122) with (76) and (121.18):

$$E_{e2}(v_{e2}=0) = 4\cdot E_{\varepsilon 2} + 2.5\cdot E_{\varepsilon 2} ;$$

$$E_{e2}\,(v_{e2}{=}0) = 6.5 \cdot E_{\varepsilon 2}\,; \qquad (\ 122.1\ )$$

that's the searched rest energy of the electron. (122.1) yields with (87.12)

$$E_{e2}\,(v_{e2}{=}0) = 6.5 \cdot {}^{1}/_{18} \cdot \left(c\hbar\,/\,G\right)^{1/2} \cdot c^2\,;$$

$$E_{e2}\,(v_{e2}{=}0) = {}^{13}/_{36} \cdot \left(c\hbar\,/\,G\right)^{1/2} \cdot c^2\,; \qquad (\ 122.2\ )$$

$$E_{e2}\,(v_{e2}{=}0) = 0.36\overline{11} \cdot \left(c\hbar\,/\,G\right)^{1/2} \cdot c^2\,; \qquad (\ 122.3\ )$$

with

$$E_{e2}\,(v_{e2}{=}0) = m_{e2}\,(v_{e2}{=}0) \cdot c^2\,; \qquad (\ 125\ )$$

(122.2) with (67.2):

$$\beta_2 := \frac{m_{p2}\,(v_{p2}{=}0)}{m_{e2}\,(v_{e2}{=}0)} = {}^{24}/_{13}\ ; \qquad (\ 126\ )$$

Eq. (122.1) enables the author to calculate the energy of the electron of the test particle on the 2nd Bohr orbit as multiple of the epsilon energy. With (87.12) one can then calculate these energies in Planck units. All this will be the topic of the next chapter, as well as the determination of the total potential energy of all neutrinos and anti−neutrinos at M = 2.

Chapter V.

As already announced at the end of the previous chapter, the author now turns to the energies and other properties of electrons on the Bohr orbit of H atoms that do not contain a test particle. The photon emitted when this electron changes its main quantum number from two to one has the energy

$$E_{\varphi 2} = 2\ E_{\varepsilon 2}\ , \qquad (127)$$

because the difference between E_{e2} (n=2) and E_{e2} corresponds to two epsilon energies, according to equations (73) and (74). Because the photon moves at light velocity, this equation also applies:

$$E_{\varphi 2} = h \cdot \nu_{\varphi 2}\ , \qquad (128)$$

where $\nu_{\varphi 2}$ is the frequency of the photon,

$$\nu_{\varphi 2} = \frac{c}{\lambda_{\varphi 2}}\ , \qquad (129)$$

let $\lambda_{\varphi 2}$ be the wavelength of that photon. (128) and (129) result with h=$2\pi{\cdot}\hbar$ in

$$E_{\varphi 2} = 2\pi{\cdot}\hbar \cdot \frac{c}{\lambda_{\varphi 2}}\ ; \qquad (128.1)$$

and one can now substitute this wavelength like that:

$$\lambda_{\varphi 2} = 2\ \pi\ r_{\varphi 2}\ ; \qquad (130)$$

with (128.1):

$$E_{\varphi 2} = \hbar \cdot \frac{c}{r_{\varphi 2}}\ ; \qquad (128.2)$$

$$r_{\varphi 2} = \frac{c\ \hbar}{E_{\varphi 2}}\ ; \qquad (128.3)$$

with (127):

$$r_{\varphi 2} = \frac{c\hbar}{2{\cdot}E_{\varepsilon 2}}\ . \qquad (128.4)$$

The equations (128) until (128.4) are only mentioned here for the sake of completeness. More about this later.

Now, first of all, it shall be determined how much potential and kinetic energy is contained in the baryonic matter at M = 2, in order to find out in the next step how large the potential energy of the neutrinos must be. By definition, the test particle is not moving, so it has no kinetic energy; according to eq. (103.11), the other two protons in the H atoms without test particle with a main quantum number n = 2 have each the kinetic energy

$$E_{kin2}(p^+;n=2) \approx 1.93041797445199372296 \cdot E_{\varepsilon 2} . \qquad (131)$$

And according to eq. (121.13), each of their electrons has a kinetic energy

$$E_{kin2}(H;e^-;n=2) \approx 2.127216478569005475 \cdot E_{\varepsilon 2} . \qquad (132)$$

Furthermore, at M = 2 there is only one lepton left, which is commonly allocated to baryonic matter, namely the electron of the test particle; on its basic Bohr orbit, that one has also the same kinetic energy as in eq. (132):

$$E_{kin2}(e^-) \approx 2.127216478569005475 \cdot E_{\varepsilon 2} ; \qquad (133)$$

because this electron, as already explained before, has the same properties as the electron on the 2nd Bohr orbit in the H atoms not containing a test particle. Thus it can be written

$$E_{kin2}(e^-) = E_{kin2}(H;e^-;n=2) ; \qquad (134)$$

furthermore, according to eq. (127), there is still a photon with an energy $E_{\varphi 2} = 2\ E_{\varepsilon 2}$, and since the photon rest mass is zero, this energy also corresponds to pure kinetic energy. Merged into one formula, what has been written on this page may be expressed numeri–cally like this:

$$2 \cdot E_{kin2}(p^+;n=2) + 2 \cdot E_{kin2}(H;e^-;n=2) + E_{kin2}(e^-) + E_{\varphi 2} \approx$$
$$\approx 12{,}24248538461100387092 \cdot E_{\varepsilon 2} . \qquad (135)$$

The rest of kinetic energy in the universe at M = 2 is completely allotted to the neutrinos. Let their common kinetic energy be $E_{kin2}(\nu°)$. The average kinetic energy of a single neutrino is $E_{kin2}(\nu_{e/\mu/\tau}°)$, because at M = 2 there are 12 neutrinos in the smallest possible sequentially observed case. The kinetic energy of an electron neutrino or its antiparticle is $E_{kin2}(\nu_e°)$, that of a μ–neutrino or its antiparticle is $E_{kin2}(\nu_\mu°)$, and that of a t–neutrino or its antiparticle is $E_{kin2}(\nu_\tau°)$.

At this point it is now necessary to return to the consideration of the photon emitted by an electron when it falls back from the 2nd Bohr orbit around the test set to the basic Bohr orbit. So the author proceeds now accordingly.

The photon in question has the energy $E_{\varphi 2} = 2 \cdot E_{\varepsilon 2}$ according to equation (127). The author now wants to find out the relation between the wavelength of this photon divided by 2π and the smallest possible error σ_2, i.e. the distance $r_{\varphi 2}$ according to (128.4). For this purpose he must examine possible candidates, e.g. the difference between $r_2(H;e^-;n=2)$ and $r_2(H;e^-;n=1)$. But the latter value is unknown up to now, because the electron in the H atoms without test particle at a main quantum number n = 1 has not been discussed in this paper yet. That shall be done now.

In analogy to eq. (120), as in the case with n = 2, the following applies:

$$E_{tot2}(H;e^-;n=1) = E_{kin2}(H;e^-;n=1) + E_{pot2}(H;e^-;n=1) \; ; \qquad (136)$$

$E_{tot2}(H;e^-;n=1)$ is the total energy of the electron in one of these H atoms, $E_{kin2}(H;e^-;n=1)$ is the corresponding kinetic energy and $E_{pot2}(H;e^-;n=1)$ is the corresponding potential energy. Thus, according to SRT[16] [please compare to eq. (14)] one can write

$$E_{e2}(H;n=1) = \left[[p_{e2}(H;n=1) \cdot c]^2 + \Big[E_{e2}(v_{e2}=0) + E_{pot2}(H;e^-;n=1) \Big]^2 \right]^{1/2} , \qquad (137)$$

$p_{e2}(H;n=1)$ is the momentum of the electron on its basic Bohr orbit.

What's more, trivially, the following applies:

$$E_{e2}(H;n=1) = E_{e2}(v_{e2}=0) + E_{tot2}(H;e^-;n=1) \, . \qquad (138)$$

(137) with (136) and (138):

$$E_{e2}(H;n=1) = \left[[p_{e2}(H;n=1) \cdot c]^2 + \Big[E_{e2}(H;n=1) - E_{kin2}(H;e^-;n=1) \Big]^2 \right]^{1/2} ,$$

$$(137.1)$$

the momentum of the electron in the H atoms not containing a test particle is defined as follows:

$$p_{e2}(H;n=1) := m_{e2}(H;n=1) \cdot v_{e2}(H;n=1) \; ; \qquad (139)$$

with (65):

$$p_{e2}(H;n=1) = 3 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n=1) \; ; \qquad (139.1)$$

into (137.1):

$$E_{e2}(H;n=1) = \left[[3 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n=1) \cdot c]^2 + \Big[E_{e2}(H;n=1) - E_{kin2}(H;e^-;n=1) \Big]^2 \right]^{1/2} ;$$

with (75):

$$3 \cdot E_{\varepsilon 2} = \left[[3 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n{=}1) \cdot c]^2 + \left[3 \cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n{=}1) \right]^2 \right]^{½} ;$$

squared:

$$[3 \cdot E_{\varepsilon 2}]^2 = [3 \cdot m_{\varepsilon 2} \cdot v_{e2}(H;n{=}1) \cdot c]^2 + \left[3 \cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n{=}1) \right]^2 ;$$

with (49):

$$[3 \cdot E_{\varepsilon 2}]^2 = [3 \cdot E_{\varepsilon 2} \cdot v_{e2}(H;n{=}1) / c]^2 + \left[3 \cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n{=}1) \right]^2 ;$$

$$\left[3 \cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n{=}1) \right]^2 = [3 \cdot E_{\varepsilon 2}]^2 \cdot \left(1 - [v_{e2}(H;n{=}1) / c]^2 \right)^2 ; \qquad / \sqrt{}$$

$$3 \cdot E_{\varepsilon 2} - E_{kin2}(H;e^-;n{=}1) = \pm 3 \cdot E_{\varepsilon 2} \cdot \left(1 - [v_{e2}(H;n{=}1) / c]^2 \right) ;$$

