Part 2

Modified Standard Model of Cosmology

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1 Introduction

The model of Big Bang is related to the discovery of the distance dependent red shift of light that reaches us from other far-distant galaxies (Doppler effect due to expansion of space; Hubble constant) and is based on a global permanent increase of the distances between the extragalactic objects. Tracing back this general expansion gives a common origin of all matter of our universe. Formerly this model was in contradiction to other (static) conceptions but got a fundamental support by the discovery of the 2.7 K background radiation, which is characterised by an unusual homogeneity with respect to all directions of space. It got a further prove by the correct forecast of the abundance of elements in the very beginning, which is found e.g. by observations using the composition of stars or clouds of the early universe. The strongest evidence for an expanding universe and a common beginning is given by a clear correlation of red shift (distance/age) and the status of evolutionary development of the observed galaxies. They show a strict natural evolution from smaller to larger more complex structure units accompanied by a growing corresponding 'metalicity' (elements heavier than He). With proceeding time there is a reduction of the density of matter due to the expansion while with respect to the density of radiation energy there is in addition a decrease due to the red shift. In consequence the tracing back has to result in a radiation dominated hot beginning of the 'universe'.

The global description of such an expanding universe is possible by help of the equations of the general theory of relativity as far as a closed system can be applied. The equations show that there are different solutions depending on the total mass or average density of matter. If this density is high enough for instance, the expansion could slow down and turn over into a gravitational collapse (Big Crunch). New satellite based high precision measurements to the intensity fluctuation of the background radiation showed, however, that in a good approximation our universe is even (Euclidian). This means it is expanding till infinity. Even more important is the very likely fact of an accelerated expansion - at least in the present stage of development of our universe. Therefore and due to the expansion without slowing down despite of the gravitational attraction forces there has to be a very strong and far-reaching force or action called Dark Energy. It should comprise a proportion of about 70% of the total universe, where the observable matter (stars, their residues or gas and dust) makes up only about 5%. The other ca. 25% are given by the so called Dark Matter which can be detected mainly by its influence on the motion of galaxies or galaxy clusters as well as different gravitation-lens effects and definitely represents a presently unknown kind of matter. This is also a direct conclusion from the kind and strength of the variation of the background radiation. Dark Matter has no possibility of interaction with electromagnetic radiation and is usually expected to be cold dark matter (CDM).

Tracing back the cosmological development the starting point seems to represent a cosmological singularity that - even in the modification of a 'nut shell' - were a state beyond any known physical laws. Because the facts, calculations and observations nearly prove a beginning through a Big Bang, the competitive Steady-State-Model can seemingly only be overcome by the assumption that (our) space-time is generated together with the Big Bang. Within a Steady-State-Universe, a pre-existing (usual) space-time, the extremely high concentration of matter and/or energy in the early universe had to be described as a black hole that would seemingly never allow any expansion or even escape. Because the generation of space with influence to matter and its expansion should be limited by the speed of light, it arises the problem to explain Dark Energy acting equally from 'outside' into the whole interior. The introduction of 'vacuum energy' or the demand of a general repulsion force, as inherent property of 'space' (usually called negative gravitation or cosmological constant) seems to be the only solution. This could be easily understood in this text via the expansion or density reduction of a 'gaseous aether' (quantum-foam-like as ideal electrofluid) with structure units that repel each other and where in addition space warp may now be interpreted as local changes of the aether density (compare part 1). The term 'physical space' (space-time) would then be given within this context by a region of space with usual or enhanced aether density that has to expand into a region of physical space with drastically lowered aether density - due to a mechanism that was influencing or generating this larger region before the Big Bang.

Irrespective of all physical or philosophical problems the presently favoured Standard Model of Cosmology is based on a Big Bang event. To accommodate reality it is necessary to introduce in the very beginning an 'inflationary phase' - an expansion beyond any physical laws with a speed much faster than that of light up to a size of at least light minutes. The necessity of such a 'physical trick' could be a hint to the fact that in reality our universe had its beginning out of a finite region with cosmic dimension (at least light minutes) and not out of the usually considered singularity (too far going back-extrapolation). Because the 'expansion of space' is assumed with the speed of light, there is no possibility of a thermodynamic balancing between regions placed opposite to each other ('horizon problem'). Due to it the exceptional homogeneity of the cosmic background radiation can obviously not be sufficiently explained and seems to force the assumption of an 'inflation' in the very beginning.

The presently accepted Standard Model of Cosmology is usually based on a beginning with singularity, emanated from a fluctuation within the everlasting but timeless nothing and expansion of the now accidentally created space-time into a nothing not even being space.

Effectively this is a contradiction within itself. Any motion and without exception also expansion should demand the prerequisite of space. On a second view this model might represent even a 'multiple singularity' (more precise effectively space, matter, time and process singularity). According to the present knowledge the final future is another everlasting nothing of an infinitely distributed finite amount of energy or matter (eternal thermal death). With other words, the model describes a singular event or process; only once an evolution of 'the' universe, opposing the up to now fruitful basic astronomical principle of Copernicus: 'we - even as a whole universe - cannot be something unique or special'.

To avoid the contradictions and especially the singularity, it needs on principal and necessarily a convincing history before the Big Bang with agglomeration of matter (within finite dimensions) and a cogent mechanism that forces the annihilation of nearly all cumulated matter into radiation. It needs an upper limit of possible matter concentrations - such as also any other physical determination-quantity is finite or limited. Therefore a concentration of a degenerating non-elementary matter (spin-carrying fermionic matter constituents) should be out of scope due to the related unavoidable self-destruction during agglomeration to extreme densities. According to the Standard Model of particle physics even matter with extreme compression were unable to annihilate and to transform into radiation. Basing the universe on the restrictions of the Standard Model of Particle Physics it is effectively impossible to come up with the model of a 'reasonable universe'. Each total system that has to be named 'universe' in the direct sense of the word cannot own a description-term such as 'age'. Any system that owns doubtlessly a definite age can be solely a sub-system.

The term 'universe' describes an absolute totality, an all-comprehensive entity that was ever existing, will be existing forever, has to exist forever and cannot own an asymmetry in time such as a beginning. Within a universe there may be always the generation of sub-systems, but there can never be the generation of the universe out of something else. This implies in addition that there cannot be parallel universes via fictive space dimensions, because only the total set of parallel universes is then representing the universe - they can be solely sub-systems. Due to a definite beginning of our observable (part of) universe and the obviously (seemingly) infinite distribution of matter in future and the fact that we can solely represent a sub-system, any Big Bang necessarily needs a logically and physically understandable pre-history.

Furthermore the process of expansion, of distribution and 'diluting' of matter density (with seemingly eternal thermal death) has to result into on-general-stochastic proceeding, but with necessity occurring new matter concentrations that give rise to new Big Bang events. Necessarily this is only possible, if our expansion finally can result into a meeting of our burned out Galaxies with the relics of other expanding Big-Bang-systems. To get a reasonable continual course of expansions causing new matter concentrations, further Big Bangs and once more expansions, it needs unavoidable an upper limit for matter concentration. Reaching such a limit the high-compressed matter has to be transformed into (electromagnetic) radiation; means definitely the present Standard Model of Matter cannot be correct. This was the starting point of an alternative model of matter such as described in part I.

To dissolve all discrepancies it demands spin-less (i.e. bosonic) neutron-matter on a true matter-antimatter basis, the subunits of which are therefore forced to come close enough together and to annihilate as soon as a critical density of matter is crossed (due to the hydrostatic pressure within the matter core of a corresponding giant black hole). It is obvious that such kind of matter is unthinkable within the frame of the present Standard Model of Particle Physics. Such a solution demands the search for a suitable detail concerning the inner structure of matter that might have been overlooked or ruled out up to now by the majority of physicists (despite of the general statement: 'any new experiment is simply demonstrating the validity of the Standard Model again and again'). It is doubtlessly the very special inner structure and dynamics of matter that is fully determining the evolution processes of our universe.

The concept presented here is based on a completely new understanding of the structure of matter (Direct Structure Model) and allows the explanation of Big Bang without the hypothesis of inflation and singularity. As discussed here the origin of our universe should be a giant over-critical black hole (of course its matter-core) that has to be transformed within a sufficiently long period of time and thus allows a nearly full thermodynamic balancing in the interior. At least within a period of time allowing several transfers of radiation fronts across the starting region. This seems to be opposed by the imagination of BH as singularities where starting with the horizon within the interior time should represent no more a reasonable description parameter. However, it has to be remarked that this expectation is a direct conclusion of GRT. But the range of validity of this theory ends already at this horizon! Thus the above statement concerning the horizon should be there solely an approximation. The models developed within this paper strongly indicate still processes to go on in the interior of BH und thus time should go by there.

Following a period of expansion and cooling down of our partial universe the formation of Quarks and nucleons via lepton-interaction should have started. Within the presently accepted Standard Model a ratio of matter to antimatter of $(10^9 + 1) : 10^9$ is assumed. According to this model the matter observed today should be only a residue of the former matter-antimatter-annihilation mechanisms in the early universe. Within a direct structure model there is no asymmetry at all, because here matter is created solely by pair creation mechanisms. This new model lays claim to the used means to be only based on well-proven physical mechanisms, avoiding the introduction of hypothetical units such as e.g. X-, Y- or Higgs-Bosons. While the Direct Structure Model enables a convincing explanation for the generation and structure of Dark Matter this is up to now impossible within the frame of the Standard Model of Particle Physics (based on a description with elementary Quarks and four fundamental fields/forces).

The following steps of cosmic development with formation of elements, decoupling of radiation or generation of stars and galaxies do not give rise to strong controversies (though still not all details could be understood up to now).

The aim of the present paper is the analysis of cosmological developments using a new nuclear physics with formation of orbitals in any level of atomic or sub-nuclear dimensions. Especially, it uses composed Quarks with relativistic lepton-orbital sub-structure (see part 1) instead of the elementary Quarks assumed within the Standard Model. By help of this Direct Structure Model (only two natural forces besides Dark Energy/eather-expansion-force) with leptons as the only elementary particles - that is not in contradiction to the experimental observations (!) - it can be shown that high-compressed matter of critical or just sub-critical density necessarily causes a Big Bang event. In addition the re-materialisation then may occur under the conditions of an accelerated expansion and gives rise to a well-understandable formation of Dark Matter (free Quarks that were unable to form nucleons and presently not detectable by experiments). Simultaneously the historic controversy (Steady-State-Universe against Big Bang) can be finally resolved. This however demands the ultimate abandoning of any obvious or hidden geocentric idea: ‘our universe’ becomes a partial-universe and appears to be a sub-system, a ‘dust particle’ within the true universe. This effectively represents a multiverse with ever-repeating evolutionary developments within the countless, completely horizon-enclosed and far-distant independent partial-universes.

2 Direct Structure Model and the end of stars

There are two dominating, contrary acting and stabilising forces in the interior of a star like our sun: the temperature-dependent pressure of the hot gas and gravity. Equilibrium is developing by this balance over long periods such that with the energy loss by the radiating star this loss has to be equalised by energy production via fusion in the interior. If the corresponding material for fusion is exhausted rapidly gravity is dominating. The remaining matter, which is not lost by off-streaming or possible explosions, usually forms high-compressed matter. The gravitational collapse causes a considerable increase of the temperature and on principle could ignite the fusion of heavier and heavier elements up to iron or initiate even a supernova. In the following discussion high-compressed matter is discussed that is beyond the possibility of any fusion.

