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Singularity-free Big Bang achieved by a Direct Structure Model of Matter

Concept of a new basic physics

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Abstract

A singularity-free Big Bang necessarily demands a pre-history and agglomeration of bosonic neutron-matter that were completely incompatible with the Standard Model of Particle Physics based on nucleons with three elementary, fermionic Quarks. However, even the summary of all present experimental results concerning the substructure of nucleons still allows a different interpretation of their internal structure. The alternative, investigated in this paper, assumes non-elementary Quarks with substructure units and results in a 'Direct Structure Model of Matter'. This model considers only structure units that are indeed contained, set free during experiments and possible to investigate in a direct manner. Prerequisite is a general principle of orbital formation that holds for any atomic or sub-nuclear dimension. The great advantage is a model with highly logical structure that uses only electrons, positrons and neutrinos. It allows in addition a straight and easy explanation of the generation, structure and properties of Dark Matter. Furthermore it will be demonstrated that there exist now only two acting forces or fields: electromagnetism and gravitation. Strong and Weak Interaction will be shown to be only effects related to the inner structure and dynamics of Quarks. A model that considers orbital structures in any level of matter allows to predict the Quark size with $4.11 \cdot 10^{-17}$ m. In contradiction to the Standard Model the Direct Structure Model is able to explain in a truly logic way the experimentally observed individual spin contributions of the Quarks to the total spin of protons. Introducing a space-filling medium with high-speed-elasticity explains Dark Energy, the mechanisms of gravitation and its relation to electromagnetism and the basics of Quantum Mechanics. In addition first crude models of photon and electron are achieved.

Übersicht

Ein Urknall ohne Singularität erfordert zwingend eine Vorgeschichte und Agglomeration bosonischer Neutronenmaterie. Diese ist aber völlig inkompatibel zum Standardmodell der Teilchenphysik, das auf Nukleonen mit drei elementaren, fermionischen Quarks basiert. Die Gesamtanalyse aller bisherigen experimentellen Befunde zur Substruktur von Nukleonen zeigt jedoch, dass ebenso ein anderes Beschreibungsmodell bezüglich deren innerer Struktur möglich ist. Die hier untersuchte Alternative geht von nicht-elementaren Quarks mit einer Substruktur aus und ermöglicht ein Direktes Strukturmodell der Materie. Dabei werden nur Unterstruktureinheiten verwendet, die tatsächlich in Experimenten freigesetzt werden und auch direkt analysierbar sind. Hierzu ist die Annahme eines generellen Orbitalprinzips erforderlich, das für atomare und sub-nukleare Dimensionen gelten soll. Der Vorteil besteht darin, dass es ein logisch verständliches Strukturmodell nur mit Elektronen, Positronen und Neutrinos ist. Es erlaubt darüber hinaus zusätzlich ein einfaches Verständnis für die Bildung, Struktur und Eigenschaften Dunkler Materie. Dabei ergibt sich, dass nur noch zwei wirksame Kräfte bzw. Felder erforderlich sind: Elektromagnetismus und Gravitation. Starke und Schwache Wechselwirkung stellen sich lediglich als Effekte dar, die sich aus der inneren Struktur und Dynamik der Quarks ergeben. Ein bis in tiefste Ebenen orbital strukturiertes Modell der Materie ermöglicht die Vorhersage der Quark-Größe mit $4{,}11 \cdot 10^{-17}$ m. Im Gegensatz zum Standardmodell kann das Direkte Strukturmodell die experimentell bestimmten Spinbeiträge der Quarks zum Gesamtspin des Protons logisch verständlich erklären. Durch Einführung eines den Raum erfüllenden Mediums mit hoch-geschwindigkeits-elastischen Eigenschaften können die Dunkle Energie, der Mechanismus der Gravitation sowie deren Bezüge zum Elektromagnetismus und die Grundlagen der Quantenmechanik erklärt sowie erste grobe Modelle von Photon und Elektron skizziert werden.

Content

Preface

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 support by the forecast of the ratio 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 and the status of evolutionary development of the observed corresponding galaxies. They show a strict natural evolution from smaller to larger, more complex structure units accompanied by a growing corresponding ‘metalicity’. 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 universe.

The global description of such an expanding universe is possible by help of the equations of General Relativity Theory 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. For instance, if this density is high enough, 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 not unlikely fact of an accelerated expansion - at least in the present stage of development of our universe. Therefore and due to the expansion 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 remaining 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 but as well by 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 be seemingly only overcome by the assumption that (our) space-time is generated together with the Big Bang. Within a Steady-State-Universe with a pre-existing space-time, the extremely high concentration of matter and/or energy in the early universe had to be described as a black hole, seemingly never allowing any expansion or 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’ within 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 more easily understood within this text via the expansion or density reduction of a ‘gaseous aether’ (quantum foam like) with structure units that repel each other and where in addition space warp may now be interpreted as local changes of the aether density. The term ‘physical space’ would be given within this context by a region of space with 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 this larger region before the Big Bang.

Irrespective of all scientific or philosophical problems the presently favoured Standard Model of Cosmology is based on a Big Bang event. To accommodate here our 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 about light minutes. The necessity of such a ‘physical trick’ could be a hint to the fact that in reality the

universe (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 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 this problem the exceptional homogeneity of the cosmic background radiation can obviously not be sufficiently explained and seems to force the assumption of ‘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 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. With other words, the presently favoured 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 (seemingly) 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 any other physical determination-quantity is finite or limited. Therefore a concentration of a degenerating non-elementary matter (spin-carrying matter constituents) should be out of scope due to the related unavoidable self-destruction during agglomeration to extreme densities. According to the Standard Model 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’.

It demands spin-less (bosonic) neutron-matter on a true matter-antimatter basis that therefore is forced to annihilate as soon as a critical density of matter due to the hydrostatic pressure within the matter core of a corresponding giant black hole is crossed. 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. It is 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 indeed allows the expected explanation of a Big Bang without singularity and inflation. As discussed later the origin of our universe should be a giant over-critical black hole (of course its matter-core) that unavoidable has to be transformed into radiation within a sufficiently long period of time and thus allows a nearly full thermodynamic balancing in the interior during the transformation process. At least within a period of time enabling several transfers of radiation fronts across the starting region.

In a subsequent period of expansion and cooling down 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. For the 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-proved physical mechanisms, avoiding the introduction of hypothetical units such as X-, Y- or Higgs-Bosons. While the Direct Structure Model enables a convincing explanation for the structure and generation 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 or 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 nuclear physics with formation of orbitals in any level of atomic or sub-nuclear dimensions. Especially, it uses Quarks with relativistic lepton-orbital substructure instead of the elementary Quarks assumed within the Standard Model. By help of this Direct Structure Model 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 without singularity and inflation. 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 build up nucleons). Simultaneously the historic controversy (Steady-State-Universe against Big Bang) can be finally resolved. This however demands the ultimate abandoning of any open or hidden geocentric idea: ‘our universe’ becomes a partial-universe and appears to be 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.

1 Introduction

The progress in high-energy physics (use of Bi-Jet-collisions, electrons with protons) has shown that also nucleons are more or less 'empty'. Though clearly the existence of only three Quarks has been proved a very larger number of scattering centres seems to be detected. The centres appear to be point-like and elementary according to the high energies of scattered electrons, i.e. at least with a size smaller than 10^{-19} m [1]. The direct prove of the existence of Quarks within nucleons was achieved by wide-angle scattering of electrons at Quarks (21 GeV, electron wavelength $6 \cdot 10^{-17}$ m) [2]. Because a reasonable wide-angle scattering should be bound to a comparable size of wavelength and diameter of the scattering particles, a finite, measurable size of Quarks in the order of 10^{-17} m should be expected and therefore actually they cannot be considered as being elementary.

The still accepted assumption of ‘point-like’, indivisible, elementary Quarks has important consequences to the Standard Model of Particle Physics. Nucleons as three-particle-systems (with three elementary Quarks) would hurt the Pauli principle. So Quarks need the assignment of a further quantum number, the ‘colour attribute’. Being elementary, unchangeable and indivisible the observed or necessary properties of Quarks within nucleons have to be necessarily also the same of the particles set free by collision experiments. According to the observations with scattering experiments it is assumed: Up-Quarks (charge +2/3 e, spin 1/2); Down-Quarks (charge -1/3 e, spin 1/2). All experiments with colliders or investigations of cosmic rays never showed particles with fractional charges (Quarks according to the assumptions of the Standard Model). Thus within this model it has to be assumed or defined that Quarks cannot exist as free particles and can never be separated of each other at lower energies (confinement).

Since the end of the 1980s it became possible to determine experimentally the individual spin contributions within the proton. According to those measurements it was shown that effectively only the two Up-Quarks give a reasonable spin contribution (about 2/3) to the total spin of the proton. It created the so-called ‘spin crisis’ of the Standard Model and forced the invention of a dynamic version, see e.g. [3]. Despite of all efforts to include even the rotational path spins of an assumed highly complex Quark-Antiquark-Gluon-structure also the new Standard Model is up to now unable to give a satisfactory explanation of the total spin of the proton. In addition the reverse conclusion gives rise to the statement that Down-Quarks (effectively without spin contribution in contradiction to the used assumptions) should be bosons. All mass-carrying bosons that were investigated in reality up to now rendered to be composed structure units. Thus at least Down-Quarks could have a suitable substructure and this gives a first hint for the solution looked for. Quarks that are composed (of fermions) can be bosons or fermions depending on their state of excitation and thus correspondingly excited nucleons too.

According to their decay products (leptons and photons) and their spins, mesons (knocked out of nucleons) are presently in general described as Quark-Antiquark-constructions - for instance positive charged Pions with Antidown-Up. The mass of Pions was determined with about 140 MeV. Neutrons (Down-Down-Up) and protons (Up-Up-Down) own with a slight difference to each other a mass of about 940 MeV. The discrepancy with respect to the mass of both kinds of particles (two-Quark-Pions <> three-Quark-nucleons) might be explained by mass production via energy incorporation (binding energy) that has to be expected somewhat larger for nucleons. Assuming the generation of rest mass within such considerations, it is questionable, if then both kinds of particles still can be interpreted using identical types of Quarks. If the corresponding necessary mass increase (nearly 80%) is achieved by kinetic energy, an estimate of the diameter of the corresponding Quark orbitals gives a size of the nucleons at least one order of magnitude lower than experimentally observed (compare estimates given in chapter 2). Thus it may be imagined that Pions represent in reality solely fragments of Quarks with an even number of sub-Quark-units instead of being two-Quark-systems.

Another problem arises for the Standard Model with the interpretation of a different kind of mesons, Kaons (half-nucleons), having about half the mass of neutrons or protons. Assuming a structure with only two elementary (indivisible) Quarks (e.g. Strange-Anti-Up) a frequent kind of decay into three particles (Pions) is hardly to understand and indicates them actually to consist of three bosonic Quark-fractions (e.g. three half-Quarks) instead of a two-Quark-system.

Today the phenomenon of Big Bang has to be taken as a fact. Thus more problems are arising related to nuclear physics in an indirect way, such as the mentioned matter-antimatter-asymmetry of the early universe that cannot be sufficiently understood up to now by help of the Standard Model of Particle Physics. Furthermore there are the problems to interpret Dark Energy or Dark Matter. The constituents of the latter necessarily have to be explainable in a straight and logical way applying a valid structure model of matter.

All the above-mentioned problems can be easily interpreted or solved introducing a description of nuclear physics using an orbital substructure of non-elementary Quarks. Such a solution should actually be a first choice for the interpretation of those quantum mechanical systems, because it creates a Direct Structure Model. The present Standard Model is an indirect one, i.e. it assumes structure units that on principal cannot be set-free during experiments and that therefore cannot be investigated in a direct way. The concept presented here shows that it is possible to develop a model that considers only structure units contained and indeed being set free during experiments: electrons, positrons and neutrinos. In addition larger structure units (Pions, Muons etc.) are observed that finally decay into just those mentioned fundamental particles, indicating to be composed of them (or

emission of Gamma-rays in case of their annihilation). By help of the Direct Structure Model it is even much easier to explain all experimental findings (see chapter 4) such as the structure-function of protons, the charge distributions of the nucleons or their internal spin contributions for example. An indirect model of structure can only be seen as proved if all possible direct models have been shown to be invalid. However, up to now this was never seriously taken into consideration.