1st solution:

$$E_{kin2}(H;e^-;n{=}1) = 3 \cdot E_{\varepsilon 2} - 3 \cdot E_{\varepsilon 2} + 3 \cdot E_{\varepsilon 2} \cdot [v_{e2}(H;n{=}1) / c]^2 ;$$

$$E_{kin2}(H;e^-;n{=}1) = 3 \cdot E_{\varepsilon 2} \cdot [v_{e2}(H;n{=}1) / c]^2 ; \qquad (137.2)$$

2nd solution:

$$E_{kin2}(H;e^-;n{=}1) = 3 \cdot E_{\varepsilon 2} + 3 \cdot E_{\varepsilon 2} - 3 \cdot E_{\varepsilon 2} \cdot [v_{e2}(H;n{=}1) / c]^2 ;$$

$$E_{kin2}(H;e^-;n{=}1) = 6 \cdot E_{\varepsilon 2} - 3 \cdot E_{\varepsilon 2} \cdot [v_{e2}(H;n{=}1) / c]^2 ;$$

$$E_{kin2}(H;e^-;n{=}1) = 3 \cdot E_{\varepsilon 2} \cdot \left(2 - [v_{e2}(H;n{=}1) / c]^2 \right) ; \qquad (137.3)$$

If one sets in (137.2) $v_{e2}(H;n{=}1)$ equal to zero, then a kinetic energy results which is also equal to zero. If one does the same with (137.3), the kinetic energy still corresponds to six epsilon energies – what's definitely wrong, because kinetic energy depends only on the velocity, and if no movement takes place, the kinetic, thus the movement energy is equal to zero. So only solution (137.2) is correct. The 1st and the 2nd solution are only identical if $v_{e2}(H;n{=}1) = c$, which is probably not the case here. But this will be shown in the course of further calculations.

(75), (122.1) and (138) yield

$$3 \cdot E_{\varepsilon 2} = 6.5 \cdot E_{\varepsilon 2} + E_{tot2}(H;e^-;n{=}1) ;$$

$$E_{tot2}(H;e^-;n{=}1) = -3.5 \cdot E_{\varepsilon 2} . \qquad (138.1)$$

Again the considerations in this respect must be interrupted. To get further, now the electron of the test particle on the 2nd Bohr orbit must be taken into sight.

In analogy to the equations (120) and (136), the following applies:

$$E_{tot2}(e^-;n=2) = E_{kin2}(e^-;n=2) + E_{pot2}(e^-;n=2) \; ; \qquad (140)$$

here $E_{tot2}(e^-;n=2)$ is the total energy of the electron in one of these H atoms, $E_{kin2}(e^-;n=2)$ is the corresponding kinetic energy and $E_{pot2}(e^-;n=2)$ is the corresponding potential energy. Also here, according to SRT[16] [please compare to eq. (14)], one can write

$$E_{e2}(n=2) = \left[[p_{e2}(n=2)\cdot c]^2 + \left[E_{e2}(v_{e2}=0) + E_{pot2}(e^-;n=2) \right]^2 \right]^{½} , \qquad (141)$$

where $p_{e2}(n=2)$ is the momentum of the electron on its 2nd Bohr orbit.

Moreover, this trivial relation applies:

$$E_{e2}(n=2) = E_{e2}(v_{e2}=0) + E_{tot2}(e^-;n=2) \; . \qquad (142)$$

(141) with (140) and (142):

$$E_{e2}(n=2) = \left[[p_{e2}(n=2)\cdot c]^2 + \left[E_{e2}(n=2) - E_{kin2}(e^-;n=2) \right]^2 \right]^{½} , \qquad (141.1)$$

and the momentum of the electron in the H atom containing the test particle is defined as follows:

$$p_{e2}(n=2) = m_{e2}(n=2)\cdot v_{e2}(n=2) \; ; \qquad (143)$$

with (62.1):

$$p_{e2}(n=2) = 6\cdot m_{\varepsilon 2}\cdot v_{e2}(n=2) \; ; \qquad (143.1)$$

and the Bohr quantum condition[31]:

$$2\hbar = m_{e2}(n=2)\cdot v_{e2}(n=2)\cdot r_2(n=2) \; ; \qquad (144)$$

(144) with (62.1):

$$2\hbar = 6\cdot m_{\varepsilon 2}\cdot v_{e2}(n=2)\cdot r_2(n=2) \; ;$$

$$\hbar = 3\cdot m_{\varepsilon 2}\cdot v_{e2}(n=2)\cdot r_2(n=2) \; ;$$

with (143.1):

$$\hbar = 3\cdot m_{\varepsilon 2}\cdot (p_{e2}(n=2) / 6\cdot m_{\varepsilon 2})\cdot r_2(n=2) \; ;$$

$$2\hbar = p_{e2}(n{=}2) \cdot r_2(n{=}2) \; ; \qquad (144.1)$$

into (141.1):

$$E_{e2}(n{=}2) = \left[\left[\frac{1}{r_2(n{=}2)} \cdot 2c\hbar \right]^2 + \left[E_{e2}(n{=}2) - E_{kin2}(e^-;n{=}2) \right]^2 \right]^{1/2} , \qquad (141.2)$$

and $r_2(n{=}2)$ is to be calculated now. This is the radius of the second Bohr orbit of the electron of the test particle.

Up to now only the orbit radii r_2, $r_2(H;e^-;n{=}2)$ and $r_2(p^+;n{=}2)$ are known; the corresponding results can be found in eqs. (109.4) and (109.5); $r_2(H;e^-;n{=}2)$ results from $r_2(p^+;n{=}2)$ according to (108.1) or from r_2 according to (117). But with the help of the Bohr quantum condition[31] and the relativistic addition theorem of the velocities[67] one comes further.

In the inertial frame of the test particle, if the frame number M equals 2, the center of gravity of the H atoms rests, if their main quantum number is n = 2, as already explained in detail on page 86. In this inertial frame, both proton and electron of these atoms move in such a way that their distance to the test particle always remains the same as long as their main quantum number does not change. Thus, the addition theorem of velocities[67] holds in one–dimensional form; if in an H atom, which does not contain the test particle, the proton moves with velocity $v_{p2}(n{=}2)$ relative to the test particle, the electron in said H atom moves with velocity $-v_{e2}(n{=}2)$ relative to the proton therein. For the test particle, however, this electron moves with the velocity $-v_{e2}(H;n{=}2)$. So here the following applies:

$$-\frac{v_{e2}(H;n{=}2)}{c} = \frac{\left[\dfrac{-v_{e2}(n{=}2)}{c} + \dfrac{v_{p2}(n{=}2)}{c} \right]}{\left[1 - \dfrac{v_{e2}(n{=}2)\cdot v_{p2}(n{=}2)}{c^2} \right]} \; ; \qquad (145)$$

resolved to $[v_{e2}(n{=}2)]/c$:

$$\frac{v_{e2}(n{=}2)}{c} = \frac{\left[\dfrac{v_{e2}(H;n{=}2)}{c} + \dfrac{v_{p2}(n{=}2)}{c} \right]}{\left[1 + \dfrac{v_{e2}(H;n{=}2)\cdot v_{p2}(n{=}2)}{c^2} \right]} \; ; \qquad (145.1)$$

by the way, one has to be very careful while inserting the respective velocities of the electron into eq. (145), because they need a leading minus sign.

$$\frac{v_{e2}\,(n{=}2)}{c} = \frac{\left[\dfrac{11 \cdot 2^{1/2}}{\left\{105 + \left[97 \cdot 433\right]^{1/2}\right\}^{1/2}} + \dfrac{\left\{105 + \left[97 \cdot 433\right]^{1/2}\right\}^{1/2}}{22 \cdot 2^{1/2}}\right]}{\left[1 + \dfrac{1}{2}\right]} \;;$$

$$\frac{v_{e2}\,(n{=}2)}{c} = \frac{589 + \left[97 \cdot 433\right]^{1/2}}{33 \cdot \left\{210 + 2 \cdot \left[97 \cdot 433\right]^{1/2}\right\}^{1/2}} \;; \qquad (145.2)$$

$$\frac{v_{e2}\,(n{=}2)}{c} = \frac{589 + (42001)^{1/2}}{33 \cdot \left[210 + 2 \cdot (42001)^{1/2}\right]^{1/2}} \;; \qquad (145.3)$$

$$\frac{v_{e2}\,(n{=}2)}{c} \approx 0.96631719457262523048 \;; \qquad (145.4)$$

and the result in eq. (145.3) is now inserted into eq. (144) together with (87.12).

$$r_2\,(n{=}2) = \frac{11 \cdot \left[210 + 2 \cdot (42001)^{1/2}\right]^{1/2}}{m_{\varepsilon 2} \cdot c \cdot \left[589 + (42001)^{1/2}\right]} \cdot \hbar \;; \qquad (145.5)$$

with (49) and (87.12):

$$r_2\,(n{=}2) = \frac{11 \cdot \left[210 + 2 \cdot (42001)^{1/2}\right]^{1/2} \cdot \hbar}{\left[589 + (42001)^{1/2}\right] \cdot {}^{1}\!/_{18} \cdot \left(c\hbar / G\right)^{1/2}} \;;$$

$$r_2\,(n{=}2) = \frac{198 \cdot \left[210 + 2 \cdot (42001)^{1/2}\right]^{1/2} \cdot \hbar}{\left[589 + (42001)^{1/2}\right] \cdot \left(c\hbar / G\right)^{1/2}} \;;$$

$$r_2(n{=}2) = \frac{198\cdot\left[210 + 2\cdot\left(42001\right)^{1/2}\right]^{1/2}}{\left[589 + \left(42001\right)^{1/2}\right]} \cdot \left(G\hbar / c^3\right)^{1/2} ; \qquad (145.6)$$

numerically:

$$r_2(n{=}2) \approx 6.2091412982189873286\cdot\left(G\hbar / c^3\right)^{1/2} ; \qquad (145.7)$$

that's a result lying in between the result in eq. (109.3) and the distance between the test particle and its antipole according to eq. (81.15).