High-compressed matter is formed as soon as the pressure due to gravitation is strong enough in such a way that the stability of the electron shells is overcome. On principle the distances between the atoms might reduce now by four to fife orders of magnitude or the density of matter by 12 to 15 orders of magnitude, respectively, nearly up to the density of nuclear matter. However, the electrons of the destroyed shells will - due to their property as spin-carrying fermions - react according to the Heisenberg relation with an increase of their momentum against the reduction of the volume (the product of the indeterminacy of momentum and of distance has to be equal or larger than $\hbar/2$). This completely temperature-independent pressure is called degeneration pressure and the related electron gas is understood as a degenerated electron gas. The most remarkable property of such matter is the fact that an increase of mass gives rise to a decrease of the volume. It is the very special kind of matter in White Dwarfs, which have an upper limit of mass with about 1.4 times the solar mass (Chandrasekhar limit) somewhat depending on the available and decisive starting electron density (usually varying with the total mass and the special composition of involved atomic nuclei; typically carbon, oxygen or iron).

In the beginning the momentum of the electrons is determined by the product of mass and velocity. Thus a larger total mass or gravitation energy of the star, respectively, will enhance the speed of the electrons. As soon as the velocity approaches within a collapse the speed of light - this is only possible in an asymptotic way - the enhancement of the momentum occurs predominantly through a relativistic increase of the electron mass. Now the volume of the degenerated electron gas reduces further and marks the above-mentioned limit.

With a higher mass after the collapse of a star there are mechanisms that are less understood using the Standard Model of Particle Physics. It is just obvious that the highly relativistic electrons react in some way with the protons into neutrons with a rising rate. There is a transition of the remaining matter (with a spectrum of nuclei depending on the starting conditions) into a neutron star. According to the radial variation of the effect of gravitation and the correspondingly varying hydrostatic pressure in the interior in general some kind of shell structure of such stars is developing. Presently in this context the electron-proton-reaction is assumed in analogy to electron capture at atoms (individual nuclei) to occur with the emission of a neutrino (process 1) because also in the cosmic reality this process occurs with a collapse accompanied by strong neutrino emission and according to the observations with usual electron capture (all this could be also a pure ‘kinetic’ effect due to the impact of highly accelerated electrons into compact nucleus matter). The Beta-activity of the generated neutrons is suppressed by the surrounding, degenerated, remaining electron gas (Pauli principle) that usually still has sufficiently high-density.

Close to the Chandrasekhar limit there is for the first time in the development of high-compressed matter the phenomenon that the increase of total mass is larger than the mass of any arriving matter into the forming nucleus. This is due to the fact that the relativistic mass increase of the degenerated electrons reaches a considerable amount - up to about 7% of the mass of the generated neutron star (if the suggested Direct Structure Model is correct). With the new orbital-based Direct Structure Model the beginning of the formation of neutrons is obviously given by electron energies of 70 MeV and means an electron mass of 137 times the rest mass. Now the deficiency in the electron orbital of one of the Quarks of the protons can be re-occupied (see part 1). A nearly complete absorption of the remaining degenerated gas sets in and causes a strong reduction of the volume.

If the usually discussed neutrino emission were true in this context, the absorbed electron has necessarily to occupy the middle orbital and one of the electrons of another Quark had to fall down to realise the observed neutrino emission. In this way a fully occupied middle orbital is generated. Though with respect to physical parameters of neutrons only little changes should be noticeable, it is obvious that such neutrons are in reality only one kind n_e of the possible neutron modifications (compare p $\rightarrow$ n_e in fig.1). The possibility of nucleon modifications has to be completely excluded within the Standard Model with elementary Quarks but is standard within a model with composed Quarks that thus allow even the formation of nucleons being either bosons (spin = 0, 1, …) or fermions (spin 1/2, 3/2, …).

The nucleon defined as the ‘true’ neutron n transforms (Beta-activity) through the emission of a neutrino and an electron into a proton p, reaction n $\rightarrow$ p in Fig. 1 (if the aether neutrino model of chapter 7 is correct, it might be effectively the exchange of a neutrino by another high-energy neutrino and a corresponding spin-compensation). To produce such a neutron n starting with a proton p actually demands a process completely reverse. Such a process in connection with the formation of a neutron star is possible too as far as there were sufficient external neutrinos. The formation of ‘true’ neutrons should be expected to have priority. Of cause process 1 (emission of neutrinos) would promote process 2 (absorption of neutrinos). However, most important is the understanding that there is a strong absorption of neutrinos in such shells of a forming neutron star. So the usual self-evident assumption of a nearly complete transparency of cosmic objects (even of very huge dimensions) with respect to neutrinos fails in the case of such high-compressed matter. The kernel of a neutron star is unattainable for external neutrinos. The missing of sufficient neutrino-reaction-partners thus should give rise to unusual modifications of neutrons within the core region of a collapsing star.

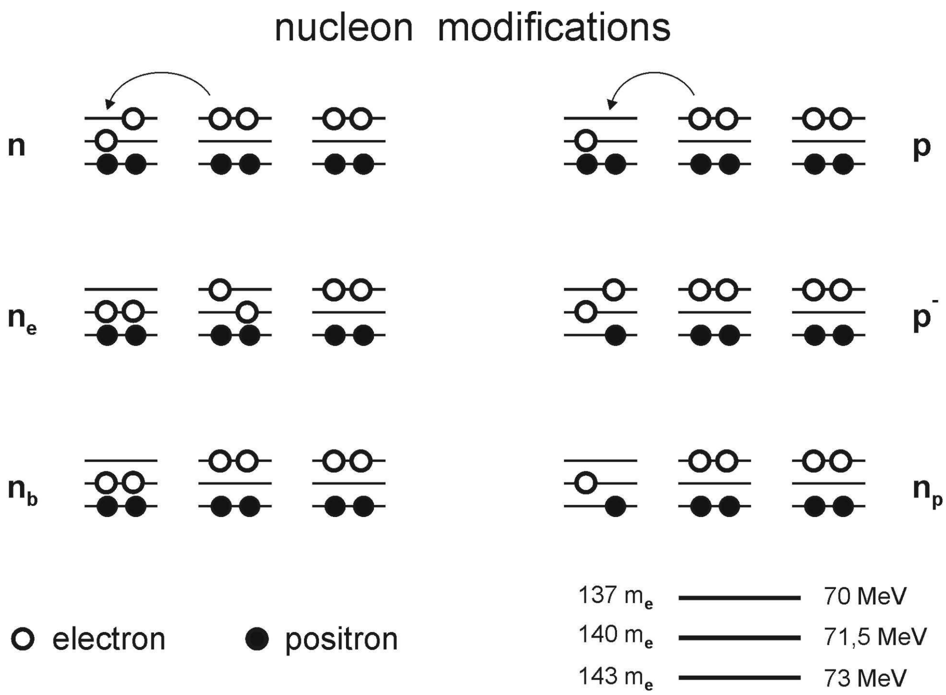

Fig. 1: Scheme of occupation states of the lepton orbitals of the tree Quarks (without spin orientations) within different kinds of nucleons. In the lower right the corresponding lepton energies within the sub-orbitals of the three Quarks are given. The cyclic exchange processes of the relativistic electrons (Strong Interaction) are symbolised by arrows. The middle orbital is occupied by leptons without electron-neutrino coupling. There are two further thinkable non-documented neutrino-depleted neutron modifications (one of it bosonic).

A third modification of neutrons n_p is restricted to high-energy conditions such as fusion within stars (e.g. within the proton-proton or the CNO-cycle). Due to the high-velocity collision or approach of two protons the extremely strong-acting repulsive forces of the electric fields may cause the knocking out of a positron (and a neutrino) out of the inner orbital of one of the three Quarks of a proton (pion emission). In analogy to the Beta-activity of neutrons, where most of the electron energy stays in the proton as binding energy, in this case again the majority of the positron energy should remain in the produced neutral particle. Thus the generated neutron modification should be only slightly lighter than a proton (that is also slightly lighter than a truel neutron n). With the new insight given by the orbital-based model it is obvious, however, that this neutral particle with 5 electrons and 5 positrons is a 2 ½ - Quark system (compare p → n_p in fig. 1). It can only be transformed into a true neutron n or proton p by the subsequent absorption of Pions or Muons.

As an immediate conclusion of the last statements it is possible to suggest an experimental prove for the direct structure model, which can be realised in a relatively easy way. If (free) neutrons are bombarded with positrons of sufficient energy (at least 150 MeV, more probable GeV range) it should be possible to remove a positron out of the inner orbital of a Quark. The particle generated should be something like a negatively charged proton p^-, have a lifetime comparable to a neutron and be **no** antiparticle (fig.1). Such **Negatons** should not only be of interest as an important prove, but could possibly get economic aspects. They can be easily handled and possibly implanted into atomic nuclei. Analogue to neutrons they could get a high stability there. Mainly the strong repulsive forces between the protons, the electric field strength, restrict the stability of heavy atomic nuclei. Implanted negatons (if possible) could reduce the corresponding instability. Thus they offer possibly the production of designer-nuclei of nearly any kind.

The lifetime of negatons is mainly influenced by the existence of free protons. The particles cause their mutual acceleration against each other and thus their destruction. This reaction is nearly indistinguishable from a corresponding particle-antiparticle-reaction. There might be even the suspicion that the up to now considered prove of the antiproton could be given by just the expected reaction (negaton-positron-atoms as 'antihydrogen'). The probability of negaton formation is much higher than the generation of antimatter due to a matter-matter-collision. The imaged particle traces during all the 'antiproton-reactions' show a large number of particles leaving the point of collision and having (as a sum) an equivalent of two times the proton mass. A true annihilation-reaction should be dominated by the emission of photons, not directly visible, and particle traces only be given by secondary reactions?

The neutrons generated via protons - that were considered up to now - have the property to carry spin. With such neutrons the matter of a burnt-out star with high neutron density is expected to develop a degenerated gas of neutrons comparable to the degenerated electron gas - usually a supra-liquid status is assumed. Thus for large gravitation energy or total mass the neutrons are characterised by very high speeds. Contrary to the degenerated electron gas the (degenerated) relativistic neutrons should be able to react with each other and cause their mutual destruction with formation of various sub-particles. Therefore it is difficult to predict within the Standard Model the upper limit of the mass of neutron stars and typically is estimated with a minimum of about 1.5…3 times the solar mass. Within the frame of the Standard Model of

Particle Physics accepted today there is no possibility of free Quarks (confinement). The destruction of the relativistic neutrons could produce e.g. Pions and/or other Mesons that have no spin and do not develop a degeneration pressure (Bosons/Vectorbosons). Within the Standard Model even point-like particles are expected, a Quark-gluon-core with ‘point-like’ Quarks. So presently often the transition of an intermediate neutron star into a black hole (BH) is assumed to be characterised as well by the formation of a space singularity - the Schwarzschild sphere is simply due to the strong gravitation field - as by the development of a ‘point-like’ matter singularity. Irrespective of the degree of compression, within the Standard Model there is no possibility to transform cumulated high-compressed matter into pure electromagnetic radiation.

Within the frame of the Direct Structure Model with a fully orbital-structured quantum world a completely different scenario is arising. Within the neutrino-shielded core of a forming neutron star or black hole the favoured formation of a fourth neutron modification n_b is possible, which is bosonic - the reaction of proton and relativistic electron (about 70 MeV) without involving an external neutrino. This results in a preferred status with fully occupied orbitals (compare p → n_b in fig.1). The generated neutrons have no spin and twice the binding energy between the Quarks compared to true neutrons n. The missing degeneration pressure (bosons) allows the formation of a solid with high-density sphere package of neutron-matter and thus results in a safe matter-core with finite and non-singular size. A further increase of matter, which enhances the hydrostatic pressure in the interior of massive neutron stars or the matter-cores of black holes, has to transfer this energy to the Quarks via increase of their speed. Because the Quarks move within orbitals the adaptation cannot be realised continuously but only with orbital jumps. Within the inner solid nucleus of a black hole (perhaps also of neutron stars) a shell structure with sharp borderlines - given by neutrons with different Quark-orbital-excitations - has to be expected which adapts in steps the radial strength of pressure. (compare appendix B).