A further questionable item of the presently accepted Standard Model is the (actually arbitrary) definition of mesons (spin 0 or entire) to be built up by only two fermions (Quarks). This total spin could be also caused by 4, 6 or even 18 fermions. The restricting definition forces the assumption of different kinds of Quarks and leads to the presently assumed three families of elementary particles. Within the Direct Structure Model the reaction processes of nuclear particles can be explained on a much easier basis by help of only two kinds of elementary particles (neutrinos are so far not considered as elementary particles due to their unclear position) and there is now only one kind of composed structure unit 'Quark' (with much larger mass than assumed within the Standard Model). Now there isn't anymore an asymmetry between matter and antimatter in the early universe; our matter is no tiny residue. In addition a so-called 'hurting of parity' can be simply understood within this context by the inner structure and dynamics of Quarks (compare chapter 4).

The main arguments for the validity of the Standard Model - based on the fundamental claim that Quarks are elementary - are founded essentially on the results of high-energy scattering of electrons at protons. The complex time-consuming evaluation of the momentums of the scattered electrons into the various scattering directions results in the so-called structure function $F_2(Q^2,x)$ of the protons. This function describes the action of charged particles as constituents of the proton. Here Q^2 is the square of the absolute value of the 4-momentum (exchanged momentum) and x the fraction of momentums (standardized to the mass of the proton) achieved at the resolution $\hbar c/Q$. As far as the proton were to consist of only one constituent or would act as a unity with low electron energies (wavelength large with respect to the proton size) a Delta-function (or peak) at x = 1 would be the result. As far as the proton consists of three sub-units (Quarks) and investigating with by far higher energies/electron momentums (much shorter wavelengths) a Delta-function at x = 1/3 appears that is smeared out however into a broader peak due to the inherent impulses of the Quarks.

Due to strong impulse transfers between the Quarks this maximum is in addition observed at somewhat smaller x-values. The prerequisite for the development of such a peak is related to the fact that at least for dimensions smaller than the size of the proton the Quarks can be practically seen as they were quasi-free, they were able to take over external impulses. Alone by the assumption of the 'confinement' the restricted motion of Quarks within nucleons appears to be realised and thus this seems to prevent an investigation in a direct way.

Assuming a further substructure of Quarks with n sub-constituents, using even higher energies of the scattered electrons (higher resolution), on principle the development of a further maximum at x = 1/(3n) has to be expected. The missing of such a peak even for very high (relative) energies (Bi-Jet) is taken as prove for the elementary character of Quarks. With increasing applied (relative) electron energies or momentums the structure function is instead developing for small x-values into a shape that resembles a function approaching a pole (unsteadiness) at x = 0. Now, at the position of the maximum generated by the three Quarks solely a plateau is remaining, see e.g. [4].

Assuming Quarks to be elementary (Standard Model), the strong increase of the structure function towards small x-values for very high relative impulses between electrons and protons has to be interpreted by the increasing 'visibility' of more and more very small structure units with increasing resolution. They are supposed to be sufficiently free to take over a large number of very small fractions of the proton momentum. It is thought that within the low-range fields around the three basic units - now named valence Quarks - a cloud of sea-Quarks should develop according to the Dynamic Standard Model (short-time generation of a large number of pairs, Quarks/Anti-Quarks out of gluons and back). In this way the valence Quarks gain something like a finite size that explains the wide-angle scattering and an effective mass of about 300 MeV, though Quarks are assumed to have only a low mass of few MeV. However, within such a picture the discrepancy with respect to the mass ratio of Pions and nucleons cited above cannot be resolved in a truly plausible way.

Assuming Quarks to be non-elementary (Direct Structure Model) - i.e. there is a true substructure - and having the result of wide-angle scattering for wavelengths in the order of 10^{-17} m in mind, there is the absolute necessity of a high localization of the n substructure units within just such a dimension. Besides the generation of clouds, as discussed above, such high localisation can be only achieved by the assumption of an orbital system. In this case there is the necessity of extreme energies of highly relativistic substructure particles (to satisfy the indeterminacy relation) that necessarily in addition have to be characterized by extremely strong interaction forces between each other (necessity of mutual binding). The extremely strong bound particles of such a high-relativistic orbital substructure cannot be considered as free with respect to impulse transfers any more. The formation of a peak at x = 1/(3n) is impossible. There will be only short-time disturbances of the orbital system with more frequent small disturbances (small impulse transfers) than stronger ones. The relativistic orbital Quark-substructure (with a total mass of this many-particle structure unit of about 300 MeV) would as well explain in a perfect way the shape of the observed proton structure function and thus should be discussed here parallel as an equivalent alternative.

The Standard Model - historically originated much earlier - was developed over decades by the contributions of thousands of physicists to a concept that allows today a quantitative use.

This is still lacking to the new Direct Structure Model just being at its beginning. As compensation the new model has for instance no problems to give statements to the generation, structure and properties of Dark Matter (free Quarks, that could not be bound within nucleons due to insufficient or incorrect kinetic energy), needs no asymmetry matter-antimatter in the early universe and has an essentially simpler basic structure with only two elementary particles and only one kind of Quarks with different excitation states. Finally dedicated experiments have to decide about the validity of models.

2 Nucleons as Quark orbitals

According to the present state of the art there are corresponding solutions for possible orbitals of Quarks with fractional charges within the nucleons on the basis of the Standard Model, which cannot be used within the search for a new alternative description. That Quarks have to move within orbitals can be easily understood analogous to the former problems with the explanation of the electron shells. It is the only solution to avoid the permanent electromagnetic energy loss of the accelerated moving charged particles. With the expected relativistic effects solutions e.g. of the Dirac equation are necessary and this first demands a new adequate description of the problem, the development of a new model. Due to the experiences with electron shells (wave mechanics) the spherical s-orbitals (Bohr radius) can be calculated in a very easy way via standing matter-waves (de Broglie-waves). A symmetry that holds for leptons, mesons, nucleons and obviously also for Quarks. Such a solution is used here to obtain a suitable model though it has to be left open at this stage which way orbital formation might be possible without a central field.

Such a simplified consideration demands an 'experimental estimate' for the diameter of the Quark orbitals or nucleons because it cannot give a selection out of the orbitals, possible on principle, as comparably obtained e.g. by help of the Schrödinger-equation in the case of electron shells. Nevertheless this simplified consideration of standing matter-waves allows a reasonable estimate for the ‘averaged orbitals’. The diameter of the Quark orbitals (as starting assumption) is taken here as about $2.5 \cdot 10^{-15}$ m (radius 1.25 fm) and can be understood as the size of a basis orbital within the somewhat larger effective nucleon cross-section - as anticipation to the next chapter (iterative procedure). This value was selected in accordance to the measured sizes of larger nuclei (nucleon distances, see chapter 4) and the fact that within scattering experiments with electrons starting with a wavelength of about $2.5 \cdot 10^{-15}$ m already first ‘shell structures’ could be clearly distinguished inside of the nucleons. The chosen starting-size of the Quark orbitals corresponds in addition roughly to a 2/3 reduction of the charge density in fig. 2 (see chapter 3.1) to involve surely also the third outer ‘shell’. Thus this starting size within the used iteration procedure represents nearly a

realistic ‘measured’ value. As discussed somewhat later any nucleon size determined experimentally should sensitive and considerable vary with the method of measurement.

Within the next chapters the individual mass or energy contributions to nucleons have to be iterative determined given by the rest mass of the three Quarks, their relativistic mass increase due to the motion within the orbitals, the exchange or binding energy, the rest mass of the sub-components of the Quarks and their kinetic energy (relativistic mass increase) inside of the Quarks. Because nucleons are composed of three Quarks, the mass of a Quark as a whole in the basis orbital is in a first approximation one third of the mass of a neutron (including the relativistic 'kinetic mass’ due to the relativistic motion in the orbitals). Within this context it is assumed that the basic structure unit ‘Quark’ is clearly defined by a definite rest mass. The necessary force responsible for the motion in orbitals, the binding or creation of nucleons is taken as based on the exchange energy of a substructure unit inherent within the real substructure of Quarks (incorporated within the rest mass), i.e. a binding energy - Strong Interaction - via particle exchange between different Quark-sub-orbitals. This means that the obtained parameters are never valid for all three Quarks at the same time because Quarks do exist that have lost the exchange-structure-unit (see e.g. chapter 3.1). According to the used starting conditions the validity is restricted to those states of the Quarks that are probably responsible for the mutual distances between nucleons within larger nuclei. The de Broglie- or matter-wavelength of such Quarks is obtained from:

$$\lambda = h/p \qquad \text{with} \qquad p^2 = E^2/c^2 - (m_0 c)^2 \qquad (1)$$

(p is the momentum, h = 6.626 $\cdot 10^{-34}$ Js and m_0 is within this context the rest mass of a Quark as a whole). The most important parameter searched for is the rest mass of the Quarks. Within a direct structure model this rest mass allows essential statements to the energy and/or number of leptons involved in the Quarks.

By simple transformations the equations used for the iteration are obtained from the equations (1) with m being the total mass of the Quarks moving in their orbital:

$$\lambda = \frac{h}{m_0 c \sqrt{\left(\frac{m}{m_0}\right)^2 - 1}} \quad . \qquad (2)$$

For highly relativistic particles (v $\approx$ c) this can be written in good approximation:

$$\lambda = \frac{h}{m_0 c} \sqrt{1 - \frac{v^2}{c^2}} \quad . \qquad (3)$$

Within these considerations it has to be remembered that λ represents the wavelength of the particles for their interaction with matter, e.g. for the scattering of electrons at a crystal lattice. We in our reference system, however, notice the wavelength with relativistic length

contraction and the same is true with respect to the size of the orbitals. The length contraction is related to the direction of motion of a particle. Within a three-dimensional orbital of spherical symmetry all directions of space occur equally. Thus the Lorentz contraction has to be applied in addition to the equations (2) and (3):

$$\lambda = \frac{h}{m_0 c \sqrt{\left(\frac{m}{m_0}\right)^2 - 1}} \sqrt{1 - \frac{v^2}{c^2}} \qquad (4)$$

$$\lambda = \frac{h}{m_0 c} \left(1 - \frac{v^2}{c^2}\right) \quad \text{for } v \approx c. \qquad (5)$$

Because the circumference of a spherical basic orbital is simply given exactly by the wavelength (condition for standing waves), with the assumed diameter D of the basis orbital in nucleons (taken as a first approximation ca. 2.5 fm) a matter wavelength of $\lambda \approx 7.9$ fm is given ($\pi \cdot D$). The total mass m of the considered Quarks corresponds to one third of the mass of a neutron ($m_n = 1.675 \cdot 10^{-27}$ kg). In chapter 3.2 it will become obvious that the mass of the 'state' of Quarks determining the distance between nucleons is indeed given by the mass average of the three Quarks involved in a neutron. The total mass m of a Quark is in addition defined by the generally valid relation between m and m_0 via the ratio v/c due to the relativistic motion within the orbital:

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (6)$$

Combining equations (4) and (6) results in

$$m_0 = \sqrt{\frac{c^2 \cdot m^4 \cdot \lambda^2}{h^2 + \lambda^2 \cdot m^2 \cdot c^2}} \; . \qquad (7)$$

The solution of eq. (7) with a matter wavelength λ (or circumference of the orbital) of 7.9 fm gives a rest mass of the Quarks searched for of about $0.5 \cdot 10^{-27}$ kg and represents about 548 times the electron rest mass m_e. There is no need for a high accuracy. Later on a further adaptation due to the internal structure of Quarks is necessary anyway (see chapter 4). The resulting orbital speed is $v/c \approx 0.448$. The mass increase ($m_0 \rightarrow m$) according to the relativistic motion of the Quarks within their orbitals is about 11.8%. Thus an important statement is the fact that at least about 12% of the mass surrounding us (and of the gravitation related to this mass) is simply due to a relativistic effect (orbital localised kinetic energy of the Quarks).

Accepting the idea that Quarks - orbiting within the quantum mechanical system 'nucleon' - move within orbitals, it has to be accepted as well, that there should be the possibility of

excited states. The transfer of energy due to an impact or due to a growing gravitational pressure within a neutron star or in the nucleus of a black hole is increasing the energy and momentum of the Quarks resulting in a smaller matter wavelength. Thus such excited nucleons become smaller once a jump into an orbital of higher energy occurs and in addition increase their relativistic mass. As far as Quarks represent indeed composed structure units any loss or gain of leptons within such reactions could give rise to spin-less nucleons if accidentally an even number of involved leptons is realised (e.g. protons forced to swallow an electron). This sight or expectation would be completely impossible within the presently accepted Standard Model considering only three spin-carrying elementary Quarks, though experiments do show no spin for Down-Quarks in the proton. Thus presently any observation of excited spin-less nucleons (three-Quark-systems) had necessarily to be interpreted as generation of heavy mesons (assumed as two-Quark-systems). The general idea of a Big Bang without singularity, being the final goal of this paper, becomes a realistic goal if indeed a substructure of Quarks appears to be a possible alternative or can be even demonstrated.