(145.6) into (141.2):

$$E_{e2}(n{=}2) = \left[\frac{\left[589 + \left(42001\right)^{1/2}\right]^2\cdot\left(c\hbar / G\right)}{39204\cdot\left[210 + 2\cdot\left(42001\right)^{1/2}\right]}\cdot c^4 + \left[E_{e2}(n{=}2) - E_{kin2}(e^-;n{=}2)\right]^2\right]^{1/2} ,$$

/ squared

$$[E_{e2}(n{=}2)]^2 = \frac{\left[589 + \left(42001\right)^{1/2}\right]^2\cdot\left(c\hbar / G\right)}{39204\cdot\left[210 + 2\cdot\left(42001\right)^{1/2}\right]}\cdot c^4 + \left[E_{e2}(n{=}2) - E_{kin2}(e^-;n{=}2)\right]^2 ;$$

with (49) and (87.12):

$$[E_{e2}(n{=}2)]^2 = \frac{\left[589 + \left(42001\right)^{1/2}\right]^2\cdot[E_{\varepsilon 2}]^2}{121\cdot\left[210 + 2\cdot\left(42001\right)^{1/2}\right]} + \left[E_{e2}(n{=}2) - E_{kin2}(e^-;n{=}2)\right]^2 ;$$

$$0 = \frac{\left[589 + \left(42001\right)^{1/2}\right]^2\cdot[E_{\varepsilon 2}]^2}{121\cdot\left[210 + 2\cdot\left(42001\right)^{1/2}\right]} - 2\cdot E_{kin2}(e^-;n{=}2)\cdot E_{e2}(n{=}2) + [E_{kin2}(e^-;n{=}2)]^2 ;$$

with (74):

$$0 = \frac{\left[589 + (42001)^{½}\right]^2 \cdot [E_{\varepsilon 2}]^2}{121 \cdot \left[210 + 2 \cdot (42001)^{½}\right]} - 12 \cdot E_{kin2}(e^-;n=2) \cdot E_{\varepsilon 2} + [E_{kin2}(e^-;n=2)]^2 ;$$

this quadratic equation is now solved to $E_{kin2}(e^-;n=2)$:

$$[E_{kin2}(e^-;n=2)]_{1,2} = 6 \cdot E_{\varepsilon 2} \pm \left[36 \cdot [E_{\varepsilon 2}]^2 - \frac{\left[589 + (42001)^{½}\right]^2 \cdot [E_{\varepsilon 2}]^2}{121 \cdot \left[210 + 2 \cdot (42001)^{½}\right]} \right]^{½} ;$$

$$[E_{kin2}(e^-;n=2)]_{1,2} = 6 \cdot E_{\varepsilon 2} \pm E_{\varepsilon 2} \cdot \left[\frac{525838 + 7534 \cdot (42001)^{½}}{25410 + 242 \cdot (42001)^{½}} \right]^{½} ;$$

$$[E_{kin2}(e^-;n=2)]_{1,2} = 6 \cdot E_{\varepsilon 2} \pm E_{\varepsilon 2} \cdot \left[\frac{262919 + 3767 \cdot (42001)^{½}}{12705 + 121 \cdot (42001)^{½}} \right]^{½} ; \qquad (141.3)$$

the 1st solution is

$$[E_{kin2}(e^-;n=2)]_1 = 6 \cdot E_{\varepsilon 2} + E_{\varepsilon 2} \cdot \left[\frac{262919 + 3767 \cdot (42001)^{½}}{12705 + 121 \cdot (42001)^{½}} \right]^{½} ; \qquad (141.4)$$

numerically:

$$[E_{kin2}(e^-;n=2)]_1 \approx 11.2531970946519435123 9 \cdot E_{\varepsilon 2} ; \qquad (141.5)$$

and the 2nd solution is

$$[E_{kin2}(e^-;n=2)]_2 = 6\cdot E_{\varepsilon 2} - E_{\varepsilon 2}\cdot\left[\frac{262919 + 3767\cdot(42001)^{1/2}}{12705 + 121\cdot(42001)^{1/2}}\right]^{1/2} ; \qquad (141.6)$$

numerically:

$$[E_{kin2}(e^-;n=2)]_2 \approx 0.74680290534805648761\cdot E_{\varepsilon 2} ; \qquad (141.7)$$

it must be noted that, up to now, it cannot be decided which of these two solutions is correct. But the corresponding potential energies can already be calculated from this and from the value of the total energy of the electron of the test particle on its 2nd Bohr orbit; that total energy can be calculated starting from (142), (74) and (122.1):

$$6\cdot E_{\varepsilon 2} = 6.5\cdot E_{\varepsilon 2} + E_{tot2}(e^-;n=2) ;$$

$$E_{tot2}(e^-;n=2) = -0.5\cdot E_{\varepsilon 2} ; \qquad (142.1)$$

the 1st solution for the potential energy results from (140) with (142.1) and (141.4):

$$[E_{pot2}(e^-;n=2)]_1 = -6\cdot E_{\varepsilon 2} - E_{\varepsilon 2}\cdot\left[\frac{262919 + 3767\cdot(42001)^{1/2}}{12705 + 121\cdot(42001)^{1/2}}\right]^{1/2} - 0.5\cdot E_{\varepsilon 2} ;$$

$$[E_{pot2}(e^-;n=2)]_1 = -6.5\cdot E_{\varepsilon 2} - E_{\varepsilon 2}\cdot\left[\frac{262919 + 3767\cdot(42001)^{1/2}}{12705 + 121\cdot(42001)^{1/2}}\right]^{1/2} ; \qquad (141.8)$$

numerically:

$$[E_{pot2}(e^-;n=2)]_1 \approx -11.75319709465194351239\cdot E_{\varepsilon 2} ; \qquad (141.9)$$

and the 2nd solution is

$$[E_{pot2}(e^-;n=2)]_2 = -6\cdot E_{\varepsilon 2} + E_{\varepsilon 2}\cdot\left[\frac{262919 + 3767\cdot(42001)^{½}}{12705 + 121\cdot(42001)^{½}}\right]^{½} - 0{,}5\cdot E_{\varepsilon 2}\ ;$$

$$[E_{pot2}(e^-;n=2)]_2 = -6.5\cdot E_{\varepsilon 2} + E_{\varepsilon 2}\cdot\left[\frac{262919 + 3767\cdot(42001)^{½}}{12705 + 121\cdot(42001)^{½}}\right]^{½}\ ; \qquad (141.10)$$

numerically:

$$[E_{pot2}(e^-;n=2)]_2 \approx -1.24680290534805648761\cdot E_{\varepsilon 2}\ ; \qquad (141.11)$$

a decision whether the 1st or the 2nd solution for kinetic as well as potential energy is correct can be made by comparing the numerical values of these 1st and 2nd solutions for the kinetic energy with the results for the corresponding kinetic energy of the electrons on the 2nd Bohr orbit in the H atoms without test particles. Those are

eq. (121.7):

$$[E_{kin2}(H;e^-;n=2)]_1 \approx 5.872783521430994525\cdot E_{\varepsilon 2}\ ;$$

eq. (121.10):

$$[E_{kin2}(H;e^-;n=2)]_2 \approx 2.127216478569005475\cdot E_{\varepsilon 2}\ ;$$

and on p. 96 the author decided himself to choose the smaller solution of the two, i.e. for $[E_{kin2}(H;e^-;n=2)]_2$. Consequently, he must now also decide for the smaller of the two solutions of eq. (141.3) as the correct solution:

$$E_{kin2}(e^-;n=2) \approx 0.74680290534805648761\cdot E_{\varepsilon 2}\ ; \qquad (141.12)$$

the corresponding 2nd solution from eq. (141.11) is

$$E_{pot2}(e^-;n=2) \approx -1.24680290534805648761\cdot E_{\varepsilon 2}\,. \qquad (141.13)$$

For comparison here again the potential energy belonging to the kinetic energy from eq. (121.10):

$$E_{pot2}(H;e^-;n=2) \approx -4.627216478569005475 \cdot E_{\varepsilon 2} \; ; \qquad (121.19)$$

and now the calculation on p. 102 shall be repeated to see if there are differences to the result of eq. (135). This time, the kinetic energy of the electron on the Bohr orbit in the H atom of the test particle together with the energy of a free photon, $E_{\varphi 2}$, is replaced by the kinetic energy of the electron in the H atom of the test particle on the 2nd Bohr orbit according to eq. (141.12) in eq. (135) and it is looked whether from this, another result than the approx. 12.242485384611 00387092 epsilon energies results:

$$2\cdot E_{kin2}(p^+;n=2) + 2\cdot E_{kin2}(H;e^-;n=2) + E_{kin2}(e^-;n=2) \approx$$

$$\approx 2\cdot 1.930417974451993 72296 \cdot E_{\varepsilon 2} +$$

$$+ 2\cdot 2.127216478569005475 \cdot E_{\varepsilon 2} + 0.746802905348056 48761\cdot E_{\varepsilon 2} \; ; \qquad (135.1)$$

and indeed, this result is different:

$$2\cdot E_{kin2}(p^+;n=2) + 2\cdot E_{kin2}(H;e^-;n=2) + E_{kin2}(e^-;n=2) \approx$$

$$\approx 8.862071811390054 88353\cdot E_{\varepsilon 2} \; ; \qquad (135.2)$$

and that is

12.242485384611 00387092 – 8.862071811390054 88353 = 3.380413573220948 98739

times an epsilon energy smaller than the result in eq. (135). Presumably this is so because the free photon, whose mass–energy is $E_{\varphi 2}$, also has a potential energy to be subtracted from $E_{\varphi 2}$, which of course means that (135) is **false**.