As a consequence any further increase of mass of the core will finally cause the crossing of corresponding energy limits and force the Quarks to jump into (energetically) higher orbitals for one or even several of such star shells at the same time. A higher energy of the Quarks means higher speed and additional relativistic mass increase. The enhanced Quark momentum results in a shorter de Broglie wavelength and in a correspondingly smaller diameter of the orbital. The neutrons become smaller in successive steps. The density of such matter is considerably higher than within atomic nuclei. All this happens within very short times and might cause something like a neutron-star-quake and an increase of the rotation speed of such objects. Depending on the diffusion speed of radiation within such high-compressed matter with a certain time lag probably there could be the emission of a gamma-ray-burst by such stars.

The death of stars is characterised by very complex and manifold mechanisms and strongly depends on the individual starting conditions. To achieve stable relics it needs a sufficiently radial symmetric collapse. The further, subsequent growth of a White Dwarf e.g. via matter transfer from an accompanying star (double system) is necessarily strongly asymmetric and has to result in a thermonuclear supernova (type I) with internal shock waves that completely destroy the nucleus. Thus the birth of a neutron star or a black hole (BH) demands the creation within only a more or less radial symmetric process of sequential steps. Hereby shock waves of fairly radial symmetry during the collapse are able to transfer considerable additional momentum and energy to the inner nucleus that may give rise to nucleon excitation and higher matter density. The accompanying impulse reversal (back bounce) and compression of outer shells via outward shock waves is related to the core collapse mechanism (supernova type II) with enormous acceleration and ejection of matter. The creation of non-stellar BH should be possible e.g. via colliding neutron stars or BH even asymmetric, where the event horizon or extremely strong fields prevent any or any remarkable escape. Nevertheless the increase of matter density (excitation of nuclei) of low- or intermediate-massive BH should usually be bound to the creation of inward shock waves, because hydrostatic pressure also enabling such excitations, demands considerably higher total mass (compare appendix B).

The transition of a neutron star into a BH may occur in a completely non-spectacular way. (Any mass above about 14 times the solar mass even with a density of atomic nuclei gives rise to a kernel smaller than the corresponding Schwarzschild radius and represents a black hole.) Volume reduction and mass increase proceed in a way self-accelerated such that the continuously growing strength of the gravitation field finally initiates a Schwarzschild sphere or event horizon that is larger than the size of the star-kernel generating the gravitation field. The probably completely solid material nucleus of a non-stellar BH is able to increase its matter density swallowing matter step by step through orbital jumps of the Quarks (successive smaller Quark-orbitals or neutron diameters). Always the growth of mass will be larger than the mass originally incorporated - there is an additional transformation of ‘gravitation energy’ into relativistic mass. The number of nucleons involved cannot be used to determine the total mass of high-compressed matter anymore.

The assumptions assumed within this text demand the possibility of reactions and changes within of BH and especially within their matter kernel. That means, time should go by inside and there should exist temporal changes. However, on general such objects are presently understood solely as objects owning nothing more than a total character without internal structures and mechanisms happening inside: Approaching the horizon the passing by of time should go to zero according to GRT. But it has to be taken into account that the approach of the horizon is related with the loss of the validity of the used theory. Thus any statement at the horizon has to be insecure and should represent probably nothing more than an approximation. Considering the existence of an aether with local density changes (understood as warp of space), it is immediately obvious, that such a horizon is given as a maximum density gradient just accessible to us in our matter world. It is nearly impossible to expect that there should exist no aether at all any more inside of the horizon. Especially, considering that any gradient within such a medium necessarily would be level compensated as far as there is no maintainance by dynamical mechanisms in the interior. There should be still aether inside and thus the possibility of temporal changes and motion with a minimal aether density in the centre of the matter core that depends on the total mass of the Black Hole. Presently BH are generally understood as singularities. But they are solely singular with respect to our world of experience, to our world of matter with experimental access. Within the frame of a space-time understood much more general, i.e. within an everywhere existing aether, they do not represent true singularities. They are only given as regions of space with extreme, exceptionally low density and extreme gradients.

3 A Big Bang within the view of a Direct Structure Model

The further compression of matter within the nucleus of a Super-BH (with at least billions times a typical galaxy mass) through orbital jumps cannot proceed till infinity. Because the diameter of the outer electron orbital within a Quark was determined with $4.1 \cdot 10^{-17}$ m (compare chapter 3 of part 1) the size of the smallest possible Quark orbital (smallest neutron diameter) has to be in the order of about $5 \ldots 4.4 \cdot 10^{-17}$ m as a minimum. In this high-density-case the mass of Quarks has to take on more than about fife times the original rest mass and means achieving the ‘B-meson-excitation’ (compare chapter 4). This is the result of the necessary increase of the Quark-momentums to get the corresponding and necessary small size of matter wavelength or orbital diameter. It represents due to a maximum pressure the maximum density of baryonic matter (bosonic neutron matter) with about $2 \ldots 4 \cdot 10^{22}$ kg/m^3 (assuming minimum nucleon size and dense sphere packing DSP) and is more than fife orders of magnitude higher than that in a typical neutron star. If this critical density of matter is crossed the Quarks (consisting of concentric electron- and positron-orbitals) have to interpenetrate each other. Necessarily a general electron-positron annihilation reaction is ignited - the tremendous event of Big Bang is initiated. Thus the considerations of part 1 indeed allow the imagination of a realistic pre-history of a Big Bang.

Within the centre of the matter-core of a Super-BH with highest possible pressure starts now the transition of highest compressed matter (localised energy) into non-localised energy (photons) with a degree of efficiency of 100%. This introduces an unbelievable pressure of radiation that compresses also the bordering matter shock-like across the limit density. This shock wave moves away radial with a speed that cannot be estimated at the moment. If a last enveloping remaining thin sphere-shell of the former compact matter-kernel of the Super-BH is transformed or blown away the real or effective event Big Bang starts. Its most important aspect is the nearly complete annihilation of the gravitation generating matter, while the unbelievable strong, nearly infinite extended gravitation field that developed within eons still exists further nearly unchanged at this moment.

With the starting annihilation of all elementary particles within this central region, accompanied by the highest possible density of gamma-quanta, there will be in addition a dramatic increase of the aether density, because all spin shells are destroyed. This resulting excess pressure (maximum Dark Energy) of high-speed Aea could possibly give a much stronger force against the inner surface of the sphere shell than the pressure of the photons. However, because the volume fraction of the leptons within the total volume of the Quarks is only about 10^{-13} (only purely static view) a considerable amount of the aether that is set free should be able to 'stream out' of the still intact matter sphere-shell. It generates an expanding excess-pressure-sphere around the matter-core starting with the very beginning (the dynamic interaction of the elementary particles with the aether should be nevertheless considerably stronger than due to static ones according to the 'orbital smearing out' of the leptons; in analogy to the air-resistance of a resting air-screw compared to a fast rotating one). Assuming a time period at least in the order of hours or days for the burning off of the matter shell (till complete or nearly complete annihilation) the dimension of the expanding high-density aether region around the matter-core gains a size of up to about 0.01 light-years that has increased to a size of about 13.8 billion light-years now. The average Aea-distance thus should have increased till today by about 12…14 orders of magnitude. To realise such a tremendous starting density it needs unbelievable aether densities at the very beginning possibly served by the spin shells of the elementary particles (e.g. as elastic quasi-liquid or quasi-solid aether) but also by all destroyed neutrinos including 'jam-zone'-neutrinos.

The Big Bang starts with the annihilation of baryonic matter composed of electrons and positrons and causes Dark Energy with a density exceeding the one of the new baryonic matter (their mass equivalent) by far. This indicates the true energy content of electrons due to the immanent Dark energy to be much higher than expected from their rest mass. Simultaneously the field energy of the electron is by far higher than its rest mass (its energy equivalent). Both cases are based on an additional kind of low-level energy (expansion force, Dark Energy) directly related to the aether itself. Thus, such as indicated in chapters 6 to 8 of part 1 for Quantum Mechanics, also the well-known matter-energy equivalence ($E = mc^2$), expected to be of universal character, should have a restricted range of validity and being valid only for matter, for those kinds of energy directly related to our matter world. Dark Energy has no equivalent of mass.

The igniting Super-BH should have had the mass of our universe (as a partial universe), i.e. according to the present estimates some 10^{23} times of a solar mass (some 10^{11} galaxies with some 10^{11} times the solar mass are considered presently). Taking an average matter density of the BH-nucleus close to the critical one (about 10^{22} kg/m^3) and the above mentioned estimate of the mass of our universe a radius of the core of the super-massive object is obtained that should be in the order of the planet paths of the inner planets of our solar system (for a somewhat better estimate with outer shells of lower density see appendix B). The transformation of such an object therefore should last at least hours and thus enables a complete thermodynamic balancing within the time of an existing hollow matter-sphere enclosing the highest possible density of radiation and aether. The former Schwarzschild radius or event horizon of the now annihilating kernel of the former Super-BH has to be expected in the order of at least 30…150 billion light-years. Larger pieces of a blown off remaining shell could possibly explain the formation of extremely massive Quasars in the early universe - the fast generation of which is otherwise very difficult to understand. Usually stars are rotating and thus their relics such as BH own rotational momentum too. This should be also the case for super-BH. Therefore the released aether of our partial universe should be characterised by rotation and a rotational plane that might be noticed in the microwave background.

Postulating that particle physics should be based on orbital structures in any level (part 1) allowed the deduction of the average strength of interaction between Quarks of 137 times the one of the strength of electromagnetism simply by using nothing else than the mass and size of nucleons. Simultaneously the ‘mystic’ number 1/137 for the fine structure constant may be understood. Instead of a ‘field’ for the Strong Interaction such an assumption gives rise to an exchange of relativistic electrons (with 137 times the rest mass of electrons) between the outer orbitals of the Quarks. Such a force is known to occur in some way comparable between the orbitals of the atomic electron shells with non-relativistic electrons in chemical bonds but of cause with strength about 137 times lower. For the first time such an interpretation allowed the explanation of structure and behaviour of nucleons or the structure and decay of mesons on a physical and logical basis. With non-point-like Quarks comprised of inner positron orbitals that are screened and shielded by outer electron orbitals arises now the possibility to explain within cosmology on a logical basis the cause of a Big Bang - using secured physical laws only. Related to this an understanding of a pre-history can be gained.

Comparing a Big Bang starting with a size in the order of the inner planet paths and a calculation that is based on a singularity, necessarily a description with a fictitious ‘inflationary phase’ has to be introduced. The nearly complete transformation of high-compressed matter into radiation causes in the central region of the former Super-BH a dramatic reduction or break down of the strength of the inner gravitation field (a considerably higher aether-density is introduced now). The still unchanged-existing outer field thus has to break down (in effect an extraordinary increased aether density moving outwards) starting from the interior with a phenomenon somewhat comparable to a strong inverted gravitation half-wave. The front of high aether-density - an aether-density that is far above the density of the ‘periverse’ - can be understood or interpreted in addition as anti-gravitation due to the reversed gradient and the stronger mutual repelling of the Aea in the inner region.