3 Orbital substructure of Quarks

At medium electron wavelengths in the order of 10^{-17} m Quarks give rise to wide-angle scattering. Thus they should have a size of just this dimension. The contradictions resulting of the high energy scattering experiments (many point-like scattering centres but only three Quarks) could be immediately equally well resolved as soon as also Quarks are assumed to be orbital systems of 'point-like', elementary particles that should not be interpreted as Quarks and Anti-Quarks. Such complex, structured Quarks at least on principle cannot scatter like particles as a whole if particles of very high energies (electrons) are used. This was at least observed in a similar way for the nucleons, which then also do not scatter as a whole.

To get an idea how many and which particles respectively sub-orbitals could form the Quarks it is useful to make the possibilities of Quark synthesis in the early beginning of the radiation-dominated universe accessible. Of course only definitely existing and directly proved well-known basic physical phenomena should be taken into consideration. The introduction of any new and possibly only hypothetical kind of high-energy-physics with e.g. X- and Y-bosons should be solely considered, if the failure of the up to now known physics is clearly obvious and unavoidable. Thus first of all only pair creation (electrons, positrons) as well as the photon annihilation mechanism (generation of neutrinos) are effectively available to create mass through radiation and should be mainly investigated with respect to a possible generation of matter following the Big Bang. Both mechanisms need the preservation of momentum and therefore the Gamma-ray collision with a particle or the collision of two

photons with each other. Furthermore it has to be taken into account that besides the setting-free of neutrinos only electrons and positrons have been observed as smallest units with rest mass, emitted by the nuclei after corresponding collision-reactions. In addition the emission of Muons is observed within such reactions, which decay into electrons or positrons; or there is the emission of Pions, which decay into Muons or into electrons and positrons (for more details see chapter 4); or Kaons are set free, which decay into Pions etc. All this suggests fairly well to assume within a Direct Structure Model a substructure of Quarks with electrons and positrons.

Before checking the demands with respect to energy and generation possibilities the discussion of the suggested general Quark structure with respect to a suitable building-up of the structure of nucleons has to be considered.

Though the usual pair creation should be the essential phenomenon, for the sake of simplicity first a hypothetical collision of two high-energy Gamma-quanta is considered. The possible result might be a quadruple of two electrons and two positrons. Quarks definitely are substructure units of nucleons. That means their size has to be expected being at least below 10^{-16} m (according to the scattering phenomena even with few 10^{-17} m), while the wavelengths and expanse of the 'fields' (amplitudes) of the photons existing during or following the radiation-dominated Big Bang is in the order of only about 10^{-12} … $6 \cdot 10^{-15}$ m (the presently accepted model, forced to use a singularity, necessarily expects completely different energy ranges, compare chapter 10). The motion of photons as well as the transversal oscillation starting from the central region of a photon (of whatever physical quantity or units) is given by the speed of light. The motion of a photon across $\lambda/4$ thus is related to a maximum extend $\lambda/4$ of the transversal oscillation process. Then this process breaks down to restart again after $\lambda/2$ in the opposite direction. This means the maximum extent of the transversal oscillation in the kernel of a photon is twice that distance and given by about $\lambda/2$. Compared with the Quark or electron size those 'fields' have a considerable extend. Thus on principle photons are able to accelerate both elementary particles against each other (electric 'field'), give the resulting orbital complex with the relativistic mass increase the necessary total mass, and forces them afterwards via Lorentz force into 'orbits' (magnetic 'field'); even if only individual photons are considered.

If the particles (electron and positron) get both into 'orbits' (additional condition of stationary matter-waves) stable orbitals are generated. Any change of those states demands sufficiently high energy (any influencing is possible alone by quantum jumps). The Quarks are thought to be created in general via pairs, thus there is in addition the permanent stabilisation by the extremely strong mutual short distance influences of the electromagnetic fields of the elementary particles to the respective other orbital. An interaction that is in some

way somewhat comparable to the effect of a central field (the field of the electron orbital holds and stabilises the positron orbital, while vice versa the latter one binds the electrons in their orbital).

Obviously such an 'orbiting' is also possible with a close passage of high-energy electrons and positrons, but the stability is lower because they are probably orbiting in the same sense. The Quarks produced through electromagnetism have definitely the advantage of opposite sense orbiting (no resulting total rotational momentum) and are in the considered hypothetical example (quadruple) characterised by two fully occupied orbitals (opposite spin orientations) and thus represent a very stable orbital system. The properties of the two kinds of elementary particles are in some way 'anti-symmetric' and in another way 'identical'. Therefore the orbitals would be exactly of the same size and such a complex of orbitals had no chance of persistence. The particles would annihilate within a very short time. However, if there is some kind of affinity of the relativistic elementary particles to the neutrinos (existing due to photon annihilation mechanisms simultaneously with a very high density; compare also chapter 7) and thus modifying the particle energies (orbital size), there could and should be an ‘orbital splitting’ or separation of the orbitals. This would permanently part the orbitals endangering each other, without questioning the conservation of energy, mass, rotational momentum or charge.

The elementary particles exist on an equal footing thus there will be Quarks with electrons in the outer orbital as well as Quarks with positrons in the outer orbital. Both are acting to each other like anti-particles. Coming close together they will start to exchange the particles of their outer shells, which necessarily results in a total annihilation reaction. In the early beginning probably both kinds of Quarks existed within domains but did not allow any coexistence. Thus necessarily one kind had to succeed (compare chapter 10). Here the intermediate annihilation does not mean any loss. The 'construction material photon' is still available for the next try under the dictate of an ‘electronic world’ (excess of electrons as free or weak-bound particles).

Summarising, a four-particle-two-orbital-system (with particles/electrons and antiparticles/ positrons) should be taken for the Quarks, having two slightly different, concentric orbitals due to neutrino absorption or coupling. It is the task now to construct nucleons by help of such Quarks. In some sense this corresponds to the concept of Quark/Antiquark-structures explaining mesons. However in this case there is the permanent stabilisation power via orbitals. In an electronic matter world the inner positron orbital appears to be highly endangered. But within this configuration it is protected in a nearly perfect way. The penetration of electrons is possible solely for very high relativistic energies. Now the interaction or annihilation probability with the positrons is already strongly reduced. The fact that the only possibility producing antimatter is given by the collision of matter with matter,

effectively demonstrates clearly that the same constituents are always contained in both types of matter. It is just a turning inside to outside which of course needs very high energy.

Obviously the true path of Quark formation is based on the generation of only one orbitalised concentric pair (half-Quark). Afterwards the half-Quark fills its orbitals within an environment containing a high density of electrons and positrons, finally resulting in a complete and neutral Quark, being a boson and presently non-accessible to any direct experimental investigation or detection.

Because there exists already an estimate for the rest mass ($0.5 \cdot 10^{-27}$ kg = 548 m_e) of one kind or state of Quarks in chapter 2 (fully occupied orbitals), it is possible in this case to calculate the relativistic electron-positron-orbitals within such Quarks again via basic orbitals of de Broglie-waves. According to this in a first approximation each of the four particles needs an acceleration to achieve 137 times the rest mass of an electron (m_e) and means nearly 70 MeV or about 99.997% of the speed of light, respectively. Accelerating the Quarks as a whole with four elementary particles ($4 \cdot 137\ m_e = 548\ m_e$) to about 45% of c (velocity of the Quarks within the nucleons; only first approximation step) the result is a further relativistic mass increase to nearly 613 m_e. Taking three Quarks together gives about 1839 m_e, the mass of a neutron.

The Quark diameter can be determined to be about $4 \cdot 10^{-17}$ m. It is sufficient to use here equation (5), where by the given relativistic mass of 137 m_e the ratio v/c is precisely determined. This finding is in accordance with the observed wide-angle-scattering at Quarks starting roughly with increasing electron scattering energies at such a wavelength of about $6 \cdot 10^{-17}$ m [2]. It has to be emphasised that this Quark size has been solely determined by using the approximately known nucleon size, the well-known fact that three Quarks form the nucleons and the nucleon mass.

Thus the mass of an atomic shell-electron compares to the mass of a nucleus-electron as about 1:137. This is in agreement as well with the average ratio of the strength of electromagnetism to Strong Interaction as with the influence of the field-fluctuations of the nucleus (relative motion of the nucleus-electrons to the positron orbitals) on the surrounding electron shells (as soon as there is a non-zero probability of stay at the nucleus) visible in the fine-structure of the spectra (fine structure constant a).

The well-known Coulomb law for the electric force between two opposite charged elementary particles within vacuum is given by:

$$F = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{e^2}{r^2} = -\frac{\hbar c \alpha}{r^2} \quad \text{with} \quad \alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c} \ . \qquad (8)$$

Here a is the Sommerfeld fine-structure constant or electric coupling constant, respectively. The latter relation becomes even more understandable considering the corresponding electric potential term (-a/r) e.g. within the Schrödinger-equation of the hydrogen atom and a representing the strength of coupling to the proton. Equation (8) is valid within this context irrespective of the state of motion of the charge carriers. In general it is found in textbooks of physics for two resting charges. In case of one resting and one moving but localised charge carrier the possible solutions are described by the Schrödinger-equation (or relativistic extensions). It is not very surprising that in this case the solutions for the ground level have to be fully determined by this electric coupling constant (e.g. the Bohr radius or the ratio of the average speed v to the speed of light in the ground orbital; v/c = a).

For the expected Quarks described within this paper there are now four moving, localised, interacting charge carriers. Thus also here it is no surprise that again the constant a should have a very strong influence. That the used experimental values indeed demonstrate this expectation is actually a further hint to the correctness of the presented model. The above found ratio $m/m_e = 1/\sqrt{1-(v/c)^2}$ º 1/a = 137.036 allows the determination of the Quark-diameter (l/p) by help of equation (5) for the highly-relativistic electrons as:

$$d_Q \approx \frac{h}{\pi m_e c} \cdot \alpha^2 . \qquad (9)$$

With eq. (9) $d_Q = 4.113 \cdot 10^{-17}$ m is obtained. Thus optimum wide-angle-scattering of electrons at Quarks has to be expected for electron energies close to 30 GeV.

The most surprising result with this kind of structure formation is that more than 99% of the mass of baryonic matter (and therefore also of the resulting gravitation) is created by the effects of the theory of relativity through localised kinetic energy (localisation by formation of orbitals). The remaining percentage to 100% of the mass of atoms is due to the rest mass of the involved leptons. This gives a real logical understanding of the ‘mass-imbalance’ between protons and the low-weight electrons in the atomic shells. With respect to the enormous difficulties to accelerate a larger mass to relativistic velocities for achieving a sufficient total mass, nature has chosen a way to ‘build up’ matter or mass via ‘stages’: Leptons that are easy to accelerate form the heavy Quarks through a strong mass-increase within a concentric high-relativistic two-orbital-arrangement. Again three of those Quarks move now with low-relativistic speeds within orbitals to generate the nucleons.

Within the frame of a Direct Structure Model there will be solely generation of individual Quarks after the very beginning of a Big Bang via pair-creation-mechanisms. They need the additional gain of kinetic energy (approaching the orbital speed of the Quarks within nucleons) to come into a stable interaction with other Quarks and to achieve mutual orbital interaction (creation of nucleons). Thus most of the generated Quarks have to be expected to

stay in the state of non-bound individuals. The relatively heavy particles dominating the early universe have a size of only $4 \cdot 10^{-17}$ m. This dimension is considerably smaller than even the wavelength of hardest Gamma-quanta. Because they are in addition neutral, have no resulting rotational momentum or magnetic momentum and also no total spin, free Quarks are nearly undetectable and can be registered solely via their gravitational effect. Free Quarks should be the one kind of particles that are presently paraphrased as Dark Matter. With their special properties they are completely radiation decoupled.

3.1 Proton structure

Protons carry a positive charge and this necessarily demands a deficiency in one of the outer electron orbitals of the three Quarks. With respect to the instability of free neutrons (they decay via emission of an electron and a neutrino into protons, lifetime about 900 s, Beta-activity) the corresponding emission introduces the deficiency and obviously generates an energetically favourable situation. The re-occupation of this deficiency by a relativistic electron of the neighboured Quark is obvious or likely. There this leaves behind another deficiency or positive charge and a field now spreading out there, but this is necessarily limited with the speed of light. The frequency of the orbiting Quarks in the proton is about $2 \cdot 10^{22}$ per second (orbital circumference of about 7.9 fm and a speed of 0.45c; only first stage of iteration). If the electron exchange takes about one sixths of an orbit of the three Quarks (electrons and field have nearly twice the speed of the Quarks with only 0.45c) the developing electric field has solely a time in the order of 10^{-23} seconds before it breaks down again. Therefore the maximum expanse of the regulating electric field is only in the order of few 10^{-15} m within that time (well known range of Strong Interaction).