Since now all potential energies of baryonic matter at M = 2 are known, one can sum them up in an analogous way to (135.1); the numeric values come from the eqs. (103.13), (121.19) and (141.13):

$$2\cdot E_{pot2}(p^+;n=2) + 2\cdot E_{pot2}(H;e^-;n=2) + E_{pot2}(e^-;n=2) \approx$$

$$\approx 2\cdot(-2.930417974451993 72296) \cdot E_{\varepsilon 2} +$$

$$+ 2\cdot(-4.627216478569005475) \cdot E_{\varepsilon 2} -$$

$$- 1.246802905348056 48761\cdot E_{\varepsilon 2} \; ;$$

$$2\cdot E_{pot2}(p^+;n=2) + 2\cdot E_{pot2}(H;e^-;n=2) + E_{pot2}(e^-;n=2) \approx$$

$$-16.362071811390054 88353\cdot E_{\varepsilon 2} \; ; \qquad (135.3)$$

and this is the total potential energy of the baryonic matter at M = 2. But since the total potential energy of the universe at M = 2 according to eq. (78) is 84 epsilon energies large, thus the common potential energy of all neutrinos, $E_{pot2}(\nu°)$, must have the following amount:

$$E_{pot2}(\nu°) \approx -84 \cdot E_{\varepsilon 2} + 16.36207181139005488353 \cdot E_{\varepsilon 2} \; ;$$

$$E_{pot2}(\nu°) \approx -67.63792818861 \cdot E_{\varepsilon 2} \; ; \qquad (135.4)$$

each one of all 6 neutrinos and 6 antineutrinos has an average potential energy of

$$^{1}/_{12} \cdot E_{pot2}(\nu°) \approx -5.63649401571749543 \cdot E_{\varepsilon 2} \, . \qquad (135.5)$$

Towards the end of this chapter, a list of the relevant properties of the particles and the entire universe at M = 1 and M = 2 is given on the next page for the sake of clarity. It should be mentioned that the author refrains from going beyond what has already been described concerning the case at M = 2 in which the main quantum number of all three H atoms is equal to 1, since this would involve considerable computational effort and would only yield relatively irrelevant additional insights.

Fundamental value	***M = 1***	***M = 2***
Epsilon mass $m_{\varepsilon M}$	$(c\hbar / G)^{1/2}$ (12.1) & (15.3)	$^{1}/_{18} \cdot (c\hbar / G)^{1/2}$ (49) & (87.12)
Fine structure constant α_M	1 (15.9)	$^{1}/_{9}$ (83.5)
Proton rest mass m_{pM} (v_{pM}=0)	$3 \cdot (c\hbar / G)^{1/2}$ (15.3) & (17.2)	$^{2}/_{3} \cdot (c\hbar / G)^{1/2}$ (61.6) & (87.12)
Electron rest mass m_{eM} (v_{eM}=0)	$4 \cdot (c\hbar / G)^{1/2}$ (14.3) & (15.3)	$^{13}/_{36} \cdot (c\hbar / G)^{1/2}$ (49) & (122.1)
Ratio between proton and electron rest mass β_M	3/4 (14.3), (15.3), (17.1) & (19.1)	24/13 (126)
Distance between test particle proton and its antipole, $2 \cdot R_{StatM}$*	$2 \cdot (G\hbar / c^3)^{1/2}$ (15.3), (15.9) & (16.3)	$7 \cdot (G\hbar / c^3)^{1/2}$ (81.15)
Total mass energy of the universe, E_{UnM}	$4 \cdot (c\hbar / G)^{1/2} \cdot c^2$ (15.3), (17) & (17.2)	$4^{2}/_{3} \cdot (c\hbar / G)^{1/2} \cdot c^2$ (81.16)
Elementary electric charge e_M*	$(c\hbar)^{1/2}$ (15.9)	$^{1}/_{3} \cdot (c\hbar)^{1/2}$ (83) & (83.5)
Smallest possible error of electromagnetic distance measurement $\sigma_M = l_{cM} / 2\pi$	$(G\hbar / c^3)^{1/2}$ (24.2)	$1{,}5 \cdot (G\hbar / c^3)^{1/2}$ (95.2) & (96)

[* $2 \cdot R_{StatM}$ in the smallest possible sequential case]

It is interesting that the electron at M = 2 at the antipole of the test set has no mass–energy corresponding to an integer multiple of the epsilon energy $E_{\varepsilon 2}$. However, since the epsilon is indivisible at a given frame number M, it is also not possible to realize the theoretical rest mass(–energy) of the electron. At most, for a frame number M = 2, it is possible to bring the electron to the 2nd Bohr orbit, where it has six epsilon masses. In this case, the distance between this electron and the test particle proton according to (145.7) is approximately equal to 6.2091412982189873286 Planck lengths41; the distance between the antipole of the test particle and the latter is only slightly larger, namely seven Planck lengths[41]. In a weakened form this corresponds to the situation at M = 1; there it is only possible to realize an electron at rest relative to the test particle by spending the whole mass energy of the test particle for it. Result of this is then that the electron itself becomes the test particle, because with this energy transition the universe changes at M = 1 into an antimatter universe with the same frame number, in which an antiproton is the test particle.

At the end of this chapter, the author wants to emphasize something.

At the latest, indeed at the very latest, the point has now been reached at which the reader should part with a cherished habit: The use of the concept of movement. Tacitly the author had already said goodbye to two of the three properties of the epsilons when he reduced gravitational and electromagnetic interaction to basic rules of set theory; now hopefully it became clear, although it was not explicitly expressed by the author, that also the third property is obsolete: velocity. The epsilons have no velocity; apart from the positive object in test particle and electron, thus the electrically negatively charged element, they change their relative positions to each other by quantum leaps. The terms energy (ergo also mass), electric charge and velocity have been and will be used only in order to present descriptive quantities to the reader and to avoid higher mathematical effort. For the sake of better comprehensibility, no quasi–orthodox quantum mechanical diction has been and will be used by the author in this paper.

In the next chapter the present state of the universe is discussed. Thus, the author does not deal with the cases M = 3 and following, because already the description of this model at M = 2 is so complex that the reader can imagine approximately how an increase of it at M = 3 could look like.

Chapter VI.

In the synchronous case, the smallest possible test set is defined by (2M−1) elements (protons). The author concludes this from the fact that for M = 1 one proton is the smallest possible test set, for M = 2 three protons define it in the synchronous case, and since the term (2M−1) for $M \in$ IN defines all odd natural numbers and provides the number of protons in the smallest possible test set for both M = 1 and M = 2, it is therefore true for all $M \in$ IN that this test set is defined by an odd number of protons, i.e. (2M−1).

For M = 1 it has been shown in chapter I. that r_{-1} and R_{Stat1}, i.e. both solutions of the Reissner–Nordstrøm metric[11], are identical with r_1, and that yields according to eq. (15.3)

$$r_{-1} = \frac{\hbar}{m_{e1}\, c} \,. \qquad (16.5)$$

Eq. (14.2) says that the ratio of the proton rest mass to the mass of the electron on its basic Bohr orbit , i.e. the quotient of $m_{p1}(v_{p1}{=}0)$ and m_{e1}, has to be equal to three; therefore, eq. (16.5) yields

$$r_{-1} = \frac{3\,\hbar}{m_{p1}\,(v_{p1}{=}0)\; c} \,; \qquad (16.6)$$

according to eq. (43.13), the Cauchy horizon[55] r_{-2} is equal to the smallest possible error, and because of (82.1), it can be written

$$r_{-2} = \frac{(^4/_3)\cdot\hbar}{m_{p2}\,(v_{p2}{=}0)\; c} \,. \qquad (47.4)$$

What is the value of r_- in nowadays universe? That's what the author will try to find out now.

For this purpose, the author borrows from (47.4) and refers to eq. (82):

$$r_- = \frac{k\,\hbar}{m_p\,(v_p{=}0)\; c} \qquad (47.5)$$

but for simplicity the rest mass of the proton shall no longer be written as $m_p\,(v_p{=}0)$, but simply m_p. Then (47.5) is written as follows:

$$r_- = \frac{k\,\hbar}{m_p\, c} \,; \qquad (47.6)$$

k shall be computed now.

In analogy to (41.2) which yields R_{Stat}, the Cauchy horizon[55] results from

$$r_- = ½·\Delta X - [¼·(\Delta X)^2 - ¼·(\Delta z)^2]^{½} ; \qquad (41.3)$$

in (47.6):

$$\frac{2k\hbar}{m_p\, c} = \Delta X - [(\Delta X)^2 - (\Delta z)^2]^{½} ; \qquad (41.4)$$

from the foregoing, it becomes apparent that

$$\Delta X = 2 \cdot [\, M_{Un} - M_{Test}(v_{Test}{=}0)\,] \cdot \frac{G}{c^2} ; \qquad (146)$$

and

$$\Delta z = 2 \cdot (2M{-}1) \cdot e^* \cdot \frac{G^{½}}{c^2} ; \qquad (147)$$

both equations into (41.4):

$$\frac{k\hbar}{m_p\, c} = [M_{Un} - M_{Test}(v_{Test}{=}0)] \cdot \frac{G}{c^2} - \left[[M_{Un} - M_{Test}(v_{Test}{=}0)]^2 \cdot \frac{G^2}{c^4} - (2M{-}1)^2 \cdot e^{*2} \cdot \frac{G}{c^4} \right]^{½} ;$$

$$\frac{k\hbar}{m_p\, c} \cdot 2 \cdot [M_{Un} - M_{Test}(v_{Test}{=}0)] \cdot \frac{G}{c^2} - \frac{k^2\hbar^2}{m_p^2\, c^2} =$$

$$= (2M{-}1)^2 \cdot e^{*2} \cdot \frac{G}{c^4} ;$$

substitution: $k^* := k / \alpha$; $\alpha := e^{*2} / c\hbar$:

$$\frac{k^* e^{*2}}{m_p c^2} \cdot 2\,[M_{Un} - M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} - \frac{k^{*2} e^{*4}}{m_p^2 c^4} = (2M-1)^2 \cdot e^{*2} \cdot \frac{G}{c^4} \; ; \quad / :e^{*2};$$

$$\frac{k^*}{m_p c^2} \cdot 2\,[M_{Un} - M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} - \frac{k^{*2} e^{*2}}{m_p^2 c^4} = (2M-1)^2 \cdot \frac{G}{c^4} \; ;$$

and with further changes, one gets

$$(2M-1)^2 \cdot m_p \cdot \frac{G}{c^2} - 2\,k^* \cdot [M_{Un} - M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} + k^{*2} \cdot \frac{e^{*2}}{m_p c^2} = 0 \; ; \qquad (41.5)$$

assuming that M » k* (assertion yet to be proven), and because we are dealing here with a case where M » 1, the following must hold true:

$$\Delta X \gg k^* \cdot \frac{e^{*2}}{m_p c^2} \; ;$$

$$r_p := \frac{e^{*2}}{2 m_p c^2} \qquad (148)$$

is namely the definition of the so–called „classical proton radius“, for the case that its electric charge is uniformly distributed on a spherical surface of radius r_p.[68]

Only, so that this is clear: The author is completely aware that the „classical proton radius“ has no physical meaning. It is only a size or distance indication; this model finally assumes an inner structure of the proton, thus the proton is surely no ideal sphere, and that's why the radius of the proton can be quite certainly not equal to r_p.