Free, always moving photons cannot introduce a net-effect and cause a lowering by a static local aether density gradient via Aea-transport (permanent ‘pumping’, see part 1, 1.7) and thus cannot influence the extremely high average aether density at that time via emission mechanisms. This is only possible through the creation of matter that necessarily has to lag behind the expansion front of the aether. Nevertheless the just developing matter is dragged away with the radial stream of aether and forced to the observed expansion to each other. The developing new matter can oppose this expansion (with respect to each other) or is decelerated against it by mutual gravitation forces. However, this ‘defence’ becomes weaker and weaker with growing mutual distances. The reduction of the dragging or stream pressure for matter (the created galaxies) occurs with R^{-2} according to the increasing surface of the aether region and is therefore effectively equal to the reducing action of gravitation (in first approximation no deceleration or acceleration). There will be solely an accelerated dragging or expansion with respect to the galaxies (alone being observable), as soon as the mutual interaction via gravitation is in reality slightly weaker than expected from the inverse square law. This has to happen indeed, if the spreading of the gravitation force (or its changes) is not instantaneous but occurs with limited speed and if the mutually interacting objects move already apart with speeds at least somewhat comparable to this limiting speed.

The still existing, extremely large former gravitation field is now breaking down from the interior to the outward direction via the anti-gravitation half-wave (expanding front of extraordinary high aether density). Considering the unbelievable dimension of the extended gravitation field of the super-BH even the motion with the speed of light has to be seen as extremely ‘slow’. Any still existing matter in the interior but close to the edge or any re-materialising matter there could now on principle follow a very unusual field distribution - the ‘gravitation field’ first seems strongly to grow radial with increasing distance to the centre (fig. 2, arrows).

The gradient to the still existing strong outer field is enormous and represents a second, reversed event horizon (the expansion with at least the speed of light decreases the radiation density and matter density with the third power of achieved radius). The gradient of the reverse horizon is opposite to the usual one of the former Super-BH being far away outside. So the outer horizon prevents the escape of light to the outside, the inner one the penetration of light from outside. Because this horizon represents in addition a transition between a high-density-region of the aether to a very low density, there is a border with extreme total reflection for photons. Nearly the whole radiation of the electromagnetic spectrum is hold back this way, the partial-universe is effectively a closed system. Within this context a refractive index of 10^{10} or even more is thinkable.

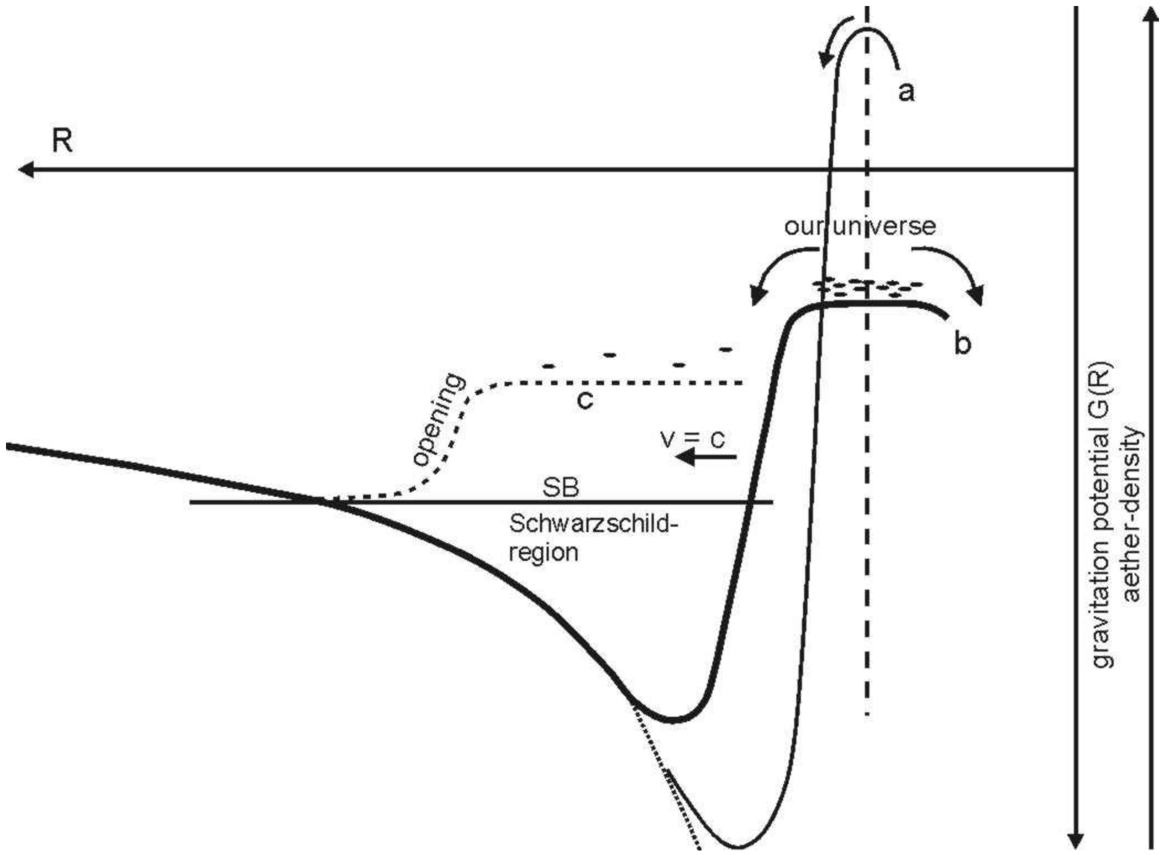

Fig. 2: Purely schematic presentation of the radial gravitation potential G(R) or aether density of 'our universe' in the 'early past' (a), at present (b) and for a future state of 'opening' (c). According to the extreme ratio in the dimension of inner and outer regions, as well the axes as the relations to each other are given only exemplary and distorted (the central region strongly enlarged). The vertical dashed line gives the position of the Big Bang. The outermost left graph (dotted in the lower part) represents the gravitation-funnel at the moment of Big Bang.

The main contribution to Dark Energy is given - within the view of the total concept presented here - by the repulsion forces between the Aea inside a high-density region of aether (our universe) embedded inside of an environment of strongly reduced aether density (former gravitation field of the Super-BH). The enclosure of a high-density region within one with lowest possible aether density necessarily demands the expansion of this inner region. This unavoidably forces the determination of the direction of the time arrow of our partial universe. As soon as both horizons with opposite gradients meet each other the partial-universe - our universe - is 'opening' (compare the schematic and unavoidable distorted presentation of a past (a), the present (b) and a future state (c) of our universe in Fig. 2).

Within the frame of an interpretation of gravity via density-gradients of a gas-like aether (see e.g. chapter 7) arises the unexpected hint that the set of constants of nature known to us presently should vary slowly but continuously with time - according to the aether density or the related changing Planck length. Especially close to the Big Bang, however, a considerable change of the constants of nature should be taken into consideration. Within the present understanding of physics there is no special attention to a possibility of a continuous change of the constants of nature. Those constants turned out to be very sensible ‘tuned’ to each other.

Already little changes of the gravitation constant, the strength of electromagnetism (fine-structure constant), strong interaction or any other constant would in turn give rise to completely different properties of matter and result in a universe different to the observed one. However, the usual procedure within such a consideration is the variation of one constant, leaving the others unchanged. This is not realistic. The changes discussed here would be due to a change of the distance between the aether constituents, the Aea, and means a change of the Planck length. This results in a variation of all constants at the same time and in balance to each other. Here it has to be taken into mind that in addition the space-time itself is changed too. It might be possible that close to the event of Big Bang the constants were even different by orders of magnitude with respect to the present values.

During the whole period of ‘burning off’ of the matter nucleus of the Super-BH its interior contains a perfect homogeneous distribution of the photons and of the aether set free (thermodynamic equilibrium). The space-time in the interior of the hollow sphere - that represents our later universe - is flat. With the loss of the last thin sphere shell now abruptly the density of photons and aether is reducing there all the time homogeneously with the expansion. Assuming for instance within the first year after the ‘setting free’ of our universe an increase of the Planck length by a factor of 100 (elimination of the BH-nucleus within about 3.6 days), causing dramatic changes of the constants, already at the time about 1 million years later the changes per year would be only about 10^{-8}. The oldest measurable galaxies after 1 billion years undergo a yearly change of 10^{-11} during their formation. Thus today a change per year of less than about 10^{-12} would be the result and this might be very difficult to detect even by high-precision measurements. If the elimination of the BH-nucleus occurred within few hours the yearly change today would be even some 10^{-14}.

The model suggested here is based on an infinite eternal universe with energy conservation, which is characterised by permanent transformation/changes in its partial regions. This is caused by two basic opposing mechanisms: the everlasting effect of gravity with agglomeration of matter and the permanent restoring redistribution of matter through Big Bang events. Prerequisite is the possibility of expansion in an eternal pre-existing space-time for the annihilating kernel of a BH afterwards being predominantly composed of non-localised energy (photons). With a smallest possible nucleon diameter of about $5 \cdot 10^{-17}$ m and densest sphere packing a lepton density of about 10^{50} m^{-3} is available for annihilation and destruction of their spin shells. This is obviously sufficient to counterbalance the strongest possible gravitational effect or highest possible depletion of aether just before the Big Bang. With the e^+/e^--annihilations nevertheless an aether density far above the one of the periverse is achieved.

Thus the annihilation with moderate current densities of low-energy electrons and positrons against each other within a well-shielded vacuum chamber should be able to counterbalance locally and at least partially the comparably weak gravitation on earth (the strongest action as anti-gravitation has to be expected below the chamber). Presently the process of annihilation is solely noticed within experiments as the emission of two Gamma-quanta that however represent alone the accompanying emission of the Bremsstrahlung. The true and final annihilation with the setting free of an enormous amount of aether (generation of 'Dark Energy') remains unnoticed up to now.

The core of a BH with finite matter or energy density can be described by an average surface and an escape velocity there, which is also finite, though it is a multiple of the speed of light. An energy-rich object such as a photon is able to depart from this surface for a finite distance (at least within the range of the indeterminacy relation) without being able to escape completely. For a kernel mainly consisting of photons such a partial escape is a permanent and noticeable property that will finally increase the average size and effectively decrease the density of the whole object. The following partial escapes will therefore occur with already a somewhat lowered escape velocity and so on; no stability is possible even if - as generally still assumed - photons gave rise to (static) space warp. With other words: photons alone cannot agglomerate or being kept agglomerated.

The generated expanding fireball of the Big Bang should give rise from the very beginning to photon collisions with formation of pairs of positrons/electrons and of neutrinos, of cause in addition to the corresponding annihilation back-reactions with permanent shifting equilibrium value depending on the changing energy density. For there is a realistic probability of multiple pair formation the nearly unique photon energy at the beginning will get a successive distribution to lower energies. If there is a sufficient amount of lepton energies with E º 70 MeV the generation of orbitalised electron-positron-pairs (neutral Pions or half-Quarks) is possible. These pairs get high stability as Quarks with a further capture of leptons resulting in fully occupied orbitals. Motivation power is the necessity to reduce permanently and as fast as possible the enormous energy density. The most efficient way is the formation of rest mass. Quarks with a size far below the wavelength of the surrounding photons (about two to fife orders of magnitude lower) and without charge, spin or magnetic momentum represent therefore already at the very beginning matter decoupled of radiation. This decoupling allows first gravitational density fluctuations visible within the CMB. Free Quarks represent Dark Matter and dominate the early universe.