The total effect of the two positive charged Quarks and the exchange electron placed variable in between during the exchange processes appears to be an action like with springs. This is up to now usually seemingly realised via a 'field' of Strong Interaction. In fact permanently changing, regulating electric fields with very short ranges and the dominating, field-controlled exchange of heavy particles (relativistic electrons) gives rise to this force. It is acting to other nucleons in immediate neighbourhood (touching or partly penetrating each other) in a similar way too (commonly used exchange electrons of the nucleons). While the binding between atoms is effectively realised by the exchange of non-relativistic electrons, the binding between Quarks or nucleons is given by the exchange of highly relativistic electrons. In this case the electrons are 137 times as 'heavy' as in the case of chemical binding and so the strength of such bonds is correspondingly stronger (much more energy is exchanged).

Contrary to chemical bonds between two atoms (both orbital complexes), that arrange to each other with a distance given by a potential valley, within a nucleon (three-Quark-system) the relativistic orbital motion (centrifugal forces) realises forces of interaction, that are far apart of the true potential minimum between two Quarks. If the possibility of Di-Quark-formation might be given, then the mutual distance had to be expected in the order of some 10^{-17} m. Thus Di-Quarks had to be seen as further possible constituents of Dark Matter. Perhaps they would indicate their presence by an additional inhomogeneous distribution around massive objects according to the action of gravity to particles of different mass.

As soon as an external disturbance increases the distance between Quarks, the range of the orbital-based Strong Interaction increases linearly. The path length of the exchange electrons varies in first approximation proportional to the change of orbital or nucleon radius. Thus the same holds to the time of exchange and the range of the influencing, regulating electric field. However, the disturbance of the system ‘proton’ will in first approximation give rise only to a reciprocal proportionality of the strength of the electric field:

$$1/(R_0 + \Delta r)^2 \approx 1/(R_0^2 + 2R_0\Delta r)$$

So the force necessary for a disturbance will be in a first approximation a constant, as experimentally observed, because especially the mass or energy of the exchange electrons stays constant. There is however only a restricted ‘confinement’ within the Direct Structure Model, because obviously a stronger disturbance of nucleons results in a setting free of Quarks. Free neutral Quarks had to be - due to their unusual properties: extremely small, neutral, no magnetic momentum and spin - the main constituents of Dark Matter, possibly together with hypothetical Di-Quarks and are in effect experimentally ‘invisible’.

The release of an electron (during the exchange of a relativistic electron) reduces the mass or momentum of a considered Quark 1 considerably and necessarily forces different path parameters, the motion of Quark 1 into an outer region of the proton. The loss of an electron (about 25% of Quark mass) means a 33% larger orbital. (According to equation (4) the matter wavelength and thus the size of the orbital varies in first approximation reciprocal with the rest mass. Therefore the size of the new orbital increases with the emission of a relativistic electron according to 1/0.75 = 1.333.) While Quark 1 is approaching this larger orbital the electric field of Quark 1 reaches Quark 2 and once the field is strong enough it forces the jump of an electron. The electron moves with nearly c to Quark 1 which falls back after re-occupation to the basis orbital (the orbital of Quarks with full occupation of both lepton-orbitals, Down-Quarks, no total spin). The term ‘basis orbital’ was chosen because it contains the Quarks in their ground level. Quark 1 stays only short time in this orbital

because within this cyclic sequence Quark 3 (that meanwhile has lost the same way its electron to Quark 2) again forces already the relativistic ionisation of Quark 1.

This appears to be some kind of wave-like motion of the two charged Quarks always above the basis orbital, while the electron is moving most of the time below the basis orbital. For an individual Quark this remembers somewhat to a disturbed elliptical motion with fast and jumping ‘perihelion’ rotation. All this happens within a kind of sphere-shell orbital and with speeds, which do not allow the resolution by any experiment. With other words and to approach the language of Quantum Mechanics there appears to be an electron orbital starting far below the basis orbital, fading radial and overlapping with an orbital of positively charged Quarks above the basis orbital. The total effect is that of a positive elementary charge. This has to be supplemented by a dominating orbital of neutral Quarks and possibly suitable orbitals of neutrinos (compare 3.2).

Already the definition of the term 'size' seems to be very difficult. If the measurement of the size uses a procedure that is mainly related to the effects of the inner orbital of relativistic electrons, a radius up to about 1 fm has to be expected. If mainly the action of the rigid neutral Quark orbitals has an influence (nucleon distances in atomic nuclei), about 1.4 fm should be determined. With a dominating influence of the positive Quark orbitals a radius of about 1.9 fm could be realised and should already the strong electric field gain sufficient influence even a ‘measurement’ in the order of 4 fm is thinkable.

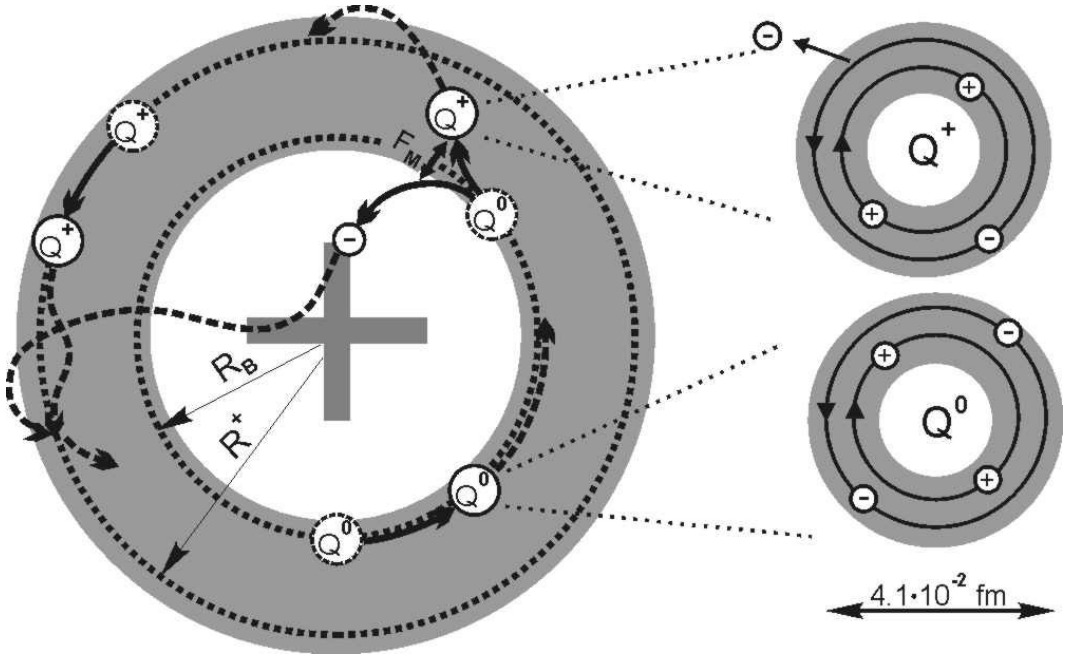

Fig 1: Two-dimensional schematic drawing of the paths of the three proton Quarks (ground state, without quantum fluctuations); ‘dashed Quarks’ at the moment of electron jump; the three Quarks (full circles) at an intermediate state; dashed arrows the most probable further paths; F_M strong magnetic repulsion forces (arrow); R_B basis orbital; R^+ standard path of the two positively charged Quarks; on the right hand side the corresponding detailed Quark structures

Due to the smallest possible quantum effect the determination of a de Broglie-orbital can only give something like an average size. It is given:

$$\Delta p \cdot \Delta x \geq \frac{\hbar}{2} \approx 3.3 \cdot 10^{-16} \text{ eVs} . \qquad (10)$$

The indeterminacy of the momentum with an indeterminacy of the position of about 2.5 fm with respect to the Quarks in equation (10) results in a variation of the Quark energy of about 9 MeV or for the three-dimensional case (factor $\sqrt{3}$) about 16 MeV. This is related to about 5% of the total energy of the Quarks and causes a corresponding ‘spreading’ of the orbitals. With respect to the relativistic 70 MeV-exchange-electrons this indeterminacy of the energy (DE = Dp·c for v º c) is considerably larger and in the order of about 50 MeV and means an indeterminacy of the position within the orbital of about 0.9 fm. The corresponding radial variation of the distance to the positively charged Quarks determines the width of the spectral lines, compare [5] and chapter 4. It is not the generally assumed vacuum fluctuation that causes the Lamb-shift, but the permanent variation of the position of the charged Quarks and the exchange electron relative to each other.

The first essential ideas about the size and structure of nucleons could be gained during the fifties/sixties of last century by electron scattering in the 1 GeV-range (wavelength about 1 fm). Because at that time the understanding to a substructure with possibly quite different mass was not a point to be considered, the interpretation was essentially based on the charge carrier density ρ according to the ideas and methods of R. Hofstadter. Though this density gives still a considerable contribution, the scattering of high-energy electrons is more favourable described by impulse transfers. A summarizing example of such early measurements is given in fig. 2 [6].

With the above-discussed orbital structure of Quarks and nucleons it appears to be difficult on a first sight to interpret the experimentally found scattering phenomena. Here it should be mentioned that the wide-angle-scattering is related to the central region of the proton while the less influenced forward scattering is represented by the weak outer extension of the measured graph. Though the original interpretation is based on three positive ‘clouds or shells’ (graphs 1-3), the existence of other negative charge carriers except of Quarks within the proton was completely out of scope at that time and such a fact cannot be simply differentiated by help of investigations using scattering.

According to the Direct Structure Model the neutral basis orbital can be found in the range 1.3 - 1.5 fm and the orbital of the positively charged Quarks between about 1.4 - 2.0 fm (to those corrected values see the end of chapter 4). The relatively heavy Quarks influence the shot-in electrons as total units and have a size nearly two orders of magnitude smaller than the wavelength of the scattered electrons. Thus there is little contribution to scattering via the

Quarks, compare interpretation-graph 3 that corresponds to the shadowed sphere-shell-region in fig. 1 (only for shorter electron wavelengths in the order of 10^{-17} m Quarks can be noticed with considerable wide-angle scattering). The essential effect of scattering in Fig. 2 is actually only given by the orbital of exchange electrons.

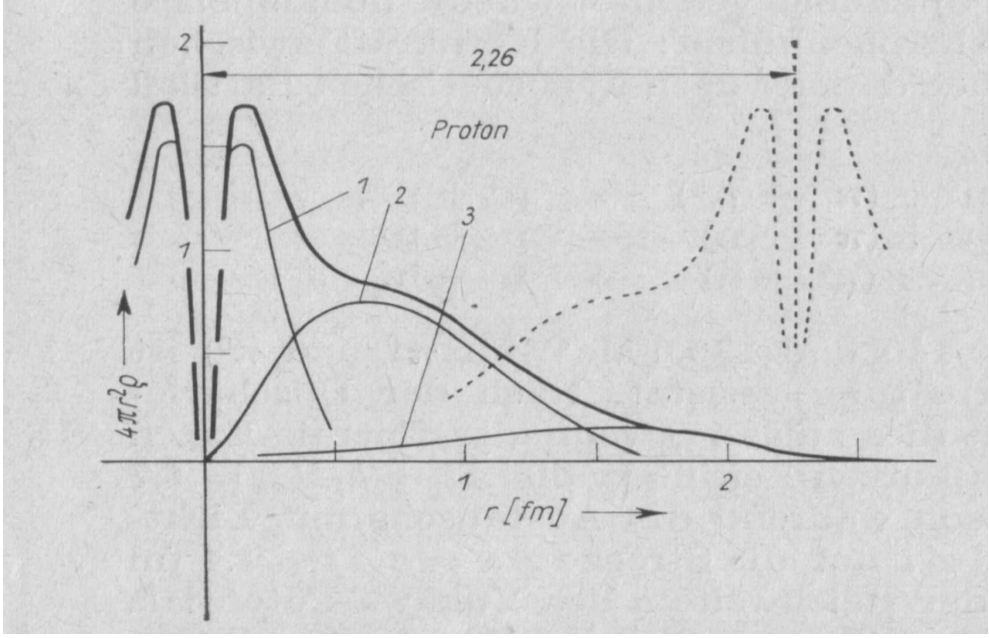

Fig. 2: Electrical charge carrier density ρ of a proton in the ground state [6]. Graphs 1 to 3 seem to represent internal charge shells (see text)

With the discussion of the orbital of exchange electrons in this chapter a scattering peak close to 1 fm should be expected, corresponding to a 'field-free' exchange. However, the positive Quarks and the electrons have to move into the same direction, i.e. the generated strong magnetic fields cause a force repelling them from each other (compare fig. 1). This influence should be small with respect to the heavy Quarks (about < 0.2 fm), but the orbital of electrons will be much more shifted into the interior of the proton. Thus it will be very likely positioned close to 0.6 fm (compare e.g. interpretation-graph 2). Also the extension of the scattering graph beyond 2 fm might be well understood by such electromagnetic forces. Despite of the dominating influence of the electric fields the exchange electrons have to move on complicated, bent paths (fig. 1).