Because of M » 1, (41.5) yields with $M \overset{!}{=} M-1$

$$4 \cdot M^2 \cdot m_p \cdot \frac{G}{c^2} - 2\,k^* \cdot [M_{Un} - M_{Test}(v_{Test}=0)] \cdot \frac{G}{c^2} = 0 \; ; \qquad / : (-2\,G / c^2) \; ;$$

$$k^* \cdot [M_{Un} - M_{Test}(v_{Test}=0)] = 2\,M^2 \cdot m_p \; ;$$

with $M_{Test}(v_{Test}=0) = (2M-1) \cdot m_p$:

$$M_{Un} - (2M-1) \cdot m_p = \frac{2}{k^*} M^2 \cdot m_p \;;$$

again because of M » 1:

$$\frac{2}{k^*} \cdot M^2 \cdot m_p + 2M \cdot m_p = M_{Un} \;;$$

$$\left[\frac{2}{k^*} M + 2\right] \cdot M \cdot m_p = M_{Un} \;;$$

also here because of M » 1 and M » k^* (what still has to be proven):

$$\frac{2}{k^*} \cdot M \cdot M \cdot m_p = M_{Un} \;;$$

$$\frac{2}{k^*} \cdot M^2 = \frac{M_{Un}}{m_p} \;;$$

$$M^2 = \frac{k^* \cdot M_{Un}}{2 \cdot m_p} \;;$$

drawing the root:

$$M = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right]^{1/2} \;; \qquad (41.6)$$

and now, for all M » 1, the following statement is surely true:

$$2M - 1 = \frac{\Delta X}{r_{-}} \;;$$

it is precisely because of $M \gg 1$ that the last equation changes into

$$2\,M = \frac{\Delta X}{r_-} \qquad \text{(what also has to be proven).}$$

This can be depicted as follows: In the smallest possible synchronous test set there are (2M−1) protons, because of $M \gg 1$ therefore about 2M. Each of them has a time span of

$$2 \cdot \frac{r_-}{c}\,,$$

at its disposal in order to have a look at the world, because the particle radius, i.e. its measurement uncertainty is equal to r_- [see also the remarks made above on equation (47.1)], and twice this radius is its diameter; thus, this particle is somewhere in between $\pm r_-$. And if this is divided by the light velocity, the result is a time span.

The time which the entirety of all protons contained in the smallest possible synchronous test set needs, in order to let the world affect itself, is obviously the (2M−1)−fold, i.e. because of $M \gg 1$ approx. the 2M−fold of it, which is nothing else than the sum of all time available in the universe, in other words, the world age.

$$2\cdot(2M-1) \cdot \frac{r_-}{c} = T_{Un}\,; \qquad \text{(Douglas–Adams}^{42}\text{ equation, 42)}$$

this formula is valid for every M > 0. Therefore, the author decided to grant the honorary name „Douglas−Adams equation"to it.

That results in

$$4 \cdot M \cdot \frac{r_-}{c} = T_{Un}\,; \qquad (149)$$

again because of $M \gg 1$. Let

$$t_- := \frac{r_-}{c}\,; \qquad (150)$$

then one gets together with eq. (149)

$$4M \cdot \frac{ct_-}{c} = T_{Un}\,;$$

transformed:

$$M = \frac{T_{Un}}{4t_{-}} \; ; \qquad (149.1)$$

however, $T_{Un} \cdot c$ is the distance of the universal horizon from the test set, i.e., R_{Un}. This is approximately equal to twice the static limit[38] of the universe R_{Stat}. For $M \gg 1$, $R_{stat} \approx \Delta X$, roughly the Schwarzschild radius of a black hole with the total mass of the universe. Thus, (149.1) yields

$$M = \frac{R_{Un}}{4r_{-}} \; ; \qquad (149.2)$$

and with $R_{Un} \stackrel{!}{=} 2 \cdot \Delta X$

$$2M = \frac{2 \cdot \Delta X}{2r_{-}} \; ;$$

$$2M = \frac{\Delta X}{2r_{-}} \qquad V \qquad \text{q.e.d.} \qquad (149.3)$$

(see p. 119 at the top); into (41.3):

$$\frac{\Delta X}{2M} = \Delta X - [(\Delta X)^2 - (\Delta z)^2]^{½} \; ; \qquad (41.7)$$

after various transformations one obtains from it

$$(\Delta z)^2 = (\Delta X)^2 \cdot \frac{4M^2 - 4M^2 + 4M - 1}{4M^2} \; ;$$

and with $M \gg 1$

$$M = \frac{(\Delta X)^2}{(\Delta z)^2} \; ; \qquad (151)$$

what's interesting is that this equation is valid for M =1, but not for M = 2.

(151) equated with (41.6):

$$\frac{(\Delta X)^2}{(\Delta z)^2} = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right]^{½} ; \qquad (151.1)$$

M_{Un} » $M_{Test}(v_{Test}=0)$ at M » 1, so eq. (146) changes into

$$\Delta X = 2 \cdot M_{Un} \cdot \frac{G}{c^2} ; \qquad (146.1)$$

hence,

$$M_{Un} = ½ \cdot \Delta X \cdot \frac{c^2}{G} ; \qquad (146.2)$$

and with M » 1, (147) changes into

$$\Delta z = 4 \cdot M \cdot e^* \cdot \frac{G^{½}}{c^2} ; \qquad (147.1)$$

into (151.1):

$$\frac{(\Delta X)^2}{\left[4 \cdot M \cdot e^* \cdot \frac{G^{½}}{c^2}\right]^2} = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right]^{½} ;$$

$$\frac{(\Delta X)^2}{\left[16 \cdot M^2 \cdot e^{*2} \cdot \frac{G}{c^4}\right]} = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right]^{½} ;$$

with (41.6) :

$$\frac{(\Delta X)^2}{\left[16 \cdot e^{*2} \cdot \frac{G}{c^4}\right]} = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right]^{3/2} ;$$

with (146.2) :

$$\frac{(\Delta X)^2}{\left[16 \cdot e^{*2} \cdot \frac{G}{c^4}\right]} = \left[\frac{k^* \, \Delta X \, c^2}{4 \cdot m_p \, G}\right]^{3/2} ;$$

$$\frac{(\Delta X)^2}{\left[2 \cdot e^{*2} \cdot \frac{G}{c^4}\right]} = \left[\frac{k^* \, \Delta X \, c^2}{m_p \, G}\right]^{3/2} ;$$

resolved to *k**:

$$k^* = \left[\frac{m_p^3 \, G^3 \, (\Delta X)^4 \, c^8}{4 \cdot e^{*4} \cdot G^2 \cdot (\Delta X)^3 \cdot c^6}\right]^{1/3} ;$$

$$k^* = \left[\frac{m_p^3 \, G \, \Delta X \, c^2}{4 \cdot e^{*4}}\right]^{1/3} ;$$

$$k^* = m_p \cdot \left[\frac{G \, \Delta X \, c^2}{4 \cdot e^{*4}}\right]^{1/3} ;$$

substituted back with $k^* := k / \alpha$:

$$k / \alpha = m_p \cdot \left[\frac{G \, \Delta X \, c^2}{4 \cdot e^{*4}}\right]^{1/3} ;$$

$\alpha := e^{*2} / c\,\hbar$:

$$k = m_p \cdot \left[\frac{\alpha\, \Delta X\, G}{4 \cdot \hbar^2} \right]^{1/3} ; \qquad (151.1)$$

and here now the currently most accurate known values are used to determine k numerically.

Specifically, these are as follows (see also appendix A: Values of fundamental physical constants):

$G = (6.67430 \pm 0.00015) \cdot 10^{-11} \cdot kg^{-1} \cdot m^3 \cdot s^{-2}$;[69] (152)
$\alpha = 7.2973525653052148804339603893221355132184406434150 56 \cdot 10^{-3}$;[69] (153)
$\hbar = 1.0545718176461563912624280033022807447228 \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}$;[69] (154)
$m_p = (1.67262192369 \pm 0.00000000051) \cdot 10^{-27}$ kg ;[69] (155)
$\Delta X = ½ \cdot R_{Un} = ½ \cdot (13.798 \pm 0.037) \cdot 10^9$ Lj $= (6.5268 \pm 0.0175) \cdot 10^{25}$ m ;[70] (156)

with those, (151.1) yields:

$$k \approx 1.495377 ; \qquad (151.2)$$

It remains now to look at k^*; it is $k^* := k / \alpha$ (see above substitution). With (151.2) and (153) one gets

$$k^* \approx 1.495377 / (7.2973525653 \cdot 10^{-3}) ;$$

and that yields

$$k^* \approx 204.92048 . \qquad (151.3)$$

One of the prerequisites in these calculations consists of the statement that the frame number M must be substantially larger than k^*. Already for this reason alone, it is necessary to determine M as well. (151.2) with (47.6) and (149.3):

$$2M \approx \frac{\Delta X\, m_p\, c}{2 \cdot 1.495377\, \hbar} ; \qquad (151.4)$$

with (140ff) and $c = 2.99792458 \cdot 10^8\ ^m/_s$:

$$2M \approx \frac{6.5268 \cdot 10^{25}\, m \cdot 1.672621924 \cdot 10^{-27}\, kg \cdot 2.99792458 \cdot 10^{8}\ ^m/_s}{2 \cdot 1.495377 \cdot 1.0545718176 \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}} ;$$

that yields

$$M \approx 5.1884 \cdot 10^{40} ; \qquad (151.5)$$

and a comparison of the equations (151.3) and (151.5) shows that $M \gg k^*$.