The interaction of Quarks with formation of nucleons demands a sufficiently high speed (speed of the Quarks in their nucleon orbitals) that has to be achieved by the impulse transfers of about two 70 MeV photons or elementary particles, for example, having an identical transfer direction within a sufficiently short period of time. Because in the central part of the Big Bang region the impulse transfers will cancel each other on average a sufficient heating up of the Quark gas is unlikely there. This should happen in the more peripheral parts with a gradient of radiation or particle impulse density. Only a small fraction of Quarks can be heated up adequate. If three Quarks with sufficiently high speed (about 0.41c) meet each other a stable mechanism of Strong Interaction can be initiated - the exchange of high-relativistic electrons between the outer orbitals. Neutrons are the primary product (trough neutrino emission realising the binding energy). The neutrons transform via Beta-activity into long-time stable protons. For the first time there are now free electrons having no counterpart with free positrons. All the time the whole mechanism of materialisation proceeds with a fully balanced ratio of matter (electrons) and antimatter (positrons).

Within the frame of the Standard Model of Particle Physics the pair-wise creation of leptons as well as of the assumed different kinds of Quarks (particles and anti-particles) is a necessary demand. However, nucleons as the basic construction elements of matter consist solely of particles and this forces the explanation with a non-understood minimal imbalance between matter and anti-matter. Within the Direct Structure Model the creation of Quarks with electrons in the outer orbital (e-Quarks) and equally well as p-Quarks is thinkable. Both are equally composed of electrons and positrons and thus represent simply matter of different kind. But they behave to each other as matter and anti-matter and react with mutual annihilation. Because matter is only composed of e-Quarks, there seems to be on the first sight the same dilemma as existing for the Standard Model.

As far as a local dominance of e-Quarks has developed (even simply due to a fluctuation) rapidly e-neutrons can be created. Within the considered early stage of the development of our universe with extremely high neutrino density an e-neutron very soon decays into an e-proton, a neutrino and an electron that is not balanced by a free positron. Free electrons react annihilating with p-Quarks resulting in negatively charged p-Quarks. They are instable and decay setting free Gamma-rays and neutrinos but in addition again an electron. Thus free electrons are able to annihilate arbitrarily many p-Quarks. They behave self-stabilising with respect to an e.g. arbitrarily created e-Quark-system. Even given a perfect symmetry of pair creation, the system as a whole is able to develop into an electronic or alternatively into a positronic partial universe. If the possibility of a tiny 'non-paired pair creation' as discussed in chapter 8 of part 1 were true the direction of development would be determined in general.

Based on a nuclear physics with orbital sub-structures it is therefore possible to interpret the experimentally observed expansion phenomena of our universe including Dark Matter and Dark Energy at least qualitatively. Of cause it still needs a plausible mechanism for the possibility to create a Super-BH approaching critical density of matter. In the case of a closed system alone this would be solely possible for the presently experimentally disproved case of Big Crunch. Today only two 'alone possible' alternatives may be imagined: a steady-state-universe or a universe with beginning and ‘end’. Our reality should be described by a third possibility - a steady-state-universe that comprises uncountable closed regions far distant apart that all follow an evolutionary development with a beginning and an ‘end’.

Steady-state-universe means in this context an eternal and infinite universe with a general homogeneity that manifests itself only by long-time and large-space averaging. It is characterised by conservation of energy but always everything is continuously changing and transforming. Presently the existence of a steady-state-universe is denied - on the one hand through the ‘prove’ of Big Bang and on the other hand by the disproval of the Olbers phenomenon. According to Olbers an infinite universe should have an infinite number of light sources (stars or galaxies) in any direction of space. Thus our sky had then to be bright during the nights. However, the logic of this statement necessarily demands a continuous and everlasting emission of those light sources. The more realistic universe should be characterised by parts that are completely screened by event horizons from the very beginning till a late stage of development. In addition there might be also considerable red and blue shifts after their ‘opening’ because of the relative motion to each other (as far as there still exists the possibility of light emission after the opening). In addition the partial universes - as ours - are surrounded by a second inverse horizon that prevents any entrance of radiation from outside.

The long-term future of our universe seems to be an unlimited lowering of the galaxy density, where the amount of material for fusion is tremendous but limited. The existence or generation of central BH in the star-rich centres should give the most decisive influence on the development of the individual galaxies. Their main property as BH - irreversible incorporation of any available matter and energy - necessarily has to cause a destabilisation of the gravitational equilibrium in the central region. Finally this means a successive shrinkage of the galaxy as a whole. The starting disk-like or elliptical gravitation field of the galaxies will transform into one of more and more radial symmetry. Before the formation of a fully dominating massive BH is achieved, probably a Quasar-like stage for spiral galaxies has to be passed, which shows creation of stars of the first generation forced by the simultaneously concentrated hydrogen gas of the halos.

In the view of extremely long time periods the Big Bang results in the expansion of ‘dying Quasars’ into all directions of space. Following their inertia and the now only very weak mutual gravitational interaction they are emitted into the eternity of space. The galaxies leave each other and the starting point of Big Bang with speeds proportional to the starting distance to the centre and move close to the outer regions nearly with the speed of light (but resting in the expanding eather). During the expansion they own no momentum or kinetic energy relative to the surrounding eather. For the advanced expansion of our partial universe - i.e. the density of eather within our universe nearly has reached the one of the periverse - the expansion of the eather finally starts to stop while the up to now dragged galaxies remain their momentum due to their inertia that is enormous with respect to the periverse. In the end of the process there will be mainly BH with a mass close to the one of an average standard galaxy.

Applying the well proven astronomical principle of Copernicus that we (even as a [seemingly] whole universe) cannot be something extraordinary, there have to be uncountable events such as our Big Bang at various times within the infinite steady-state-universe. An expansion progress of our partial universe that reaches the average density of BH of the whole infinite universe and its eather density may describe the ‘end’ of a Big Bang event. The total universe represents a space filled with a ‘diluted gas’ of BH (set free by uncountable Big Bang events) and in between a by far lower density of Super-BH, approaching or already performing a Big Bang and being screened behind their tremendous event horizons. Necessarily density fluctuations will initiate permanently growing matter concentrations over eons due to collisions or capturing of massive BH. They all are the residues of Big Bang events and cogent cause again the formation of extremely massive BH that act like dominating attraction centres.

Because BH due to their tremendous momentum and masses have a low probability of direct collision seen statistically, the formation of something like an elliptical ‘galaxy’ - consisting solely of BH that move around the central Super-BH - has to be expected. A ‘galaxy’ that owns a dimension of at least several hundred billion light-years. In long terms such a ‘galaxy of BH’ will feed the central object via destabilisation processes. Now some day the eternal circular course is closing, once a last capture of a BH brings the Super-BH across the critical density of matter. While the basic property of matter causes an everlasting concentration process, the Big Bang events initiate processes that act against this trend and again homogenise matter and energy. Black holes represent within this circulation system the ‘humus’ of the universe or better multiverse (?) in its permanent local re-birth and dying.

Appendix A

Pioneer anomaly – Properties of Dark Matter

The space explorers Pioneer 10 and 11 launched 1972 and 1973 into opposite directions of our solar system were the first ones to leave this system. Because their paths were controlled with very high precision over years/decades, for the first time an anomalous non-understood acceleration of the vehicles into the direction of the sun was detected and measured for positions beyond the large planets Jupiter and Saturn. It shall be proved in this appendix if this deceleration may be understood by an increase of the density of Dark Matter in the outer regions of the solar system through gravitative binding by the sun and the formation of a depleted region in the range of the solar system. This should be tested irrespective of the fact that the cause of this anomaly might be given by completely different (constructional) origins, just to elaborate the possible reaction mechanisms of Dark Matter. In this appendix the used constituents of Dark Matter are free uncharged Quarks as discussed in part 1 within the frame of a direct structure model of matter. They are characterised by two fully occupied relativistic orbitals of electrons and positrons, respectively. Thus they are neutral, without magnetic momentum, have neither spin nor a resulting rotational momentum and have a size of only $4 \cdot 10^{-17}$ m - they are completely decoupled of radiation. Their mass was determined with $0.51 \cdot 10^{-27}$ kg.

The launched mass of the explorers was 260 kg including about 40 kg of fuel for correction manoeuvres or direction adjustments of the antenna. The parabolic antenna with nearly 3 m diameter (7 m^2) represents the main active or resistance producing area. It was permanently oriented towards the earth and thus essentially also towards the sun. The 'final speed' was 36.7 km/s achieved by a swing-by manoeuvre at Jupiter. The determination of distance and speed was obtained by two-way-Doppler-shift and in addition by the measurement of the runtime of the signals [to get an overview and more details see e.g. H. Dittus, C. Lämmerzahl, Phys. Journal **5** (2006) no. 1, p. 25] . Taking all acceleration producing influences into account an increasing deceleration was detected starting about at the position of the path of Jupiter and reaching a final value beyond the path of Saturn. Then it was constant over many years with a value of

$$- (8.74 \pm 1.33) \cdot 10^{-10}\ m/s^2.$$

This value was nearly identical for both explorers. Taking an average mass of the probes of 240 kg this corresponds to a constant force of deceleration F_B of about $2 \cdot 10^{-7}$ N.

Within the frame of statements in part 1 - Quarks are not elementary but composed structure units - the presently accepted assumption of a 'confinement' of Quarks is not justified anymore. In this case Dark Matter should consist of free neutral Quarks giving rise to the best approximation to an ideal gas possible. Because there is no interaction with electromagnetic radiation, Dark Matter is assumed to be ‘cold’ (CDM). Within this appendix it is sufficient to assume particle speeds reasonably smaller than the speed of the explorers. Depending on the temperature of this gas there should be a distance, outside of that there is no possibility to hold back the particles by the gravitation field of the sun. This means the originally existing density of Dark Matter in this part of the solar system should be still preserved. Over long terms inside this region the particles are hold or accelerated towards the sun and at least partly captured there or blown away. Any spacecraft moving away of the sun, out of this depletion zone, could realise an increasing force of friction leaving the depletion region as far as there is a possibility of interaction with (normal) matter. In the beginning the simple radial symmetric distribution shall be investigated.

A fast-moving free Quark approaching an electron in the shell of an atom cannot give rise to an appreciable impulse transfer. On the one hand the electron has a size and mass too small for reasonable impulse transfers and on the other hand it will be repelled and make way for the Quark coming close to the electron orbital of the Quark (despite of the neutral behaviour from larger distances). A successful impulse transfer is only possible hitting the nucleus. The extension of an area belonging to an atom on the surface of a solid is given by few 10^{-10} m while the dimension of nuclei is given by few 10^{-15} m. Thus the atomic cross-section q_a, given by the ratio of the areas, is about $1 \cdot 10^{-10}$. On average for 10^{10} free Quarks hitting the ‘area’ of an atom (including its surroundings, distance of chemical bonds) only one is hitting the nucleus.

To get the probability of an impulse transfer of a fast-hitting Quark to a Quark in their orbitals of a nucleon, first of all the probability of Quark-Quark-hitting is necessary. According to the considerations in part 1 (1.4) the outer diameter of the range given by Quark orbitals is about 3.8 fm (basis orbital 2.8 fm). With 36.7 km/s a transit time through the nucleon of about $1{\cdot}10^{-19}$ s is necessary (it is increasing somewhat with a smaller speed of the vehicle). Within the basis orbital the circulation frequency is given by $1.4 \cdot 10^{22}$ /s (circulation with 0.41c) which is somewhat lower in the outer regions of the orbitals such that an average value of $1.2 \cdot 10^{22}$ /s should be taken. During one circulation two meetings are possible and there are three Quarks in the nucleon. In case the orbitals would fill the whole volume there will be 7200 meeting possibilities per transit ($1{\cdot}10^{-19}$ s * $1.2{\cdot}10^{22}$ s^{-1} * 2 * 3). In a proton the transit time through the orbital shell represents about 30% of the total transit time, thus there are about 2160 meeting possibilities per transit. With a cross-section of a Quark of $13.2 \cdot 10^{-4}$ fm^2 (diameter $4.1 \cdot 10^{-2}$ fm) there are altogether 2.85 fm^2 per transit (individual cross-section times the meeting possibilities). With respect to the total cross-section of the proton (for Quark-Quark interactions) of about 11 fm^2 thus the hitting probability is nearly 25% for such a high speed of transition or hitting.