To understand the scattering phenomena in the very interior of the proton one has to take into mind that the electron orbital is given by a relativistic orbital. First of all, this means a very small size, such that due to the indeterminacy relation (eq. 10) there exists a considerable indeterminacy of the momentum and correspondingly of the mass of the electron (actually without having any noticeable changes of the speed). Within the dynamic interactions of the electric and magnetic fields, which are permanently changing with the complex motions (of the Quarks and the exchange electron), obviously the states of the electron in the central region get a higher momentum/mass. While in Fig. 2 graph 2 is

probably representing the dominating effect of the charge carrier density/probability of stay, graph 1 is due to a dominating impulse transfer (wide-angle scattering). Both graphs 1 and 2 are related to one and the same relativistic electron orbital. In addition this orbital is characterised by an outer ‘extension’ due to the final stage of the electron exchange between the Quarks dominated by the strong electromagnetic fields (neutralisation of the positive Quarks).

There exists no chance for a high probability of stay within the very interior of the proton (density minimum), given by the fact that there exists an opposite motion of one and the same type of charge carrier. Again this causes repelling magnetic forces and a limit for the electron orbital in the very central part. (Due to a minimum speed of 0.999c the electrons show within a ‘momentary picture’ a lower, orientation-depending deviation of a usual charge. They are characterised by a comet-like ‘charge cone’ or field cone. Their action as a charge is a ‘retarded’ action.) The dashed graphs symbolise a probable distance of nucleons within nuclei and the development of nuclear forces due to possible orbital overlapping. Suggested by the experimental observation of the ‘charge shells’ the author concluded the used transition of non-relativistic radial-symmetric orbitals for atomic shells with ‘centre-dominated, radial-fading full-spheres’ into sphere-shells for non-central-field relativistic high-mass orbitals that are even further ‘narrowing’ in the high-relativistic case (Quarks). This expectation is further supported by the strong explanation power achieved in chapter 4.

Actually at any time a proton is characterised by two positively charged Quarks (in the outer region; up) as well as one neutral Quark (down, see fig. 1). The corresponding excitation states are changing equally between the three structure units. Thus within statistics over the time any Quark owns a +2/3e-charge. The commonly used exchange electron that is jumping from each Quark to each other Quark results within statistics to a -1/3e-charge for each Quark. Thus there are within the proton two units with +1e -1/3e = +2/3e and one unit with 0e -1/3e = -1/3e. During the passage of a charged probe through the proton the probe realizes always the 2:1 charge distribution. Within this new model the well-proven quantisation of charge within matter with entire units of e is valid even for Quarks.

Depending on the kind of experimental investigation of protons and especially the 'time integration' or resolution, the experiments detect a large number of point-like scattering centres (elementary particles at various positions of space), charged cloudy shells (orbitals) or according to Fig. 1 gives rise within a dominating period of time to two charged complexes (Quarks) with spin as well as to one neutral and spin-less complex (up-up-down). Thus about 2/3 of the total spin belongs to the Up-Quarks and only 1/3 to the exchange electron with relatively wide spatial variation or distribution. The Quarks residing within the basis orbital are bosons. Within this Direct Structure Model indeed only the two relativistic-ionised Quarks contribute to the total spin just as determined by experiments. Within the Standard Model this

experimental finding cannot be explained in a sufficient way. The Up-Quarks are moving above (up) of the Basis orbital or in the outer regions of the proton, respectively. The new alternative model thus gives a better and direct explanation of the experimental findings. In addition it enables even more the possibility of a Big Bang without singularity, being the general and essential intension of this paper as a whole. This central goal is necessarily bound to mass agglomeration of bosonic neutron matter (no or entire spin) solely enabling highest non-singular, non-degenerated mass concentrations within a finite volume.

3.2 Neutron structure

It is difficult to understand the synthesis of (free) neutrons by help of three fully occupied Quarks, especially with respect to the observed astonishing stability. But the strong binding force created by a deficiency was already discussed in the previous chapter. It is just the problem of the not yet emitted corresponding electron. The 'interim solution neutron' therefore demands the formation of a negatively charged Quark with three electrons where only the condition of a lowering of total energy of the three-Quark-system has to be satisfied. The necessary short-time coupling of a third electron to a Quark (for about 10^{-23} s) can only be a ‘Weak Interaction’.

The most probable way to realise this coupling could be the occupation of a separate, intermediate orbital without neutrino absorption/coupling (no orbital splitting) related to this electron. The loss of the corresponding neutrino (or change of neutrino energy) thus realises the binding energy. Alternatively a triple occupation of the outer orbital of a Quark for a very short time could be considered, because the de Broglie-wavelength of the electron allows only an orbital of about just this size. However, due to the Pauli principle there would arise immediately a serious problem. It has to be realised in addition that all this is related with the special subject of relativistic Quantum Mechanics with a still insufficient instrumentation. It is characterised by considerable mass changes during formation or change of orbitals. Considerable changes of mass and energy necessarily cause large changes for the impulse and rotational momentum. Thus it is immediately obvious that these enormous differences cannot be equalised by photons anymore - this can only be achieved through particles having something like rest mass, via neutrinos. Wherever neutrinos were found probably physicists are faced with phenomena of relativistic Quantum Mechanics. With those considerations it should be obvious that the mechanisms described as Strong Interaction have to be connected in addition with an accompanying movement or stream of neutrinos. The astonishing fact of the neutron spin might be explained by an asymmetric charge carrier distribution - this asymmetry is reality - but the spin can be much better understood by the emission of a spin- and energy-carrying neutrino (binding energy).

Within neutrons the ionisation of a Quark 1 has to be adopted. The released electron moves to Quark 2 (additional occupation of the middle- or intermediate-orbital by an electron without neutrino-coupling) resulting in a negative ionisation while the spreading field of Quark 1 causes Quark 3 (after achieving sufficient field strength introduced by both Quarks 1 and 2) to emit another electron. This then re-neutralises Quark 1. Within this process the electron gains only a fraction of the possible accelerating power of the electric field. The spreading field of Quark 3, however, causes as fast as possible the de-ionisation of Quark 2 (Weak Interaction with the third electron). Thus the now emitted electron gains nearly the total accelerating power possible towards Quark 3. Therefore the following spontaneous ionisation of Quark 3 can now be understood somewhat better by the slightly enhanced additional kinetic energy within this cyclic process. While the electron moves in one direction the occupation states of the Quarks move in the other.

Knowing already the necessary changes for the path parameters of the Quarks connected with relativistic ionisation processes, within the neutron there has to develop a wave-like motion of the Quarks above and below the basis orbital. This means an inner negative Quark orbital (about 25% heavier Quarks), an intermediate neutral orbital (basis orbital) and an outer orbital of positive-ionised Quarks (about 25% lighter Quarks). An asymmetric orbital of the exchange electron and perhaps suitable neutrino orbitals have to superimpose in addition those three Quark orbitals. Due to the negative charge of the inner Quark orbital the orbital of the exchange electron - that is much easier influenced by charge distributions - is strongly pushed towards the outside and thus screens now completely the more outside positioned positive Quark orbital. Within the long-time average there is also a status realised with positive charged Quark (up), two neutral Quarks (down) and the exchange electron. According to the Direct Structure Model a neutron should have the following sequence of charged regions: a negative inner shell, a neutral region, a positive charged shell and outside a negatively charged screening shell of the highly relativistic exchange electron. Exactly this charge distribution could be recently extracted from experimentally observed data [7].

The release of an electron out of the outer sub-orbital of a Quark has to be connected with an electron-neutrino emission (ν_e) and the re-occupation necessarily with electron-neutrino absorption. A possible exception would be the negative Quark with occupation of the intermediate orbital. So there are strong indications that the Beta-activity of neutrons is related in some way to disturbances of the accompanying neutrino flux. This should be influenced by external effects (see e.g. $\nu_e + {}^{71}Ga \rightarrow {}^{71}Ge + e^-$). As far as the neutrino flux density in our environment would increase, according to this model the (half-) lifetime of free neutrons should decrease, but especially close to the Big Bang. It might be solely a general assumption that radioactivity appears to be ‘spontaneous’. A much higher probability

for its ignition is the fairly low but stochastic acting hitting probability (impulse transfers) of external neutrinos.

The loss of an electron (and a further neutrino) - Beta decay into a proton - strongly increases the binding energy (change of the orbital structures). Proton and neutron differ only slightly with respect to their mass, i.e. more than 134 m_e of the electron energy remains within the 'system proton'. Within the internal exchange processes the neutron owns either two opposite charged Quarks (one in the interior and the other one in the outer shell) and one neutral complex in an intermediate position or two neutral Quarks and a charged one as well as the exchange electron. One Quark and the exchange electron as well as the emitted neutrino give rise to the total spin of the neutron. This has to be set into relation with the interpretation of the static Standard Model with down-down-up, that however has to be seen today as invalid in some parts. In this case there is only one spin-carrying and charged outer (up) Quark. The term Down-Quark is less related to special properties (neutrality) but more to the relative probability of the position within the nucleon.

If this model of the Quarks and in succession of the nucleons could be confirmed by the existence of a peak of the strength or intensity of wide-angle scattering at Quarks at about 30 GeV (measurement of the Quark size) there will be considerable consequences on the conception of our world. Then it would be impossible to cumulate mass till infinity. Black holes should have an upper limit of mass, above which the Quarks, composed of electrons and positrons, come extremely close together within a related matter-core, finally penetrate each other and now have to annihilate and to transform back into radiation (non-localised energy). The assumption of a Direct Structure Model necessarily demands a finite upper limit of mass-concentrations, the annihilation into radiation after crossing a limit of hydrostatic pressure and therefore on principle enables a pre-history of a Big Bang without matter-singularity.

4 Generation of electron-positron-Quarks - reaction mechanisms

Since decades the collision of high-energy beams of electrons and positrons against each other is a standard topic of research and meanwhile a common energy up to or above about 200 GeV has been achieved. Besides various reaction products within such collisions the created neutral Pions take on an exceptionally important contribution. As neutral particles without spin they are not detectable in a direct way but can be doubtlessly identified due to their specific decay products (two Gamma-quanta or an electron-positron-pair). The primary process within a beam collision is given by the motion of charge carriers against the fields of the meeting particles. Necessarily this means the emission of photons, the emission of Bremsstrahlung. The direction of the photons is determined by the direction of the moving

particles and thus there is a high probability of photon-photon collisions. With sufficient photon energies those collisions therefore create secondary electron-positron-pairs. Such a reaction (pair-creation via collision of photons) is experimentally proved in a direct way.

The initiated secondary pairs (or even of higher order) with very high density have to move within the dynamically changing fields of the primary particles and also the correspondingly related magnetic fields. They can give rise to a mutual 'capture' and rotation around each other, which means an accelerated motion and emission of energy via electromagnetic radiation. At least until the lepton paths reach a multiple of the de Broglie-wavelength of the secondary particles (condition of orbital formation). Within an environment with high electron and positron density orbitalised pairs now can fill their orbitals in an easy way and create (within the view of the Direct Structure Model) free Quarks (Dark Matter) that at the moment on principle cannot be detected experimentally. The Quarks might take over impulses (direct or indirect) from the primary high-energy particles and thus even create neutrons by reactions among each other. Via direct hits of all composed particles with the primary electrons and positrons also various destruction products, e.g. mesons, can be formed. Thus within such collision experiments the observed generation of baryonic or hadronic matter can be easily understood especially by help of the Direct Structure Model. The energy necessary for such reactions can be only gained through the primary particles that show this loss of energy by their mutual scattering.