V q.e.d.

The number *k* is now to be calculated in a different way.

For this purpose, the author refers to a paper of the author Robert L. Oldershaw from the US–American Amherst College in Amherst, Massachusetts. Its title is „The Gravitational Bohr Radius“.[71] Oldershaw wants to show that the gravitational constant G is dependent on the considered order of magnitude; on atomic level it must be according to Oldershaw about 10^{39} times larger than its value given in eq. (152). In fact, one can draw a quite different conclusion from the calculations carried out in said paper, if one takes into account the basic concept of a proton as a test particle.

Oldershaw argues as follows: Assume that neither proton nor electron carries an electric charge. So they attract each other only gravitationally. The Bohr radius[36] of this H atom is

$$\hbar = m_e \cdot v_e \cdot R \; ; \qquad (157)$$

the gravitational attraction in this H atom balances with the centrifugal force:

$$\frac{m_e \cdot m_p \cdot G}{R^2} = \frac{m_e \cdot v_e^2}{R} \; ; \qquad (158)$$

$$\frac{m_p \cdot G}{R} = v_e^2 \; ; \qquad / \sqrt{} \qquad (158.1)$$

(only positive velocity values:)

$$v_e = \left[\frac{m_p \cdot G}{R} \right]^{1/2} ; \qquad (158.2)$$

with (157):

$$\hbar = m_e \cdot \left[\frac{m_p \cdot G}{R} \right]^{1/2} \cdot R \; ;$$

$$\hbar = m_e \cdot (m_p \cdot R \cdot G)^{1/2} \; ; \qquad / \text{Quadr.}$$

$$\hbar^2 = m_e^2 \cdot m_p \cdot R \cdot G \; ;$$

resolved to R:

$$R = \frac{\hbar^2}{m_e^2 \cdot m_p \cdot G} ; \qquad (158.3)$$

if one uses the values of $\hbar$, m_e, m_p and G set in eq. (152), the following equation (see appendix A: Values of fundamental physical constants)

$$m_e = (9.1093837015 \pm 0.0000000028) \cdot 10^{-31}\ \text{kg} , \qquad (159)$$

eqs. (154) and (155), and introduces them into (158.3), one gets

$$R \approx \frac{(1.0545718176 \cdot 10^{-34} \cdot m^2 \cdot s^{-1})^2}{(9.1093837015 \cdot 10^{-31})^2 \cdot 1.67262192369 \cdot 10^{-27}\ kg \cdot 6.6743 \cdot 10^{-11} \cdot kg^{-1} \cdot m^3 \cdot s^{-2}} ;$$

$$R \approx 1.2005239 \cdot 10^{29}\ m ; \qquad (158.4)$$

and that's about a thousand times bigger than R_{Un}. Oldershaw's statement in his paper[71] is that this is generally considered as a robust proof that inner–atomic processes are not subject to gravitational interaction.

If, however, the assumption of a proton as a test particle is included in the calculation, it is necessary to adapt Bohr's quantum condition[31] in eq. (157) to it; thus, from now on, one considers the proton as a test particle orbiting an electron at a distance R, just as in this treatise presented to the reader in the universe at M = 1, with the small difference that the electron is no black hole now, and no frame dragging effect[54] comes into play at all:

$$\hbar = m_p \cdot v_p \cdot R ; \qquad (157.1)$$

eq. (158) is changed into this:

$$\frac{m_e \cdot m_p \cdot G}{R^2} = \frac{m_p \cdot v_p^2}{R} ; \qquad (158.5)$$

and all calculation steps from (158.1) up to and including (158.4) are repeated, this time starting from (157.1) and (158.5). That yields

$$R = \frac{\hbar^2}{m_p^2 \cdot m_e \cdot G} ; \qquad (158.6)$$

the author calls this R the so–called „reciprocal gravitational Bohr radius“.

Numerically:

$$R \approx \frac{(1.0545718176 \cdot 10^{-34} \cdot m^2 \cdot s^{-1})^2}{(1.67262192369 \cdot 10^{-27})^2 \cdot 9.1093837015 \cdot 10^{-31}\ kg \cdot 6.67430 \cdot 10^{-11} \cdot kg^{-1} \cdot m^3 \cdot s^{-2}} ;$$

$$R \approx 6.53826 \cdot 10^{25}\ m ; \qquad (158.7)$$

this is something that agrees with the result in Eq. (156) within the margin of error given there. The author draws the conclusion from this that

$$R = \Delta X ; \qquad (160)$$

introduced together with eq. (158.6) into eq. (151.1):

$$k = m_p \cdot \left[\frac{\alpha \hbar^2 G}{4 \cdot \hbar^2 \cdot m_p^2 \cdot m_e \cdot G} \right]^{1/3} ;$$

$$k = \left[\frac{\alpha\, m_p}{4 \cdot m_e} \right]^{1/3} ; \qquad (151.6)$$

with

$$\beta := \frac{m_p}{m_e} \qquad (161)$$

(151.6) yields

$$k = \left[\frac{\alpha \beta}{4} \right]^{1/3} ; \qquad (151.7)$$

numerically:

$$k \approx 1.496251880041 ; \qquad (151.8)$$

and if this result is compared with (151.2),

$$k \approx 1.495343 , \qquad (151.2)$$

so it is allowed to say that (151.8) confirms eq. (151.2). But for this an error estimation is still to be made:

$$\frac{\Delta k}{k} = \left[\frac{{}^1\!/_3 \cdot (\Delta\beta)^2}{\beta^2}\right]^{1/2} ;$$

with the values in appendix A:

$$\frac{\Delta k}{k} \approx \left[\frac{{}^1\!/_3 \cdot (0.00000011)^2}{(1836.15267343)^2}\right]^{1/2} ;$$

$$\frac{\Delta k}{k} \approx (\, 11 \cdot 10^{-22}\,)^{1/2} ;$$

$$\frac{\Delta k}{k} \approx (\, 11 \cdot 10^{-22}\,)^{1/2} ;$$

$$\frac{\Delta k}{k} \approx 3.4 \cdot 10^{-12} ;$$

with (151.8) one gets this result:

$$\Delta k \approx 1.496251880041 \cdot 3.4 \cdot 10^{-12} ;$$

$$\Delta k \approx 5 \cdot 10^{-12} ;$$

=> $$k = 1.496251880041 \pm 0.000000000005 \qquad (151.9)$$

or a little more clearly

$$k = 1.496251880041(5) ; \qquad (151.10)$$

(158.6) with (160):

$$\Delta X = \frac{\hbar^2}{m_p^2 \cdot m_e \cdot G} ; \qquad (158.8)$$

like he did it before, the author sets R_{Un} equal to $2 \cdot \Delta X$; with the values from appendix A with (158.8) :

$$R_{Un} \approx \frac{2 \cdot (1.0545718176461 \cdot 10^{-34})^2 \cdot m}{(1.67212692369 \cdot 10^{-27})^2 \cdot 9.1093837015 \cdot 10^{-31} \cdot 6.6743 \cdot 10^{-11}} ;$$

$$R_{Un} \approx 1.30842586 \cdot 10^{26}\ \text{m} ; \qquad (158.9)$$

that corresponds to

$$R_{Un} \approx 13.830451 \cdot 10^{9}\ \text{Lj} ; \qquad (158.10)$$

error estimate:

$$\frac{\Delta R_{Un}}{R_{Un}} = \left[\frac{2(\Delta m_p)^2}{m_p^2} + \frac{(\Delta m_e)^2}{m_e^2} + \frac{(\Delta G)^2}{G^2} \right]^{½} ;$$

with the values from appendix A :

$$\frac{\Delta R_{Un}}{R_{Un}} = \left[\frac{2 \cdot (0.00000000051)^2}{1.67212692369^2} + \frac{0.0000000028^2}{9.1093837015^2} + \frac{0.00015^2}{6.67430^2} \right]^{½} ;$$

$$\frac{\Delta R_{Un}}{R_{Un}} \approx [\ 1.8 \cdot 10^{-19} + 9 \cdot 10^{-20} + 5 \cdot 10^{-10}\ ]^{½} ;$$

$$\frac{\Delta R_{Un}}{R_{Un}} \approx 0.000022 ; \qquad (158.11)$$

with R_{Un} from (158.10) one gets

$$\Delta R_{Un} \approx 0.000022 \cdot 13.830451 \cdot 10^{9}\ \text{Lj} ;$$
$$\Delta R_{Un} \approx 0.0003 \cdot 10^{9}\ \text{Lj} ;$$

thus it can be written

$$R_{Un} = (13.8305 \pm 0.0003) \cdot 10^{9}\ \text{Lj} ; \qquad (158.12)$$

or for the sake of better readability

$$R_{Un} = 13.8305(3) \cdot 10^{9}\ \text{Lj} ; \qquad (158.13)$$

=> $½\, R_{Un} = \Delta X = 6.9152(2) \cdot 10^{9}\ \text{Lj}$; (158.13.1)

or $½\, R_{Un} = \Delta X = 6.5421(2) \cdot 10^{25}\ \text{m}$; (158.13.2)

and if one compares this now with the value in (156), one does not only find a clearly higher accuracy, because there R_{Un} is indicated with 13.798(37) billion light–years[70], but the result in (158.13) lies beyond that also well within the borders of the result indicated in (156)! So the result is a world age $T_{Un} := R_{Un} / c$, which comes to lie completely within the error data of the Planck Space Observatory project[72] with the age specification for the universe.