Due to the more extended region of orbitals and a somewhat higher circulation frequency the hitting probability for a neutron is close to 45%. With relative Quark velocities below or close to 10 km/s (effectively ‘thermal’; this corresponds roughly to the final speed of Pioneer 10 after leaving the solar system) the probability of impulse transfers reaches 100% already for individual protons. Taking in mind that the materials used for the construction of the explorers necessarily have a large number of nucleons in their nuclei, even with the considered high speed of the probes in the beginning, the assumption that any hit of a nucleus gives rise to an impulse transfer is a very good approximation. Thus the above given cross-section q_a is also a measure for the probability of impulse transfers; 10^{10} Quarks approaching an 'atomic surface region' of a solid give rise to one impulse transfer.

The determined high probability for the interaction between matter and Dark Matter - an interaction that is possible in both directions - has an enormous meaning for astronomy and cosmology. Radiation-decoupled Dark Matter is expected to exist without thermodynamic balancing. With the above-obtained cognition, however, such a balancing is possible with the mediation property of matter. A Quark-gas after the Big Bang can be cooled down or heated up by the presence of matter. In the environment of a large mass, within large dense gas or dust clouds and also within the interior of developing stars the temperatures can be adjusted within long terms. The emission of low-mass particles/Quarks/Dark Matter carrying high energy away is an effective cooling system promoting the development of new stars. Though Quarks are extremely long-time stable, on principle they may give rise to neutron generation or penetrate each other via central collisions and then even could cause their mutual annihilation.

The force of deceleration of the Quark-gas to the Pioneer probes is given by:

$$F_B = \Sigma \Delta p \qquad \text{(A1)}$$

where the change of the momentum Δp of an individual Quark is determined by the mass of a Quark and the relative velocity (that of the explorers for low-speed Quarks). As a result of the elastic collision a value of the (relative) momentum of zero is assumed (both nearly taking the same speed; within a solid the atoms are essentially fixed to each other and much heavier than the Quarks, such that there is a reflection similar to that at a wall). To calculate the deceleration force the number of free Quarks reaching the surface A_S of the explorers and especially the fraction that gives rise to a (complete) impulse transfer has to be determined.

$$F_B = A_S \cdot N_I \cdot \Delta p \qquad \text{(A2)}$$

N_I is the number of transferred momentums per unit area A_U and per unit time Δt.

$$N_I = f \cdot \frac{A_u \cdot v_s \cdot \Delta t \cdot \rho_Q}{A_u \cdot \Delta t} \qquad \text{(A3)}$$

With v_S the speed of the probes and ρ_Q the average density of free Quarks of Dark Matter. The product in the numerator gives the number of approaching Quarks and f is the fraction that indeed gives rise to hits of the nuclei in the solid. It is a number between 0 and 1 as a maximum, as soon as all arriving particles cause an impulse transfer. It is determined by the thickness of the material and cannot increase anymore as soon as the maximum penetration depth is reached. With d being the foil thickness (penetration depth, respectively) and ρ_a the density of atoms in the material the number f (the ratio of hit nuclei to the number of arriving Quarks at the unit area) is given as:

$$f = \frac{A_u \cdot d \cdot \rho_a \cdot q_a}{A_u \cdot v_s \cdot \Delta t \cdot \rho_Q} \qquad \text{(A4)}$$

By help of the mass of the sun ($2 \cdot 10^{30}$ kg) the total number of nucleons contained is determined with $1.2 \cdot 10^{57}$ and this enables a first estimate for the density ρ_Q . The number of (mainly) hydrogen atoms creating our sun can only stem from a region with about 4 light years diameter. This is the distance to the Alpha-Centauri-system as the nearest competitor for the available starting material. Thus the available volume (catchment basin) is about $3 \cdot 10^{55}$ cm^3. With an average gas density in our galaxy of roughly 1 atom(proton)/cm^3 the generation of the sun were impossible. The starting density should have been at least 400 atoms/cm^3. Because the complete depletion of the outer regions of this volume is unlikely and in addition losses via various mechanisms during the star formation occur, even a value of about 1000 atoms/cm^3 should be taken into account. Such a density of gas is in agreement with the present understanding of star generation and formation of spiral arms due to the development of a shock front due to the fast rotation speed of the galaxy as a whole with speeds higher than the sound velocity of the gas (somewhat comparable to the shock wave and gas compression at high-speed jets, in addition the shock wave of a nearby supernova might be considered). For the compression of gas has to be expected also for Dark matter (with at least fife times the mass density of matter that is commonly expected), the Quark density ρ_Q should be at least roughly $1.6 \cdot 10^4$ cm^{-3} (1000 atoms/cm^3 $\cdot 5 \cdot 3.2$). According to the model used 3.2 Quarks give rise to the mass of one proton.

In the following considerations aluminium is taken as a typical material. It has a density of 2.7 g/cm^3 which corresponds to an atom density ρ_a of $6 \cdot 10^{22}$ /cm^3. The number of Quarks reaching per second with maximal possible speed the explorer surface of 1 cm^2 is given by:

$$1\ cm^2 \cdot 3.67 \cdot 10^6\ cm/s \cdot 1\ s \cdot 1.6 \cdot 10^4\ cm^{-3} \approx 6 \cdot 10^{10}.$$

Already for a material thickness of 10^{-2} cm = 100 µm the number of hittable nuclei is

$$1\ cm^2 \cdot 0.01\ cm \cdot 6 \cdot 10^{22}\ cm^{-3} \cdot 1 \cdot 10^{-10} = 6 \cdot 10^{10},$$

i.e. starting with about that thickness the factor f (eq. A4) takes the value of 1 and reduces for smaller thicknesses according to the foil thickness d. For any sufficiently massive component of the explorers the number of impulse transfers is with 36.7 km/s always $N_I = 6 \cdot 10^{10}$ $cm^{-2} \cdot s^{-1}$.

Thus with the assumption of a 'massive' parabolic antenna as the main acting part the deceleration force F_B can be estimated with eq. A2:

$$F_B = 7 \cdot 10^4 \text{ cm}^2 \cdot 6 \cdot 10^{10} \text{ cm}^{-2} \cdot \text{s}^{-1} \cdot 3.67 \cdot 10^6 \text{ cm/s} \cdot 0.51 \cdot 10^{-27} \text{ kg} \approx 7.9 \cdot 10^{-8} \text{ N}.$$

This force of deceleration is nearly by a factor three smaller than the measured one. As a primary source of error first of all the estimate of the average density of Quarks ρ_Q has to be discussed. Taking for instance a size of the radial capturing region using the average via the nearest neighbours of the sun (larger catchment basin; smaller starting density of ρ_Q), the force would be reduced even by a further factor of 2 or 3. In addition it has to be considered that probably the unfolded antenna is - at least to a reasonable extend - made by thinner foil material that needs a description with a factor f smaller than 1. However, with a reduced speed of the vehicle the impulse transfer rate to the nuclei is increasing and a necessary foil thickness could be lower. Thus to transform the above given estimate into a real measurement of the density of Quarks in the interstellar space it needs very precise construction data of the explorers with active areas, kind of material and thickness of the material of any component of the vehicles as well as the real position-dependent speeds.

The used fundamental assumption of a complete impulse transfer with a single collision is only for thin foils a further source of error. With a sufficient thickness of the solid material any remaining momentum of scattered Quarks is transferred with a following second or third collision with a nucleus of the atoms.

Any space vehicle without propulsion looses speed leaving the range of attraction of the sun and thus for constant gas density within long terms the deceleration power has to decline till the constant final speed is achieved. The strength of transferred momentum by any Quark is proportional to the speed of the probe. In addition the number of Quarks hitting the surface of the vehicle per unit time decreases with reducing speed as far as the density of Quarks stays constant (effectively all together a variation with the square of the speed). Within the range of the determined 'final value' of the deceleration (beyond Saturn) the speed of the probe Pioneer 10 has reduced to about 20 km/s, this means

$$F_B \approx 7 \cdot 10^4 \text{ cm}^2 \cdot 3.3 \cdot 10^{10} \text{ cm}^{-2} \cdot \text{s}^{-1} \cdot 2.0 \cdot 10^6 \text{ cm/s} \cdot 0.51 \cdot 10^{-27} \text{ kg} \approx 2.4 \cdot 10^{-8} \text{ N}.$$

This force is only 10% of the measured action. Assuming further on that the density of Dark Matter stays constant within near interstellar space, the deceleration beyond Uranus (further lowered speed of the vehicle) should even reduce to about $-6 \cdot 10^{-8}$ m/s^2, as far as the density of Dark matter were already at this position constant along the way passed by. The speed of the probe is already reducing by about 20% between the paths of Saturn and Uranus. However within this region a constant deceleration was found. Thus expecting a deceleration by Dark Matter it has to be assumed that the depletion zone is at least extending beyond the path of Neptune and that within this considered region the additional decrease of the speed of the vehicle is roughly given by an increase of the density of Dark Matter. The possible decrease of the non-understood deceleration via speed reduction expected above can only occur as soon as the depletion zone is passed (achieving a constant density and still reducing speed).

Concluding it is possible to state that using a Direct Structure Model of Matter and an estimate of a least density of matter and Dark Matter (free Quarks) the correct order of magnitude of the up to now non-understood deceleration of space crafts in the outer regions of our solar system is solely obtained, if there was a higher real starting-density of the initial gas of about 10^4 atoms/cm^3 within the former star generation region of our solar system (as far as there was a radial symmetric density distribution that would still exist).

According to the present state of art the solar system was created by the collapse of a partial region of a much larger cloud. Due to conservation of rotational momentum and the centrifugal forces a gas disc (proto-planetary disc) is developing containing now a much higher gas density than within the former reservoir with radial symmetry. The missing order of magnitude for the density ρ_Q of Dark Matter could be very well realised by this collapse to a disc and create the necessary density of about $1.6 \cdot 10^5$ cm^{-3} to explain the Pioneer anomaly. The mass-rich central region (proto-star) of this disc is continuously growing by accretion until the increasing temperature is igniting the fusion reactions. Close to the young and still instable sun temperature and radiation are ionising the gas causing an electric current within the plane of the disc. This means a magnetic field orthogonal to the disc increasing towards the sun. Thus a considerable fraction of the ionised gas is able to leave the system via a micro-jet (Herbig-Haro-objects, T Tauri stars). A further depletion of the gas disc results from the radiation pressure and from the pressure of the solar wind, blowing most of the remaining gas away.

Those three dominating mechanisms - that meanwhile have blown away nearly completely all (ordinary) gas - cannot act the same way to free Quarks (Dark Matter). Because DM consists of neutral particles there is no depletion via a jet (magnetic fields). Because there is no interaction with radiation, DM is not blown away by photons. According to the low mass of about one third of hydrogen there is only little gravitative binding. Alone the impulse transfers by the particles of the solar wind - its density is decreasing with the square of the distance to the sun - are able to lower the density of DM over long terms. However, it remains questionable if the resulting depletion could be strong enough because the interaction is about three orders of magnitude weaker than for ordinary gas (ratio of the cross sections proton <> Quark to proton <> proton). All this might be somewhat supported by the gravitation of the sun. Thus if at all the former gas disc of Dark Matter is solely depleted within the range of the planets and there should remain a ring-shaped disc with nearly the conserved density of the beginning. It should be characterised by a relatively high thickness comparable about to that of the proto-planetary disc.