Within a consideration with elementary Quarks the creation of baryonic matter in such experiments is not explainable in a straight, direct way. Thus in the Standard Model it is assumed that within the frame of the vacuum fluctuation model the generated photons of the Bremsstrahlung fluctuate into different energy-rich states (e.g. also gluons or Quarks) and that finally only those transformation products react mutually with each other forming the observed secondary particles (with respect to the validity of the model of vacuum fluctuation see the beginning of chapter 6). Depending on the transferred momentum between the primary electrons and positrons a 'degree of virtuality' is defined for the generated photons, a hadronic fraction is associated with the photons. Within that context the creation of e.g. neutral Pions (p^0) is understood as a direct product of a photon-photon-interaction. Instead of a relativistic circulation of electrons and positrons around each other the formation of a Quark/Antiquark-complex is assumed. In some way such a sight could be even brought together with the Direct Structure Model if various individual processes were considered as only one total mechanism, as a generalised fictitious head-process. However, all this would be in conflict with the expectation that all matter-particles in the Direct Model demand a substructure alone with electrons, positrons and neutrinos.

It is possible to accelerate elementary particles up to relativistic energies without external fields only by help of photons. In the PHD thesis of M. Kaempfe [8] nanoscopic metal

spheres embedded in glass were irradiated with a single pulse of a laser (30 fs / 400 nm). Here two clouds of small metal clusters were found diametrical positioned with respect to the metal spheres according to the polarisation direction of the photons. The distance of the clusters to the sphere surface was about 20 nm. The only interpretation up to now is the release and acceleration of metal electrons into the glass matrix and the following diffusion of metal ions towards the fixed electron clouds during the short-time 'thermalisation-period'. To generate this structure the electrons had to overcome obviously at least 20 nm or more probable 60 - 100 nm. To achieve such path lengths in glass it needs energies of at least 0.5 - 2.5 keV (plus energy for the release; compare any book about Electron Microscopy). To transfer the observed effects to the possible effects of Gamma-quanta with Compton wavelength (0.51 MeV) simply the ratio of wavelengths has to be taken because the acting field strength depends reciprocal on the field width (λ/2, compare chapter 3). With this an amplification factor of $M = 1.66 \cdot 10^5$ is obtained (the same is achieved simply using the ratio of the corresponding photon energies). Thus an acceleration power of at least 83 MeV ($M \cdot 0.5$ keV) should be expected if there is a synchronised action of the photons. Therefore already (synchronised) 0.51 MeV photons are able to realise the necessary 70 MeV for the generation of the relativistic lepton orbitals as basic structures of the Quarks. The quantum density during the Big Bang event (within the Direct Structure Model estimated to be about 10^{50} photons/m^3 using the highest possible matter density given in chapter 10) is in addition by orders of magnitude higher than in a laser. The formation of at least local resonances has good chances because pair creation and pair annihilation represent a periodic process for such high quantum densities. The fields of elementary particles and photons can influence each other and the particles are free to adjust in such a way that at least local short-time resonance is supported.

A pair just generated can be accelerated one to another within the electric half-wave of such a local resonance and gain high energy, speed and mass increase. Before colliding, the immediately following magnetic half-wave (orthogonal to the direction of motion) is able to initiate two opposite sense orbitals (due to the different signs of the charges) via Lorentz force and incorporation of neutrinos, existing with high density due to photon annihilation mechanisms. The now generated neutral particle completely fills the orbitals and is nearly free of any further affection by the surrounding fields or photons except of impulse transfers by the photons, electrons or positrons still being possible. The whole system striving for energy reduction can achieve this in a very efficient way by the generation of rest mass (Quarks).

According to the above suggested Quark formation mechanism orbitalised pairs (half-Quarks) should be frequently observed and exist with high density. The particles should have a mass of 274 m_e ($2 \cdot 137\ m_e$) plus neutrino energy (orbital splitting). They should be neutral

due to their composition, have a spin 0 and have to create with their decay two Gamma-quanta. In the radiation of the upper atmosphere there are e.g. frequently p^0-mesons (neutral Pions) with a rest mass of about 280 m_e, charge 0, spin 0 and they decay into two Gamma-quanta. In about 1% of all cases they even decay into their basic constituents - one electron and one positron. Within the Standard Model those particles are instead interpreted as quantum mechanical interference states of Up/Anti-Up and Down/Anti-Down Quarks.

The value of the rest mass of neutral Pions cited above (280 ≤ ca. 6 m_e) was obtained by the very difficult analysis with energy-sensitive plates concerning the energy of Gamma-quanta set free (two Gamma-quanta of about 70 MeV) and in addition by the evaluation of the secondary pair-creation with 295 ≤ 20 m_e and is related to the extrapolated starting mass of neutral Pions [9]. Today usually a value of 264.14 ≤ 0.011 m_e is given for neutral Pions in encyclopaedias using the above-cited 1%-decay into elementary particles, which offers a much higher precision of measurement, see also [10]. However, this kind of decay should be caused by neutrino emission in advance - nearly impossible to detect.

If the electron-neutrinos (with lower energy) are emitted, the orbital splitting is removed and both elementary particles are positioned within the same orbital - they annihilate (about 99% probability). If the Muon-neutrinos (with higher energy) coupled in addition are emitted (in a symmetric way), the elementary particles loose their ability to orbit - they are separated by the centrifugal forces (compare also chapter 7). The necessary presence of Muon-neutrinos results from the interpretation of charged Pions and Muons within a Direct Structure Model (see below). The setting-free of large quantities of different kinds of neutrinos during the relativistic crashing of matter against the central matter-core with high-compressed matter during a super-nova of type II is a further clear hint to the presence of many neutrinos bound within the atomic nuclei.

A fairly precise measurement of the mass of neutral Pions at the very moment of their annihilation into two Gamma-quanta was recently possible within the collision experiments of high-energy electrons and positrons against each other at the CERN with a value of about 273.8 ≤ 0.2 m_e [11]. All three above cited values for the rest mass of the particles (neutral Pions) actually have to be seen all together within the sight of the Standard Model as incorrect in some way. Within the view of the Direct Structure Model, however, it becomes obvious that all three values might be correct and simply describe different, momentary states of those particles: 1. initial or total mass of about 280m_e, 2. the mass after emission of the electron-neutrinos with 274m_e (annihilation) or 3. the mass after the emission of the Muon-neutrinos with 264m_e (decay into two charged leptons).

If the quantum world is striving in general for orbital structures, orbitalised (heavy) elementary particles should be found too. Experimental observation: The charged Pions with

about 275 m_e 'decay' with emission of a Muon-neutrino into a charged Muon (about 207 m_e) and Muons again with emission of two neutrinos (Muon- and electron-neutrino) into an elementary particle (electron or positron). With the idea of charged Pions as additional excited orbitals of elementary particles (the electron spin is balanced by the orbital formation/neutrinos) their jump into a (larger) orbital of lower energy with necessary emission of a neutrino and transfer of kinetic energy to the remaining product Muon can be easily understood now. The 'decay' of the Muons then can be seen as complete de-orbitalisation, as the loss of the orbital status of a charged lepton.

The formation of relativistic orbitals is obviously connected with the generation respectively coupling of (or to) Muon-neutrinos and even after a high-energy-collision the coupling to electron-neutrinos (orbital splitting) usually still exists. As far as the stability of relativistic orbitals is caused by the creation of Muon-neutrinos a critical least energy has to be expected. If this critical energy would be reached for electrons approaching 137.036 m_e, immediately an easy understanding of Quark formation and the extreme stability is possible (see also chapter 7). In addition a neutral Quark (Boson, spin 0) could be understood in this context as a 4-Muon-system (not with respect to the involved energy but on principal with respect to the general structure) and consists of 4 charged orbitalised leptons (2 electrons, 2 positrons, 4 Muon-neutrinos and 4 electron-neutrinos) and contains altogether 12 leptons. Within this understanding a neutron with 3 Quarks consists of 36 - 1 = 35 leptons, where the emission of one neutrino realises the necessary binding energy.

Within the view of the Direct Structure Model a Muon is no member of a ‘lepton-family’ but a relativistic elementary particle (electron/positron) with orbitalised status (with two coupled neutrinos) and thus being a fermion (3 leptons, spin ½). The leptons moving within the orbital system of the Quarks are extremely strong bound. Thus it is impossible to obtain a scattering peak at 1/(3n) investigating collisions of high-energy electrons and protons (now specified with n = 4, only charged ones are counting). Furthermore, the orbitalised leptons within the Quarks can only be knocked out if the colliding particles posses sufficiently high momentums. Therefore orbitalised leptons that are set free (Pions or Muons) always own higher additional energy, preferably related to the higher energy of the bound neutrinos. The orbitalised particles set free thus have a higher mass than the particles within the Quark-orbitals (strongly bound).

A speciality within the collision of relativistic orbital systems with other such systems is obviously the fact that the related substructure units are preferably set free in an orbitalised form. Because this setting-free demands very high energy, in most cases this first causes an additional excitation of the primary orbital system (from the original ‘Muon-state’). This means e.g. the formation of charged Pions with higher mass (and/or the excitation of the modified orbital system ‘nucleon’). The excitation into a Pion (4 leptons, spin 0) will be raised first

(neutrino emission) and the result is again a Muon (3 leptons, spin ½) with relatively long lifetime (effectively a quarter-Quark). Somewhat later it emits the remaining two neutrinos and a relativistic electron or positron is detected.

According to the (indirect) Standard Model those Pions should consist of an elementary, indivisible Quark and a corresponding Antiquark. Within the Direct Structure Model discussed here the observed particles set-free are seen as the only and direct constituents. A charged Pion represents here the relativistic excited state of a Muon; a Muon a relativistic orbitalised elementary particle with necessary coupling to two neutrinos. The neutral Pion (half-Quark) consists of a concentric orbital-complex of a positively and a negatively charged 'Muon' (only structural view). The wrong declaration of the name of neutral Pions is solely based on the accidental similarity of the mass (275 m_e for charged Pions und 280 m_e respectively 274 m_e for half-Quarks). Within Bi-Jet-collisions usually various excited internal components (mesons/hadrons) are knocked-out and set free in forward direction of the protons because the proton momentum is a multiple of the one of the scattered electrons. With respect to the assumed composition with Quarks the corresponding jets are sometimes called 'Quark-Jets'.

An essential experimental result of nuclear reactions is the strict preservation of the baryon number. Because nucleons are composed structure units, it will be obvious - especially in the Direct Structure Model - that this strict preservation becomes a limit, if the used collision energy per nucleon approaches the order of magnitude of the self-energy of the nucleons (about 940 MeV) or even exceeds it. According to the structure model discussed here nucleons consist of 33 respectively 35 leptons. Thus it is a trivial expectation within such a view that high-energy-collisions of heavy ions (about 400 nucleons involved) have to result in thousands of emitted orbitalised or non-orbitalised, individual or more complex compound-units, because several thousand leptons can be set free. For an overview of such experiments see e.g. [12]. Within the (indirect) Standard Model the interpretation of such results is much more difficult and demands the hypothesis of a 'Quark-Gluon-plasma'.

As far as the suggested orbital structure of Quarks describes reality, it should be possible to knock out an inner positron of a Quark in a neutron by help of high-energy-processes and create in this way a 'negative proton', a Negaton (because the electron-exchange-processes of the outer Quark-orbitals remain nearly unchanged, there should be still Beta-activity comparable to the neutron). The strongest danger for Negatons results from the presence of free protons causing the acceleration and necessarily their mutual destruction. The acceleration would be driven by the charged Quarks, such that the acceleration would proceed till an approximation in the order of some 0.01 fm. Thus the energy per nucleon would cross even the mentioned border of 940 MeV. Necessarily the result had to be a destruction reaction and the setting-free of about or at least 20 - 66 particles, analogous to the high-energy-collisions with heavy ions described above. Within the (indirect) Standard

Model with three spin-carrying elementary Quarks there would be no possibility to identify such particles as Negatons. Instead this model had to identify them as antiprotons. However, real antiprotons should be expected to annihilate via a primary setting-free of electromagnetic radiation and the production of particles only within secondary reactions. But the up to now observed and described ‘antiprotons’ always showed a primary setting-free of a large number of particles at the very point of reaction!? That the sum of the mass of the particles emitted out of the point of reaction represents exactly the mass of two protons is seen as prove for the proton-antiproton-reaction. However, this is more or less demonstrating a destruction-reaction instead of the expected annihilation. Therefore it could be possible that the atoms produced as Anti-Hydrogen actually had to be called Negatonium.