Therefore, the author considers the **assumptions underlying this model** hereby as **proven**; the model thus obviously corresponds to the real conditions in this universe. In particular, eqs. (151.11) and (151.12), which follow from (151.7), are thus presented as the main result of this paper:

$$\frac{\alpha\,\beta}{4} = k^3\,; \qquad \text{(for M » 1)} \qquad (151.11)$$

respectively

$$k = \left[\frac{\alpha\,\beta}{4}\right]^{1/3}; \qquad \text{(for M » 1)} \qquad (151.12)$$

It is important to emphasize that (158.8) is also one of the most significant results of this paper; however, the author reshapes this equation somewhat using $R_{Un} = 2{\cdot}\Delta X$ and the amplitude of the Compton wavelength of the proton, $A_c := l_c / 2\pi = \hbar / m_p c$, as follows:

$$\frac{2\pi \cdot R_{Un}}{2 \cdot l_c} = \frac{c\hbar}{m_p \cdot m_e \cdot G}\,; \qquad \text{(for M »1)} \qquad (158.8.1)$$

or with $M_p := (c\hbar \,/\, G)^{½}$; see eq. (84):

$$\frac{\pi \cdot R_{Un}}{l_c} = \frac{M_p \cdot M_p}{m_p \cdot m_e}\,; \qquad \text{(für M »1)} \qquad (158.8.2)$$

of course one can also write it like that:

$$\frac{2\pi \cdot \Delta X}{l_c} = \frac{M_p^2}{m_p \cdot m_e}\,; \qquad \text{(für M »1)} \qquad (158.8.3)$$

and for the sake of completeness here as one of the further main results of this paper again the equation for the Cauchy horizon[55] of the universe:

$$\frac{2k\hbar}{m_p\, c} = \Delta X - [(\Delta X)^2 - (\Delta z)^2]^{1/2} \; ; \qquad (41.4)$$

but what's left now is to calculate the total mass of the universe.

On this behalf, eq. (146.2) is used, together with the values for G from eq. (152), ΔX from eq. (158.13.2) and $c = 2.99792458 \cdot 10^8\ ^m/_s$:

$$M_{Un} \approx \tfrac{1}{2} \cdot 6.5421 \cdot 10^{25} \cdot \frac{(2.99792458 \cdot 10^8)^2}{6.67430 \cdot 10^{-11}} \cdot \text{kg} \; ;$$

$$M_{Un} \approx 4.404766 \cdot 10^{52} \cdot \text{kg} \; ; \qquad (146.3)$$

and the relative error $|\Delta M_{Un}| / M_{Un}$, which for the sake of simplicity will be written here without the vertical bars, i.e. $\Delta M_{Un} / M_{Un}$ (after all, all other errors in the context of this paper have been given with a positive sign so far), results from the following:

$$\Delta M_{Un} / M_{Un} = \left[\frac{\Delta(\Delta X)^2}{(\Delta X)^2} + \frac{\Delta G^2}{G^2} \right]^{1/2} ; \qquad (162)$$

the value of the speed of light in vacuum c has been fixed in 1983 by the 17th General Conference on Weights and Measures in the Paris suburb of Sèvres to exactly 299792458 meters per second and is therefore known to be error–free. (162) with the numerical values from (152) and (158.12):

$$\Delta M_{Un} / M_{Un} \approx \left[\frac{(0.0003)^2}{(13.8305)^2} + \frac{(0.00011)^2}{(6.67430)^2} \right]^{1/2} ;$$

$$\Delta M_{Un} / M_{Un} \approx 0.000027; \qquad (162.1)$$

thus, it may be written

$$M_{Un} = (\, 4.404766 \pm 0.000027 \cdot 4.404766 \,) \cdot 10^{52} \cdot \text{kg} \; ;$$

$$M_{Un} = (\, 4.40477 \pm 0.00012 \,) \cdot 10^{52} \cdot \text{kg} \; ;$$

it surely makes sense to write it like this:

$$M_{Un} = 4.40477(12) \cdot 10^{52} \cdot \text{kg} \; ; \qquad (146.4)$$

and if one relates this to the proton rest mass from (155), one gets the following numeric result:

$$\frac{M_{Un}}{m_p} \approx \frac{4.40477 \cdot 10^{52} \cdot \text{kg}}{1.67262192369 \cdot 10^{-27}\ \text{kg}} ;$$

$$M_{Un} / m_p \approx 2.63345 \cdot 10^{79} ; \qquad (146.5)$$

the author finds it irritating that this value corresponds to rough estimates of the proton number in the universe, because it is known since the PSOP mission[70] that the universe contains approximately 4.82±0.05% ordinary baryonic matter, 25.8±0.4% dark matter and 69±1% dark energy.[70,72,73] Since the latter presumably shouldn't be counted to M_{Un}, but quite contrary to dark matter, the actual proton number N_p cannot possibly be as big as the value shown in eq. (146.5). This model here as it is may not be able to give an answer to this question.

What is still left to be done is to calculate the present–day image number M as accurately as possible. Starting with (41.6), one gets

$$M^2 = \left[\frac{k^* \cdot M_{Un}}{2m_p}\right] ;$$

with the back substitution $k^* = k / \alpha$, the following results:

$$M^2 = \frac{k \cdot M_{Un}}{2 \cdot \alpha \cdot m_p} ;$$

drawing the root:

$$M = \left[\frac{k \cdot M_{Un}}{2 \cdot \alpha \cdot m_p}\right]^{1/2} ; \qquad (41.8)$$

numerically:

$$M \approx \left[\frac{1.496251880041 \cdot 4.40477 \cdot 10^{52}}{2 \cdot 7.2973525653 \cdot 10^{-3} \cdot 1.67262192369 \cdot 10^{-27}}\right]^{1/2} ; \qquad (41.9)$$

$$M \approx 5.195979 \cdot 10^{40} ; \qquad (41.10)$$

and here is the corresponding error estimate:

$$\frac{\Delta M}{M} = \left[\frac{1/2 \cdot (\Delta k)^2}{k^2} + \frac{1/2 \cdot (\Delta M_{Un})^2}{M_{Un}^2} + \frac{1/2 \cdot (\Delta m_p)^2}{m_p^2}\right]^{1/2} ;$$

with the values of k, M_{Un}, α and m_p [see equations (146.4) and (151.10) as well as appendix A] :

$$\frac{\Delta M}{M} \approx \left[\frac{0.000000000005^2}{2 \cdot 1.496251880041^2} + \frac{0.00012^2}{2 \cdot 4.40477^2} + \frac{0.00000000051^2}{2 \cdot 1.67262192369^2} \right]^{1/2} ;$$

$$\frac{\Delta M}{M} \approx 0.000019 ;$$

with (115.15):

$$\Delta M \approx 0.000019 \cdot 5.195979 \cdot 10^{40} ;$$

$$\Delta M \approx 0.000098 \cdot 10^{40} ;$$

=> $$M = (5.195979 \pm 0.000098) \cdot 10^{40} ; \qquad (41.11)$$

for the sake of easier readability:

$$M = 5.195979(98) \cdot 10^{40} ; \qquad (41.12)$$

this result differs by $\Delta M = (5.1960–5.1884) \cdot 10^{40} = 0.0076 \cdot 10^{40}$ from equation's (151.5) result. => $\Delta M / M = 0.0076 / 5.1960 = 0.0015$; that's a lot less than the relative error of M based on the Planck mission[70] results.

Here's the error estimate for equation (151.5):

$$\frac{\Delta M}{M} \approx \left[\frac{[\Delta(\Delta X)]^2}{(\Delta X)^2} + \frac{(\Delta m_p)^2}{m_p^2} + \frac{(\Delta k)^2}{k^2} \right]^{1/2} ;$$

$$\frac{\Delta M}{M} \approx \left[\frac{0.037^2}{13.798^2} + \frac{0.00000000051^2}{1.67262192369^2} + \frac{0.000000000005^2}{1.496251880041^2} \right]^{1/2} ;$$

$$\frac{\Delta M}{M} \approx 0{,}0027;$$

mit (151.5) :

$$M = (5.1884 \pm 5.1884 \cdot 0.0027) \cdot 10^{40} ;$$

$$M = (5.1884 \pm 0.014) \cdot 10^{40} ; \qquad (151.13)$$

and if one compares that with the result in equation (41.11)

$$M = (5{,}195979 \pm 0{,}000098) \cdot 10^{40},$$

than it becomes instantly obvious that the latter lies well inside the error boundaries of (151.13), 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. With baryons, each of them can form a kind of atomic analogon, quite comparable to normal atoms consisting of protons and neutrons in the 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); apart of a possible weak interaction, solely gravitational attraction acts between them, which in case of hydrogen atoms is approximately 10^{39} times weaker than the electromagnetic attraction between proton and electron, and that makes these atomic analogons 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 look 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 $n \approx 1$. 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[74], 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[74] 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 most influencable partner in that couple; in this analogon of an atom the mass difference is so huge that by raising the main quantum number by one, the radius of the neutrino orbit is greatly increased, while that of the proton remains nearly unchanged. The consequence of this and the Pauli exclusion principle[74] 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, with the difference that neutrinos are primarily responsible for its explosion.

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 something like a wall of lead about 3,000 light–years thick 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 hypothesize 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.

N, 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[12] 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 most the model can make more exact statements to the topic of the dark energy, whereby the author would like to publish the appropriate calculations only at a later time in a further paper building up on this paper.