The speciality of the path of Pioneer 10 was its proximity to the ecliptic. Thus the strongest possible interaction with a ring-shaped area of Dark Matter was given. Probes that are leaving the solar system sufficiently outside of the ecliptic would not be influenced by such a kind of anomaly. Obviously at the inner side of the ring the density is fading till the path of Jupiter and this fading had to start at least beyond the path of Neptune. The gradient of this fading seems to balance the lowering of the speed of the vehicle in this region of the solar system giving rise to a nearly constant deceleration (the friction reduces with the square of the speed that reduces roughly linear with the distance and the density increases with the square of the distance to the sun). A constant density of DM should exist beyond the path of Pluto. But now the lowering of the speed due to the attraction of the sun is only weak and the reduction asymptotic till the final speed of about 10 km/s is achieved. The presented results to the Pioneer anomaly seem to indicate a weak reduction of the effect beyond about 40 AU though considerable errors of measurement do not allow a truly clear interpretation. The maximum thinkable density of Dark Matter within the solar system would result in the correct order of magnitude of deceleration of Pioneer 10. However, considering the enormous losses during the formation of the young developing sun with the necessity of emission of Dark Matter for a sufficient cooling seems to indicate that its contribution to the anomaly should be solely small and more probable a negligible one.

Appendix B

To the Physics within Event Horizons

Presently the by far most developed theory related to gravitation is the General Theory of Relativity that loses their range of validity approaching an event horizon. Any corresponding extension demands the knowledge of the deep fundamental mechanisms of gravitation and also of corresponding models related to the structure and construction of the matter-core of black holes (BH), the very structure of high-compressed matter. A very good starting point is served by the developed ideas about the orbital structure of matter, especially of Quarks, and the assumption of an all-comprising aether, filling the infinite space, that - in contradiction to the 'solid aether' still considered by Einstein - is taken here as an 'gaseous aether'. The absolutely necessary realisation of transversal oscillation processes demands active constituents of the aether - the Aea (aether atoms). They realise a distant-dependent mutual repulsion force (Dark Energy/ Negative Gravitation) as the only existing primary force within the aether. Their average distance is the Planck length. Thus all Aea have to take the by far most remote positions to all the other Aea. Surrounded by fixed borders (or with infinite extent) such a medium is striving for maximum-possible homogenisation (the assumption of such a kind of gas-like aether would not only allow the reproduction of the second law of thermodynamics, it would even serve a foundation for the existence of such a low). Embedded inside a (symmetric) medium with much lower density such aether had to expand immediately and homogeneously into all directions of space. All other forces known to us are generated by complex, coupled interactions of large collectives of Aea (see part 1; 1.6 - 1.8).

The source of gravitation is given through matter that - according to the discussed direct model of matter - is based only on two different elementary particles, electrons and positrons (in combination with neutrinos) via corresponding orbitals or orbital structures (compare part 1, orbital model). Those two elementary particles consist of highly complex dynamic and static structures with considerable density changes of the aether and comprise at least about 10^{37} Aea (given by the probable size of electrons and the Planck length). However, according to the experimentally observer incredible increase due to the expansion of our universe there should be Aea densities within the elementary particles being by orders of magnitude higher than the above given value. Probably this is only thinkable, assuming some kind of transition of the physical status (liquid or elastic solid) for the aether within the spin shells. This would allow densities by orders of magnitude higher. Now as well the high stability of the spin shells as the high Aea densities set free during the Big Bang would be explainable.

The elementary particles permanently emit tiny longitudinal photon pieces (LP) of both signs (enhanced and reduced internal aether density) into the surrounding aether. There is a predominating sign for each kind of elementary particle (probably a ratio 2/3 : 1/3) causing the property of 'charge'. The perfect balance of both anti-symmetric particles (due to pair creation) gives rise to global neutrality of the universe or partial systems of it. Any local asymmetry in their distribution generates an electric field. The differing emission (charge) necessarily causes differing density distributions or structures in the interior of the two kinds of elementary particles (compare part 1, 1.7; 1.8). The slightly changed internal density-distributions have to introduce the emission of longitudinal photons that have in addition a slightly enhanced aether density for both kinds of field quanta (as well as for enhanced as for reduced internal aether density). This weak asymmetry does not allow a perfect total balance and is the source of the by far weaker acting gravitation.

The permanent emission of such 'non-balanced' longitudinal photons with slightly enhanced aether density gives rise to a continuous 'pumping away' of Aea. It results in a reduction of the aether density around concentrated matter. The permanent back-stream of Aea by diffusion and drift mechanisms is counteracting such an active depletion and causes a long-time stable, distance-dependent equilibrium with development of a radial-symmetric density gradient in the neighbourhood of matter. This gradient is usually called gravity or space warp. To human beings based on matter (elementary particles) any nearly homogeneous aether is understood as (physical) vacuum (matter-free space; free of elementary particles) irrespective of density or gradients. Due to the active action of Aea among each other the aether represents a medium with tremendous inner energy content.

As soon as the matter concentration gets too strong (exceeding a mass-dependant critical density of elementary particles) starting with a certain distance smaller than a critical distance to the matter the diffusion and drift will be unable to balance the emission - now a considerably stronger reduction of the aether density takes place. Such a border has to be understood as a Schwarzschild sphere or event horizon. Even transversal oscillation processes (photons) are unable to pass outwards of such an extreme gradient of density.

The reduction of the aether-density gives rise to an increased Planck length and thus to a reduced speed of light (the transfer of excitation states of motion from Aea to Aea has to occur across larger distances). In addition all mechanisms of emission by the elementary particles will become less effective (such as also technical gas-pumps get less efficient with the reduction of the environmental gas pressure). This holds as well for the mechanisms of electromagnetism as for the inevitably involved gravitation. An increasing concentration of matter causes within the event horizon an approaching towards a self-limitation of the emission mechanisms. With reduced aether-density also a change of the variation of the number of Aea involved into the individual mechanisms has to be expected, so even the Planck constant h changes. Up to now physics was taught to us and understood more or less self-evident and essentially unconscious as physics with nature-constants. Now it has to be realised that inside event horizons there are no nature-constants at all. They all become variables of the local Planck length. Because the mutual interaction of density-gradients ('pressure differences') are especially dependent on the level of density, the constant of gravity is to be expected to be specific varying with the aether density.

To obtain a realistic theoretical description of such 'physics without nature-constants', necessarily the best possible knowledge to the kind and range of the interaction potentials between Aea have to be gained. A direct experimental access is impossible due to the unbelievable small dimensions. Any thinkable experiment can be performed only using photons and/or elementary particles. Both have dimensions at least 12 orders of magnitude larger than the Planck length (average distance of Aea). An indirect access might be possible by computer-simulation of the three-dimensional, transversal oscillation processes of photons in such a medium.

As well known the energy of a (harmonic) wave is proportional to the square of the amplitude A and the square of the wave number ν (= 1/λ)

$$E \propto \mathrm{A}^2 \nu^2.$$

On the other hand it is manifold proven that the energy of photons is given by E = hν . Thus A^2 has to be proportional to the wavelength λ. The Aea potentials have to be constructed in such a way that the effective amplitude of the oscillation process of photons is just given by a proportionality to the square root of λ.

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After this extended summary of parts 1 and 2 with a very special view it is tried in the following to estimate the conditions for the ignition of a Big Bang using a basis given by the direct structure model of matter with orbital structures in all levels. The orbitals for the motion of the Quarks in the last possible compression state of matter in the matter-kernel of a Super-BH (matter density about 2...4 · 10^{22} kg/m^3) have to be seen as highly relativistic. Thus it should be possible to calculate them simply by using equation (5) (part 1). Due to the size of Quarks with 4 · 10^{-17} m the orbital diameter within nucleons of a still just stable orbital (basis orbital) has to be larger than this value. Taking a diameter of 4.4 · 10^{-17} m (the circumference of the orbital corresponds to the de Broglie wavelength of the Quarks) equation (5) results in a relativistic mass increase of 5.6 (with respect to the rest mass of the Quarks) and gives for a highly-excited nucleon with three Quarks a mass of 5.28 GeV (9.42 · 10^{-27} kg). This compares fairly well to the mass of B-mesons. While in the mass range of observed high-excited particles up to the B-meson several particles with increasing mass can be found, above the mass of B-mesons there is a distinct gap and correlates very well with the given suggestion of a smallest possible Quark-orbital (compare also table 1). The only far more massive particle known has a short lifetime and mass of about 9.5 GeV. It is known as the Y-meson that probably can be understood as the high-energy-product of the collision of two nucleons, where the involved 6 Quarks circulate for a short time around a common centre.

Though the speed of Quarks in B-mesons should have about 0.98c, equation (5) still gives only an approximation. Using the correct equation (4) and the experimentally given mass of B-mesons the size of the Quark-orbital would be only $3.7 \cdot 10^{-17}$ m. This is completely impossible. Thus it has to be expected that the measured value still comprises a fraction of kinetic energy (relativistic mass).

The rest mass of B-mesons has to be expected closer to 4.8 GeV ($8.6 \cdot 10^{-27}$ kg). With such a rest mass also eq. (4) gives a smallest thinkable size of the orbital of $4.4 \cdot 10^{-17}$ m (neutrons need sufficient space for the further inner orbital of the negatively charged Quarks).

In the interior of the matter-core of a Super-BH a last pressure-stabilised kind of matter should be created in form of B-meson-matter. It should represent the highest possible excitation state of bosonic neutrons. The total size of those last-end high-compressed nucleons is $(4.4 + 2x2 + X) \cdot 10^{-17}$ m (2x2 results from the finite size of Quarks [two times the Quark-radius] and X represents the Quark circulation in the positive ionisation state in the high-energy state of the orbital based Strong Interaction). Taking a touching of the basis orbitals into account as usual in normal matter (i.e. a distance of $8.4 \cdot 10^{-17}$ m) and using a densest sphere packing (DSP) a matter density of about $2 \cdot 10^{22}$ kg/m^3 is the result. In case there is still a possibility of some overlapping of the basis orbitals a maximum thinkable matter density of about $4 \cdot 10^{22}$ kg/m^3 could be expected.

To get some imagination of the tremendous matter density the following considerations shall be given. Filling the total area of the city of Berlin (about 900 km^2) with express train engines (15m x 4m x 5m; mass about 80 t) and piling it up in several layers to a height of 165 m the result will be about $4 \cdot 10^{10}$ t. Compressing now this amount of matter to the size of a pin-head (1 mm^3) this results in the above given density of $4 \cdot 10^{22}$ kg/m^3.

The force F necessary to bring such extremely compressed high-energy-nucleons for a very short time into a last instable orbital (due to the overlapping of the Quarks within a very short time the complete annihilation of the involved electrons and positrons will occur) can be estimated by:

$$F = \frac{dE_{pot}}{ds} \approx \frac{\Delta E}{\Delta s} = \frac{\Delta m \cdot c^2}{\Delta r} . \qquad \text{(B1)}$$

Taking an estimated reduction of the orbital size from $4.4 \cdot 10^{-17}$ m to $3.5 \cdot 10^{-17}$ m the relativistic mass increase of the Quarks/nucleons changes according to equation (4) from about 5.6 to 6.3 (in each case related to the rest mass of Quarks). Introduced into equation (B1) this results in a necessary force of about $2.1 \cdot 10^{7}$ N ($\Delta m \sim 1.1 \cdot 10^{-27}$ kg; $\Delta r \sim 0.47 \cdot 10^{-17}$ m). Taking instead only a reduction to $3.9 \cdot 10^{-17}$ m the necessary force per nucleon is about 40% smaller ($1.5 \cdot 10^7$ N). Having in mind that there could be in addition a contribution of the electromagnetic forces and a possible action related to the Pauli principle, an alternative estimate might be tried. The maximum change of mass then is given by a complete annihilation of matter (complete transformation into non-localised energy) related to the reduction of the orbital size to the fictitious value of 0. Introduced into eq. (B1) this results in a force of about $3.5 \cdot 10^7$ N. To achieve the necessary pressure per square meter the density of nucleons is determined again with a touching distance of nucleons of $8.4 \cdot 10^{-17}$ m. This results in a value of about $1 \cdot 10^{32}$ nucleons/m^2 (DSP). Thus the pressure for the ignition of a Big Bang event, searched for, has to be expected in the range of $1.5...3.5 \cdot 10^{39}$ N/m^2.