A further hint into such a direction of interpretation might be given by the creation of Sigma-sub-B-particles (with a mass more than that of Helium-nuclei) [13]. Reducing the action of self-acceleration of ‘antiprotons’ and protons against each other by additional kinetic energy, the dominating central collisions will transform also more and more into grazing collisions that actually should still give rise to annihilation. Instead probably the creation of heavy 6-Quark-systems is observed (possibly similar to the deuterium-complex; dump-bell-shaped common orbital-system of the Quarks of two nucleons; with the loss of one of the Quarks a Penta-Quark might be formed). With an interpretation of ‘antiprotons’ as Negatons (that would represent an artificial but normal structure of normal matter) the generation of Sigma-sub-B-particles can be explained much simpler. For high-energy collisions of protons and Negatons still nearly direct impacts can be imagined that would transfer almost the whole momentum into the excitation of both nucleons and could create especially strong excited bosonic di-neutron-complexes. Di-neutrons of this type could gain easily a total mass in the order of 10 GeV. If two protons or Negatons hit for instance such particles more or less simultaneously the result would be highly excited proton- or Negaton-Helium-nuclei. The enormous now transferred momentums give rise to highly relativistic particles with a total mass in the order of 100 GeV or above. Thus particles of such or similar structure (e.g. bosonic Negaton-Tritium) could be easily confused with the W-bosons expected within the Standard Model.

A further example of mesons that are set free due to collisions is the formation of half-neutrons (K^0) that could be imagined consisting of three half-Quarks (neutral Pions). For there are only partly occupied orbitals (and a clearly larger distance between the half-Quarks) a low stability has to be expect. They should quickly decay into three Pions (as experimentally observed). Because of the permanent changing status conditions of the half-Quarks (compare 3.2) sometimes the decay should give rise to different residues, e.g. decay into two Pions and Gamma-rays/symmetric neutrino-emission (also observed in experiments, e.g. due to the annihilation/decay of one of the three neutral Pions). The status conditions of

the half-Quarks result in a much stronger change of the path parameters compared to the one within nucleons - up to the limits of the binding forces. For the artificially produced Kaons there should be sometimes an insufficient time to stabilise via the emission of a spin-carrying neutrino (binding energy, short-life Kaons, 18 leptons, spin 0) or even the necessity of the emission of two neutrinos (long-life Kaons, 16 leptons, spin 0). An understanding of the complex decay reactions of Kaons seems to be possible accepting that by energy consumption (Gamma-rays and/or neutrinos) elementary particles can be transformed back into Muons and Muons into charged Pions and accepting as well that there might be a reverse transformation mechanism between Gamma-rays and neutrinos.

The (indirect) Standard Model, that knows only elementary fermionic Quarks, has a problem with heavy ‘mesons’ (the most extreme representative is the B-meson with more than 5 times the nucleon mass) and thus needs the definition of further ‘kinds’ of Quarks that are not constituents of normal matter. The Direct Structure Model with a large number of involved leptons serves the easy understandable expectation of bosonic, excited nucleons (accidental even total number of leptons, spin 0 or entire) as a result of high-energy collisions. This energy primarily gives rise to an increase of the Quark momentum in the nucleon-orbitals (smaller nucleon diameter) necessarily causing a larger relativistic mass. Those high-energy-excitations cannot be stable, unless they are forced by gravitation (hydrostatic pressure) within neutron stars or the matter-cores of black holes. B-mesons with circulating Quarks within smallest possible orbitals have to be seen as the pre-stages of Big Bang (compare chapters 9 and 10).

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The main intention within this paper was up to now to suggest an alternative (direct) model of nucleons and Quarks, where the individual steps of the iteration procedure should be made obvious. Thus it is necessary to remove in a last step the incorrect consideration of equal energies of the particles within the sub-orbitals of the Quarks. The orbital splitting demands different energies and this could be achieved and specified using a second experimental value, the mass of neutral Pions p^0 (half-Quarks: one orbitalised electron and one positron; 280 m_e = 137 m_e + 143 m_e), besides of the fine structure constant (1/137). Thus there are now (neutral) Quarks consisting of two electrons with a mass of 137.036 m_e and two positrons with about 143 m_e. Due to the higher energy or mass the positrons are moving within a slightly smaller, inner orbital.

According to the inaccuracies due to the setting of the starting diameter of the basis orbital (despite of the used experimental basis) the rest mass of the Quarks determined at the beginning can only be given approximate with about 548 m_e = 4 · (137 ± ca. 5) m_e . The final independent and better adaptation or confirmation of the lepton energies or mass within

Quarks can and should be achieved by help of the mentioned experimental data using the total mass of neutral Pions or half-Quarks (280 m_e) and the fine structure constant. Because the determination of the (total) p^0 -mass is difficult and uncertain the adjustment of the energy of the positrons has to be uncertain too and only exemplary. However, their energy value determines the size of the proton (see below) and the fairly well agreement between interpretation-graph 3 within fig. 2 and the size determined via the adopted positron-energy demonstrates that the used value cannot be essentially wrong.

In consequence the rest mass of the neutral Quarks is about $0.51 \cdot 10^{-27}$ kg = 560 m_e, their speed in the orbitals of the nucleons has to be corrected to about 0.41c and the size of the basis orbital (diameter) then is close to $2.8 \cdot 10^{-15}$ m (for the total cross section about 4 fm). In this case the matter wavelength and speed within the orbitals was re-determined by equations (4) and (7) using the now better-known rest mass or the mass ratio.

It is remarkable that this diameter (2.8 fm) coincides with the most probable experimental value for the radius R_0 (1.4 fm) within the droplet model of nuclei: $R = R_0 \sqrt[3]{M}$ (R core radius; M number of nucleons) e.g. [14]. This suggests a flexible deformation of the outer shell of the nucleons and a rigid behaviour with about the size of the basis orbital.

With a value of R_0 = 1.4 fm the starting size of the (touching) diameter of nucleons with 2.5 fm within the iteration procedure could be gained out of the size of heavier nuclei using a densest sphere packing (about 74% filling of the volume). Taking the above-obtained final value of 2.8 fm a volume filling of the nuclei of nearly 100% is achieved. Using the 'nucleon-charge-radius' determined e.g. by Udem et.al. [5] (about 0.89 fm) within this context a nucleus-filling-factor of only about 25% is obtained. Such a low filling of nuclei is highly unlikely with respect to the enormous strength of Strong Interaction.

The width of spectral lines (variation of their energy) - coupled via the indeterminacy relation to the variation of the position of the proton substructure units - seems to give the above-cited radius of the protons of about 0.9 fm. Within those considerations the Quarks were considered to be elementary and charged according to the Standard Model; i.e. the variation of the position of the sub-units within the proton had to correlate in a direct way to the size of the proton. However, this view is in contradiction to the measurements with high-energy electron scattering (distribution of the charge density) such as shown in fig. 2. As far as a substructure of the Quarks is assumed as well as an exchange of substructure units between the Quarks (Direct Structure Model), the line width of the spectral lines is also somewhat dependent on the positions of the Quarks, but now essentially the change of relative positions of the differently charged constituents of the proton to each other, the change of the position of the exchange electron, is determining the line width. The kinetic energy or

momentum indeterminacy is not corresponding to the electromagnetic indeterminacy if there are neutral structure units within the system. Because Down-Quarks have been found without spin within the proton, this is at least highly likely and they have to be expected to be neutral. Within the Direct Structure Model there is no discrepancy any more between the measurements with electron scattering (much larger proton radius) and the results obtained using the width of spectral lines. The latter measurements are not determining the size of the proton but the expanse of internal exchange processes.

Further contradictions with respect to the Standard Model result from similar measurements using the Lamb-shift and spectroscopy of Muon-hydrogen [15]. In this case the shell electron is replaced by a much heavier Muon and the shell orbital is now about 200 times smaller and thus closer to the proton, such that the variations of the position of the structure units inside of the proton are essentially stronger influencing. Thus the accuracy of the measurements is considerably higher but now results in a smaller apparent 'proton radius' of about 0.84 fm. This is clearly different and far enough outside of the error-range of corresponding measurements using ordinary hydrogen (with electron shell). While those fundamental results are at the moment non-explainable within the frame of the Standard Model (the dominating Up-Quarks with positive charge should be stronger attracted by the Muon-shell being now closer to the nucleus and the proton should instead even increase its size), those results are easy to understand by the Direct Structure Model. The high-relativistic exchange electrons moving between the Quarks become restricted with respect to their motion due to the same kind of charge of the Muons being much closer now to the nucleus than the electrons in the shell of ordinary hydrogen. The repelling between the corresponding charge carriers hindering the motion away of the proton centre results in a reduced 'width' of the orbital of exchange electrons and at the same time gives also rise to a small reduction of the effective proton radius.

The splitting of the orbitals within the Quarks can be determined close to $1.5 \cdot 10^{-18}$ m (difference of the orbitals with 137 m_e and 143 m_e, eq. (5)). In the case of the formation of an intermediate orbital for Weak Interaction the distance to the other orbitals would be about $8 \cdot 10^{-19}$ m (in the same dimension as known for the 'range' of Weak Interaction). Estimating the energy indeterminacy of the elementary particles within the Quarks by equation (10) the indeterminacy of the distance has to be performed within their reference system (137 times larger). The uncertainty of the energy of the relativistic electrons and positrons is in the order of 30 MeV. With respect to the small size of the gap the symmetric 'broadening' of the orbitals would result in a clear 'overlapping' and reduction of stability. Thus not only the extremely strong electromagnetic attraction forces (order of magnitude 10^9 N) have to be considered, which prevent the shift of the orbitals against each other and stabilises the

Quarks via mutual forces between the two orbitals, but also the strong effect (repelling) introduced by the spins of the charge carriers (Pauli principle).

Summary of chapters 1 to 4

High-energy scattering experiments with electrons have doubtlessly shown that nucleons are composed of exactly three substructure units (Quarks) being able to take over impulses as a whole and causing wide-angle scattering. But even using extremely high scattering energies no additional peak of the obtained corresponding structure function appears that could indicate a further substructure of Quarks. Thus presently Quarks are assumed on principle to be elementary. However, for further substructure units there is the necessity to be extremely strong bound (due to the demanded extremely high localisation). So they were in any case unable for a quasi-free taking over of impulses that might cause a corresponding additional scattering peak.

Thus within the first chapters of this paper it was tried to investigate with the highest possible consequence the practicability of the only left alternative: Quarks do consist of substructure units. With the necessary extremely high localisation the indeterminacy relation allows only highly relativistic sub-units. Due to the upper limit of total mass of Quarks the sub-units therefore need a low rest mass and effectively only leptons can be taken into consideration. This is well supported by the fact that all nuclear destruction products always finally decay only into leptons (trying a Direct Structure Model; the particles set free in reality should be the true components). Furthermore there are only pair-creation mechanisms for the generation of matter in the radiation-dominated starting universe. At least if only clearly and direct experimentally proved mechanisms are taken into consideration and if the introduction of a hypothetical new physics is refused. This is indeed possible without problems, because there is no singularity in the very beginning using a Direct Structure Model (see chapters 9 and 10). In contradiction to the Standard Model Quarks composed of Leptons can exist as bosons or fermions (depending on the excitation) and thus nucleons too. So high-compressed matter e.g. within the matter-core of black holes can exist without degeneration as highly excited, extremely dense, bosonic neutron-matter.

The preferred, most simple substructure of Quarks with such a high localisation (< 0.1 fm) that allows all charge states inclusive neutrality is a relativistic double-orbital-system of electrons and positrons. To achieve the necessary high stability a complete occupation of both orbitals with opposite spin orientations has to be realised. According to this, Quarks are bosons within the ground state, as indeed observed for Down-Quarks in protons. All tests or interpretations taking a large number of well-known experimental facts and using this new kind of Quark structure did not give rise to any contradiction. Even better, with this structure

simpler and more logical interpretations are achieved. Therefore there is no need to look for a more complex substructure-model of Quarks.

Using this most simple Quark-substructure-model without any problems also the structural composition of nucleons is explainable. Here as well the experimentally found spin contributions of the Quarks, the charge density distributions as the mass of the nucleons can be reproduced and interpreted in a very logical way. Instead of Strong Interaction seen within the Standard Model as a field-action, there is now the exchange of high-relativistic electrons between sub-orbitals of different Quarks, where the electron energy gives rise to a 137-times higher mass of the exchange-electron compared to its rest mass. The exchange-electrons carry the non-understood, missing spin contribution to the total spin of the proton. Because there are no hints to a failure of pair creation mechanisms, even for very high photon densities, they still should be in general responsible for the formation of Quarks in the early universe. The resulting consequence is now no asymmetry between matter and antimatter. Quarks are extremely small but massive, neutral, bosonic matter-units of the early universe that they are dominating already in the first instance. Because only a fraction of them is able to react and this way to create nucleons (necessity of correct and sufficiently high kinetic energy) their majority is forming the so-called Dark Matter.