Anyway, the density of matter in the universe in this model lies distinctly above the critical boundary[75] of $5 \cdot 10^{-27}$ kg/m³, thus with (146.2) approximately at

$$\frac{M_{Un}}{V_{Un}} \approx \frac{\frac{1}{2}\,\Delta X\, c^2 / G}{2\,\pi^2\,(2 \cdot \Delta X / \pi)^3}\,, \qquad (163)$$

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[12] did it before.

With (163) 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 (152), (156) and c = $2.99792458 \cdot 10^8$ m/s as well as $\pi \approx 3.141592654$, that results in

$$\frac{M_{Un}}{V_{Un}} \approx 3.10359 \cdot 10^{-26}\ \text{kg / m}^3\;; \qquad (163.1)$$

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.[75]

Because equation (163) 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 at an extremely fast pace, until it seemed to have reached a considerable extent after a very short duration – which, seen from an hypothetical observer at that time, would correspond to the most minute distances and a very young universe. By the way, the gravitational waves detected within the BICEP program[76] are no longer an issue, contrary to the statements of the author of this paper in its previous versions[77].

And now some last remarks concerning the image number M. The quantum state defined by M is not that of the universe, what the author assumes to be complete nonsense. But it is a quantum state of the test set, as was already mentioned before.

And alike all decent atoms the latter also tends to reach a low–energy state. If M is a number more or less equal to 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 frame number M. The subject could also choose something else, for example a sequence of states at an unchanging, constant frame number M.

Something else is notable, concerning the cosmological model presented here; the principle in it showing striking analogies 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 nucleus 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 happen to occur much too frequently.

Tritium is not yet realisable at M = 2, because there are five anti–T rishons in its nucleus, what implies a frame number M > 2. 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. Even theologically significant consequences arise, whose discussion would surely go well beyond the scope of this paper. Nevertheless, its remarkable conclusion that only a subject defined as a test set of at least 2M−1 protons can perceive the world synchronously should be emphasized to this. This creates a strange two−class society of subjects; the ordinary subjects who can perceive the world only sequentially and the subjects who have the choice to do this sequentially or synchronously. The author, until now a convinced atheist, must come to the realization that if his cosmological model has indeed been derived by him without error, it seems almost inevitable to call such test sets consisting of at least 2M−1 protons „gods", as much as he dislikes it.

Finally, the author would like once more to go through the single points of the list which names the properties and fundamental natural forces of the universe explained by the cosmological model presented here. Said list can be found on page 3 of this paper.

1. Spatial three−dimensionality is explained on pages 30 and 31 of this paper.
2. The fact of a universal space curvature not detectable from the earth space curvature, although this must exist according to the general relativity theory – on page 135 and page 136 this contradiction is eliminated.
3. The connection between electromagnetism and gravitation is explained on page 5.
4. The structure of matter is treated in chapter III. for the image number M = 2.
5. Likewise, in chapter III. the structure of protons, electrons, neutrinos and anti−neutrinos are derived.
6. The asymmetry between matter and antimatter in the universe is derived in Chapter I.
7. The expansion of the universe is shown by a comparison between the universe at a frame number M = 1 and the universe at a frame number M = 2. It is shown that for both M = 1 and M = 2 the universe corresponds to a Reissner−Nordstrøm hole; in chapter VI. it is finally shown that also the present universe is such a Reissner−Nordstrøm hole.[11]
8. Here the central insight consists of eq. (41.4).

9. The relationship between the smallest possible error and the largest possible error of the distance determination is explained in chapter II., beginning on page 32.
10. Mass and spatiotemporal extension of the world are treated for M =1 in chapter I., for M = 2 in chapter III.−V. and for the present in chapter VI.
11. The interdependence between the Compton wavelength of the proton, the fine structure constant and the mass ratio between proton and electron culminates in insights described by eqs. (151.11)/(151.12) and (158.8) resp. (158.8.1)/(158.8.2)/(158.8.3).
12. Dark matter consists to a relevant part of decelerated neutrinos and anti−neutrinos.

Appendix A: Values of Fundamental Physical Constants

(CODATA 2018 – „recommended values“)

Gravitational constant $G=6.67430(15) \cdot 10^{-11} \cdot kg^{-1} \cdot m^3 \cdot s^{-2}$;

Velocity of light in a vacuum $c=2.99792458 \cdot 10^8 m/s$;

Planck's constant $h=6.62607015 \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}$;

[reduced: $\hbar \approx 1.0545718176461 \cdot 10^{-34} \cdot kg \cdot m^2 \cdot s^{-1}$;]

Elementary electric charge $e^*=4.80320471257026372 \cdot 10^{-10} \cdot g^{1/2} \cdot m^{3/2} \cdot s^{-1}$
$\approx 1.51890669597764 \cdot 10^{-14} \cdot kg^{1/2} \cdot m^{3/2} \cdot s^{-1}$;

Proton rest mass $m_p=1.67262192369(51) \cdot 10^{-27}$ kg ;

Neutron rest mass $m_n=1.67492749804(95) \cdot 10^{-27}$ kg ;

Electron rest mass $m_e=9.1093837015(28) \cdot 10^{-31}$ kg ;

Fine structure constant $\alpha=7.2973525693(11) \cdot 10^{-3}$;

Ratio of proton mass to electron mass $\beta=1836.15267343(11)$;

Ratio of electrical to gravitational attraction in the Bohr model of the hydrogen atom
$\gamma=2.268661(22) \cdot 10^{39}$;

Planck mass $M_p=2.176434(24) \cdot 10^{-8}$ kg ;

Planck length $R_p=1.616255(18) \cdot 10^{-35}$ m ;

Planck time $T_p=5.391246(60) \cdot 10^{-44}$ s ;

Appendix B: Conversion Factors Between Units

1 C = $2.99792458 \cdot 10^9 \cdot g^{1/2} \cdot cm^{3/2} \cdot s^{-1} \approx 9.4802699262 \cdot 10^4 \cdot kg^{1/2} \cdot m^{3/2} \cdot s^{-1}$;

1 A = $2.99792458 \cdot 10^9 \cdot g^{1/2} \cdot cm^{3/2} \cdot s^{-1} \approx 9.4802699262 \cdot 10^4 \cdot kg^{1/2} \cdot m^{3/2} \cdot s^{-2}$;

1 V = $^1/_{2.99792458} \cdot 10^{-2} \cdot g^{1/2} \cdot cm^{1/2} \cdot s^{-1} \approx 1.05482228648 \cdot 10^{-5} \cdot kg^{1/2} \cdot m^{1/2} \cdot s^{-1}$;

1 Lj ≈ $9.46047145189709 \cdot 10^{15} \cdot m$;

1 a = $3.1556736 \cdot 10^7 \cdot s$ [notice: If the length of the year is set equal to 365,24 days];

1 eV= $1.602176634 \cdot 10^{-19} \cdot kg \cdot m^2 \cdot s^{-2}$.

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.

Epsilon: The most fundamental (and 'smallest') particle in this universe. Depending on the 'frame 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. If the frame number M increases, they are getting smaller and smaller.

Image: The subject's quantum state. It is characterised by an 'frame number' M, the latter obviously becoming bigger and bigger while the universe gets older.

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.[57] 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 all 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.

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[notice:

Commonly, the thought experiment is reported in a somewhat modified form as follows: 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 two 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 realized, 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 realizing 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!]

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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

$$Q(r_p) = \frac{4 \cdot \pi}{3} \cdot \rho_{el} \cdot r_p^3 \; ; \qquad (164)$$

assuming the charge density is kept constant, and if a spherical shell with the thickness dr_p is added, its charge is

$$dQ(r_p) = 4 \cdot \pi \cdot \rho_{el} \cdot r_p^2 \, dr_p \; ; \qquad (165)$$

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:

$$dE_{pot}(r_p) = -\int_{\propto}^{r_p} F(r_p)\,dr_p = -Q\,dQ\int_{\propto}^{r_p} r_p^{-2}\,\mathbf{d}r_p = Q\,dQ\,r_p^{-1};$$

the total energy contained in the uniformely charged sphere is with (164) and (165)

$$E_{pot.tot} = \int_0^{r_p} dE_{pot} = \int_0^{r_p} Q\,dQ\,r_p^{-1} = \int_0^{r_p} 1/3\cdot 4\cdot\pi\cdot\rho_{el}\cdot r_p^3\cdot 4\cdot\pi\cdot\rho_{el}\cdot r_p^2\cdot r_p^{-1}\,dr_p = \frac{(4\pi)^2\cdot\rho_{el}^2\cdot r_p^5}{15};$$

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:

$$E(r_p) = -\frac{e^*}{r_p^2}$$

and the energy density on the outside of this charge is

$$w(r) = \frac{1}{8\pi} \cdot \left[-\frac{e^*}{r^2} \right]^2 = \frac{e^{*2}}{8\pi \cdot r^4} \; ; \qquad (166)$$

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 (166) :

$$E_{Feld} = 4\pi \cdot \int_{r_p}^{\infty} e^{*2} \cdot 1/8\pi \cdot r^{-4} \cdot r^2 \cdot dr \; ;$$

$$E_{Feld} = ½ \cdot \int_{r_p}^{\infty} e^{*2} \cdot r^{-2} \cdot dr \; ;$$

$$E_{Feld} = e^{*2}/2 \cdot \int_{r_p}^{\infty} r^{-2} \cdot dr \; ;$$

$$E_{Feld} = \frac{e^{*2}}{2} \cdot \frac{1}{r} \Bigg|_{r_p}^{\infty} \; ;$$

$$E_{Feld} = \frac{e^{*2}}{2r_p} \; ;$$

and by equalising with the relativistic rest mass m_p the result is

$$m_p c^2 = \frac{e^{*2}}{2r_p} \, ;$$

transformed:

$$r_p = \frac{e^{*2}}{2m_p c^2} \, .$$

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[The author himself translated the original german text
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which was achieved on March 3rd, 2023]