To determine the pressure in the centre of the matter-core as a result of the gravitation first the pressure in the interior of a homogenous sphere of matter is considered. The acceleration $g_o(r)$ outside of a homogenous sphere of matter with a mass M, a radius R and a density ρ is given by:

$$g_o(r) = \frac{GM}{r^2} \qquad (r > R), \qquad \text{(B2)}$$

where G is the gravitation constant and $g_o(R) = g$ the acceleration at the surface. In the interior of the sphere the acceleration $g_i(r)$ is zero in the symmetry centre and increases linearly to the surface:

$$g_i(r) = \frac{GM}{R^2} \cdot \frac{r}{R} = g \cdot \frac{r}{R} \qquad (0 \le r \le R). \qquad \text{(B3)}$$

The change of pressure on an area A in the interior is described by:

$$dp(r) = \frac{dF(r)}{A} = \frac{g_i(r)dm}{A} = \frac{1}{A}\left(g\frac{r}{R} \cdot \rho\, A\, dr\right) = \frac{g}{R}\rho\; r\, dr. \qquad \text{(B4)}$$

The pressure of interest in the centre p_c is obtained by the integration along the radius:

$$p_C = \int_0^R dp = \int_0^R \frac{g}{R}\rho\, r\, dr = \frac{1}{2} g\, \rho\, R. \qquad \text{(B5)}$$

Alternative this pressure can be expressed by (the mass M is the product of density and sphere volume):

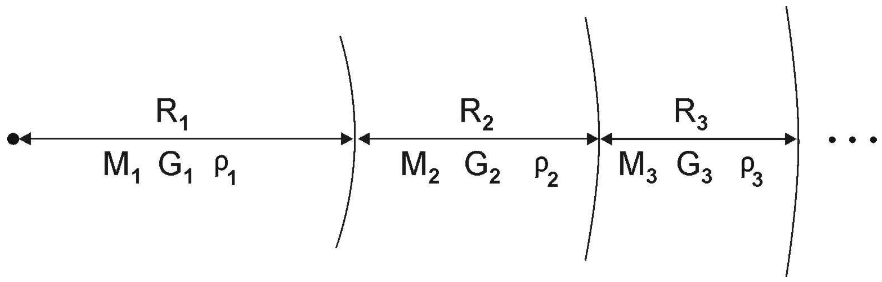
$$p_C = \frac{2}{3}\pi\, G\, \rho^2\, R^2. \qquad \text{(B6)}$$

Considering the matter-core of a black hole (BH) there will be no homogeneous distribution of matter. The pressure in the interior is growing towards the centre and forces - crossing corresponding limits - the Quarks of the compressed nucleons into smaller and smaller orbitals with higher excitation energy; the density of matter is growing (only orbitals based on central forces grow with increasing energy). In this way develops a shell-structure with shells of homogeneous matter density. As soon as a critical pressure is crossed a denser homogeneous shell is generated until the pressure again increases towards the centre, giving rise to a next denser shell. A perhaps possible estimate of the shell thicknesses might be obtained by the radial pressure distribution where for p(r) has to be integrated from r to R:

$$p(r) = \int_r^R dp = \int_r^R \frac{g}{R}\rho\, r\, dr = \frac{1}{2} g\, \rho\, R\, [1 - (r/R)^2]. \qquad \text{(B7)}$$

Taking an equidistant change of pressure for the corresponding orbital jumps eq. (B7) indicates an extended central region with shells getting thinner and thinner. This is due to the weak changes in the central region. However it holds only for moderate changes of the matter density.

To determine the pressure in the centre of a shell structure of the matter-core of a Super-BH according to the above given discussion to the change of aether density inside of event horizons besides the mass M_i, the densities ρ_i and the radii/thicknesses R_i also a possible change of the gravitation constant G has to be taken into account.



With the additional definition $g_i(R_i) = g_i$ at the corresponding interfaces the pressure in the centre is given by:

$$p_C = \int_0^{R_1} \frac{g_1}{R_1} r\, \rho_1 dr + \int_0^{R_2} (g_1 + \frac{g_2 - g_1}{R_2} r)\rho_2\, dr + \int_0^{R_3} (g_2 + \frac{g_3 - g_2}{R_3} r)\, \rho_3\, dr + ... \qquad \text{(B8)}$$

This is a result of the linear change of the acceleration inside the individual shells. It gives:

$$p_C = \frac{1}{2} g_1 \rho_1 R_1 + \frac{1}{2}(g_1 + g_2)\rho_2 R_2 + \frac{1}{2}(g_2 + g_3)\rho_3 R_3 + ... \qquad \text{(B9)}$$

The g_i are given by:

$$g_1 = \frac{G_1 M_1}{R_1^2} \qquad M_1 = \frac{4}{3}\pi\, \rho_1\, R_1^3$$

$$g_2 = \frac{G_2(M_1 + M_2)}{(R_1 + R_2)^2} \qquad M_2 = \frac{4}{3}\pi\, \rho_2\, [(R_1 + R_2)^3 - R_1^3]$$

$$g_3 = \frac{G_3(M_1 + M_2 + M_3)}{(R_1 + R_2 + R_3)^2} \qquad M_3 = \frac{4}{3}\pi\, \rho_3\, [(R_1 + R_2 + R_3)^3 - (R_1 + R_2)^3]$$

... ...

Here it might be possible to use an averaged weight of the G_i with all the corresponding shells involved, because there should be only a weak variation of the gravitation constant inside the matter-core. This might be justified because the reduction of the gravitation constant/density of aether occurs across a distance in the order of 10^{11} light years (size of the event horizon) while the matter-core has a dimension of only some light minutes.

With equation (B9) not only the pressure in the centre is accessible but also those pressures existing at the various interfaces. They are simply given by omitting the corresponding inner terms of the equation. The above given description was structured such a way that the reproduction and modelling of the conditions in the matter-core are easy for everybody and can be performed simply by table calculation. With respect to the many unknown data and relations there will be no definitive solution, but at least some determining factors or trends should be available.

The greatest problems at the moment are given due to the data about the excitation states of bosonic neutrons that are the constituents of the central region of neutron stars or the matter-cores of BH. A good indication might be obtained by those heavy particles generated by high-energy collision-experiments with nuclei or nucleons. The majority of them should have as slightly modified nucleons very similar excitation states. In this connection first of all the most profound discrepancy to the Standard Model has to be mentioned. Because it uses the hypothesis that Quarks are elementary, there has to be a differentiation between heavy particles with spin ½ and such without spin (or vector bosons). The former are interpreted as excitation states of nucleons and the latter ones have to be considered as two-Quark-systems (mesons). Within a direct-structure model with orbital-structured, non-elementary Quarks the resulting spin plays no decisive role anymore - at least with respect to the structural classification or the general interpretation. Within such a model also particles characterised as mesons can still be three-Quark-systems: A proton p consists here of 33 leptons, a normal neutron n of 35 and a bosonic neutron n_b of 34 leptons. Within the Standard Model it has to be described as a meson but still is a three-Quark-system, a nucleon. Also with the additional loss of some few leptons due to a high-energy collision it will still have a comparable size of the basis orbital.

By help of equation (B9) and table 1 an 8-shell-system was modelled that is characterised by the interface pressures and the pressure in the centre. It realises the pressures given in table 1 (irrespective of the fact that the one or the other value might be irrelevant or the table incomplete). Assuming in a first try that the gravitation constant has the unchanged well known value of $6.67 \cdot 10^{-11}$ $m^3/(kg \cdot s^2)$ such a BH would approach an instable state already with some ten times the solar mass. This is a clear hint to the fact that there is no possibility to create with such an involved low mass such extremely high matter densities - though on principle the corresponding interface pressures are able to stabilise those layers if their pre-existence is assumed. Trying on the other hand to transform a star of pure neutron matter (density about $1 \cdot 10^{17}$ kg/m^3) into a BH by using eq. (B5) and assuming a continuous stream of matter it needs about 650 times a solar mass to simply force the transition of the core into the Lambda-excitation of the nucleons. Any matter concentration consisting of non-excited bosonic neutrons having a mass larger than about 14 times the solar mass necessarily creates an event horizon larger than the matter-core and thus is a black hole. The generation of neutron stars with matter densities above 10^{17} kg/m^3 or the formation of smaller/low-mass BH seems to be possible only through the collapse of a star, where the kinetic energy of the collapsing matter serves (for a short moment) the corresponding high pressure in the interior.

Kind of particle	Mass 10^-27 kg	Density(DSP) [kg/m^3]	Orbital diameter [m]	Limit pressure [N/m^2]
n (Boson)	1.675	9.90E+16	2.84E-15	2.97E+34
Lambda	1.989	1.20E+18	1.28E-15	1.09E+35
Sigma	2.126	2.50E+18	1.03E-15	3.14E+35
Chi	2.344	6.10E+18	7.77E-16	1.96E+36
Omega	2.988	4.30E+19	4.22E-16	6.53E+36
D-meson	3.336	9.60E+19	3.27E-16	8.22E+37
J/Psi-meson	5.524	2.30E+21	1.10E-16	8.38E+38
B-meson	(9.42)* 8.6	2.00E+22	4.44E-17	(1.5 - 3.5)E+39

Table 1: Experimentally known particles as possible excitation states of nucleons; size of the basis orbital according to equation (4); the resulting density of a homogeneous material and the pressure necessary for a transfer to the next higher orbital excitation according to eq. (B1)
* experimental value probably not representing the rest mass

The matter density achieved with such a process clearly should depend on the (remaining) starting mass of the collapsing star. The necessary high compression will be only achieved in the central region. Assuming a remaining mass of a burnt-out star of few times the solar mass and simulating a core with matter densities in the order of $10^{20}...10^{21}$ kg/m^3 surrounded by a very thick shell of pure neutron matter to realise a BH, it is impossible to get the necessary pressure for creation of such high-compressed matter by the outer shell. The shell realises only some percent of the corresponding pressure. Nevertheless this seems to be sufficient to suppress a reversal of the process - the expansion into matter of lower density. The expansion demands enormous amounts of energy (the acceleration in the core regions is in the order of 10^{14} m/s^2). This energy is on principle available and stored in the high-compressed nucleons but only a synchronised setting-free by all nucleons allows the reversal.

Modelling an 8-layer-system with simultaneous reduction of the gravitation constant outside/at the surface of the matter-core of a just sub-critical Super-BH a drastic increase of the total mass is achieved with a significant reduction of the gravitation constant. If a total mass of some 10^{23}

times the solar mass is required as the starting condition for a Big Bang this ‘constant’ has to take a value smaller than about $2 \cdot 10^{-25}$ $m^3/(kg \cdot s^2)$, a deviation by about $3 \cdot 10^{-14}$ from the present value. In this case the 8-layer-system can be applied, because now a system is considered that indeed grows over very long periods by permanent increase of the total mass and no radial symmetric impulse transfers are able to initiate orbital jumps. It produces denser and denser regions in the interior. The radius of the matter-core determined this way is somewhere between that of the paths of the planets Mars and Jupiter, but more probable close to the one of Jupiter.

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