By help of the Direct Structure Model a considerably reduced complexity for the description of nature is achieved, a reduction to only two basic kinds of fields or forces (electro-magnetism and gravitation). Strong and Weak Interaction showed to be solely internal interactions related to the inner substructure and dynamics of Quarks. This is accompanied by a reduction of the zoo of elementary particles to solely electrons, positrons and neutrinos.

5 Basic demands to the structure of Electrons - Pair creation

To further extend the Direct Structure Model, the principle of orbitals for the localising of energy might be tentatively applied also to the structure of elementary particles. Thus standing light waves or something comparable within a suitable sphere might be considered. This represents a next step within the iteration procedure towards a Big Bang without singularity with clear general intension of top-down search. Usually it is tried to close the gap between the level of elementary particles and the ‘substrate of everything’ by a bottom-up-procedure (irrespective if strings, branes, various aether-constituents, foam, strands or whatever is considered). However, if there exists a further level of physics in between, only proceeding top-down could detect the true situation.

The possibly unique force known to bend the path of light in vacuum is space warp, which does not seem to play any significant role in nuclear or particle physics. However, the generation of two particles with rest mass is definitely observed once two quanta of light of sufficient energy are hitting each other. Presently the upper limit of the size of electrons is according to electron scattering known to be at least about 10^{-19} m or even considerably smaller. Thus their minimum density of matter as particles of necessarily finite size is determined at least as 10^{27} kg/m^3 (electron rest mass within the tiny volume with a diameter of 10^{-19} m). This density is about ten orders of magnitude higher than the one in a neutron star, which in some way is already a precursor of a black hole. Thus it should be possible to imagine that electrons are smallest Black Holes (micro-cavities), which in addition captured the photons or parts of them (more precise details in chapter 8).

Pair formation is observed above quantum energies of 0.51 MeV (wavelength $2.4 \cdot 10^{-12}$ m). With such a dimension (pm-range) it is obviously impossible to imagine a sufficient density of energy or of equivalent mass. Photons are 'objects' moving relativistic; they have to be liable to length contraction. Applying the (continuum) theory of relativity to photons necessarily a size of zero is obtained - the borderline of application is obviously reached. Of course a value of zero is impossible, there has to be at least a limit with the Planck length. Though there is no corresponding yet sufficient extension of the theory up to now, at least it has to be stated that the ‘action-size’ of photons is considerably smaller than suggested by their wavelengths. Photons are realised as particle-like. Only in the reference system of the photon the wavelength has the well-known value determined by experiments. Related to this wavelength the photon is reacting with e.g. a double slit or matter.

Photons notice each other like particles in our matter-world but obviously seem at the same time to be characterised by their ‘fields’. Meeting each other with orthogonal electric ‘field’ planes the photons just might give rise to a short elliptical interim state (or ignore effectively each other). If the impact happens with nearly parallel ‘field’ planes, ‘field’ and energy amplification seem to occur in some way within an extremely small volume. Now the border to a critical energy density could be crossed (possibly connected with a maximal and localised ‘field’ density) to form a 'screened area of space' - the generation of a micro-cavity (see chapter 8 for details).

According to the new results of theoretical considerations by M. Kuchiev [16] small black holes have to be perfect mirrors to radiation with wavelengths in the order of the size of the cavities or larger. With this knowledge the phenomenon of pair formation could be on principle explained. Crossing the critical energy density the mirror effect abruptly cuts off further energy flow into the forming particle, indicating at least a first direction to look for, searching for a possible creation mechanism of elementary particles.

Because elementary particles act as charged particles it has to be understood in addition that an odd number of half-waves - e.g. two negative, one positive directed to outside - have to be captured or encapsulated. The piece of photon circulating now within the cavity thus on average could give rise to an effect like a 'charge' due to the difference of the fields and this acts equally into all directions of space (compare the more detailed discussion in parts 7 and 8; an even number of half-waves would produce on average a complete balance of the 'fields'). According to $m = E/c^2$ the cavity could get now a rest mass and due to the defined sense of circulation on principle also spin and magnetic momentum.

After the generation of the electron the remaining pieces of the photons again interfere to form a second cavity. But now the asymmetric cut pieces give rise e.g. to two positive and one negative encapsulated half-waves, resulting in the anti-particle. Still remaining photon pieces are absorbed with the acceleration or separation of the electron and the positron. The impact of the anti-particles might result in some way in an enlarged volume with sub-critical energy density. On principle the photon pieces could be released and move apart as photons again.

Pair formation occurs for any quantum energy higher than 0.51 MeV. The above-described mechanism (odd number of half-waves) seems to be incompatible with the fact that different wavelengths always give rise to the same experimental result. The screened photon pieces will immediately transfer via Fourier transformation into their spectrum of harmonics. This might look completely different compared to the original piece but still acts in the sense of the field difference. This spectrum could be obviously created with all photon pieces (even having different wavelengths) but exactly the same total energy.

Pair creation with one photon by hitting the nucleus of an atom (more precise hitting of one of its elementary particles) demands twice the photon energy. Here the photon is reflected back into itself and is able to generate in a comparable way the necessary energy density and therefore the formation of a pair of elementary particles. This mechanism is observed in reality too and can be understood as some affirmation of the cavity mechanism and especially the related action as a mirror. At least such rough considerations should give first hints to the general direction to think now. According to the statements of General Relativity Theory nowadays any physicist is aquainted with the fact that matter and energy cause space warp. Thus the reverse claim should hold too. Any matter unit and type of energy should be on principle related, based or brought into existance via suitable kinds of space warp. Of course with local gradients of space warp much stronger than the static gradients usually initiated by gravitation. It will be the intension of the following chapters to develop some first ideas to dynamic space warp with more details.

6 Static fields

The ideas of the following chapters should open up the possibility of a deeper and perhaps even complete understanding of the general or basic physical processes or their foundation (e.g. unified field model), though such solutions might possibly introduce sometimes more new questions than they can give answers. It is the aim of the next chapters to develop first reasonable main features of the basic processes of a new ‘sub-h-physics’ that realises the probabilistic character of Quantum Mechanics by a large number of interferences with sub-h-action.

Within modern physics just such influences are described with the term ‘hidden or local variables’. The aimed approach thus is opposed by the seemingly clear prove that such hidden variables cannot exist on principle. Using experiments or the equations of Quantum Mechanics, that finally are based on the validity of the indeterminacy relations (that have to be seen without any doubt as experimentally proved), it is possible to show that there cannot be any processes (for matter) with an action smaller than $\hbar/2$. However, using the equations of classical physics - that are equally well verified by experiments - it is easily possible to show that there should be no Quantum Mechanics at all (e.g. use of any non-excluded small value in the corresponding equations)?

The essential problem is hidden within the range of validity of corresponding theories. If one seemingly gives a clear prove that no hidden variables do exist, one tacitly assumes that obviously for the first time physicist do have with Quantum Mechanics a theory that has no restricted range of validity towards smaller dimensions. To give a doubtless prove of just this should be more than difficult. So what would be if the indeterminacy relations do not represent fundamental, general laws of the universe as a whole but also or only the range of validity of Quantum Mechanics, the physics of matter, of small amounts of matter? The non-limited extending of the indeterminacy relations/Quantum Mechanics into the sub-h-range (to a non-matter-region, to the physical vacuum, to the quanta of fields) is the basis for the foundation of the model of ‘virtual photons and particles’, of the vacuum fluctuation.

Using the indeterminacy relation eq. (10) a very small restriction with respect to the position (high localisation) results in a very large indeterminacy of the momentum or the corresponding energy, respectively. Thus the experimental search into very small dimensions is ascribed to the term high-energy-physics. This seems in addition to be justified with respect to the necessary high energies for the acceleration of elementary particles to get very short wave lengths, to achieve the wanted high resolution. The product of the indeterminacies of energy and time is given as a completely equivalent description of the indeterminacy relation. Thus a large indeterminacy with respect to the energy can only exist within a very short period of time.

Transferring the statements of the indeterminacy relations with the assumption of an unlimited range of validity also to the physical vacuum (in general completely foreign to the nature of matter), within very small ranges of this vacuum the spontaneous generation of photons and/or pairs of elementary particles had to be expected there for very short periods of time (i.e. the setting free of the more energy the smaller the *considered* volume). However, the action of the indeterminacy relations is based on a real localisation in space or a restriction that is forced by natural actions of which kind ever. Such results of localisation cannot be expected within an undisturbed, matter-free physical vacuum (localisation of what?/ by help of which effect?).

One assumes within this understanding the generation of pairs (e.g. elementary particles/ antiparticles) with an immediately following annihilation and uses the term vacuum fluctuation or polarisation. Because the pairs/photons should exist only for very short periods of time, hurt the energy conservation, are non-accessible to direct experiments, have no direct influence on our material world and may have actions smaller than the Planck quantum they got the label ‘virtual’. Integrated over longer periods there would be altogether an average energy content, vacuum energy. It has to be emphasised, however, that the discovery and verification of the indeterminacy relations is based on experimental results. Thus first of all they are valid only for our material world - matter, constructed by elementary particles and the light quanta existing there - and for the reactions of elementary particles, i.e. small amounts of matter and their localisation/determination and nothing else.

In no way the completely different ideas or models considered here should set the validity of Quantum Mechanics in question. Quantum theory has to be seen definitely as proved experimentally. But ‘checked by experiments’ shows that by help of the usable means, being solely of material kind, alone the reactions and interactions of matter/photons can be investigated, recognised and proved. The lower limit of the smallest action $\hbar/2$ (given by the indeterminacy relations) corresponds in addition to the smallest possible spin action, the action of an individual elementary particle without field, kinetic energy and alone its action of spin (e.g. the action of a neutrino with lowest energy). This fact should also demonstrate that the indeterminacy relations are related solely to the reactions of matter. As far as non-material constituents of the universe are considered (field quanta or space-time itself) actually the range of validity of Quantum Mechanics is left and vacuum fluctuation becomes a pure fiction. Matter (and the related photons belonging to it) cannot transfer smaller direct actions to other matter than the plain spin action of a smallest matter unit (e.g. an elementary particle) without kinetic energy and field action. This statement of the indeterminacy relations must not be transferred without additional considerations to a completely different constituent of the universe with respect to matter, the physical vacuum.

Transferring the laws of Quantum Mechanics into the range of very small dimensions also of the vacuum or space-time - as today generally done - one should thus be aware that this might be simply a try, an assumption that could be likewise wrong. As far as also Quantum Mechanics is limited by a lower boundary of application (only valid for matter, small amounts of matter) it is thinkable that there could be (non-material, mass-less) structure units, dynamic space warp regions, with very small dimensions that are characterised by very small momentums and very small energies. Then the consideration of the physics of small volumes as high-energy-physics might be wrong.

As far as contradictions can be constructed, if micro-systems are calculated on the one hand by help of Quantum Mechanics and alternatively calculated using the assumption of existing local or hidden variables, then the conclusion or interpretation of the resulting discrepancy might be: the existence of local or hidden variables is impossible on principle. However, with the same right it can be concluded that within those ranges of validity of hidden variables the validity of Quantum Mechanics isn't given anymore. The first statement is simply based on the *assumption* that the laws of Quantum Mechanics are valid without restriction for any dimension of space. Actually, within the early days of Quantum Mechanics comparable chains of conclusion could be drawn to show that this Quantum Theory cannot be correct, because the laws of classical physics stood the test over centuries. On principle it is impossible to judge about a physics of smaller dimensions or energies by help of a kind of physics with validity within much lager dimensions. The same way as in general classical physics cannot show the validity of Quantum Mechanics or disprove this theory, again on principal a sub-h-physics cannot be disproved by Quantum Mechanics.

Determining the vacuum energy by means of General Relativity Theory (GRT) and using astronomical observations, a value in the order of 10^{-9} J/m^3 is obtained. Determining this physical observable by help of 'Quantum Mechanics', i.e. with the assumption of the validity of vacuum fluctuation (integration over all zero-point-oscillations), a value of about 120 orders of magnitude larger is obtained. Usually this is seen as some kind of 'incompatibility' of GRT and Quantum Mechanics, but in effect this view should be a misinterpretation. It is the non-allowed extending of the laws of Quantum Mechanics into a non-material region of the universe, the physical vacuum, giving rise to this tremendous discrepancy.

Considering a resting proton and electron 1 m apart, the resulting force is according to the Coulomb law eq. (8) about $2.3 \cdot 10^{-28}$ N. The electron is then accelerated with about 252 m/s^2 due to this Coulomb force. Taking a well measurable change of distance of 1 mm, it needs about $2.8 \cdot 10^{-3}$ s for the electron to move there. (As a good approximation the force and acceleration may be considered as nearly unchanged and constant within this interval of 1 mm.) The kinetic energy transferred is about $2.3 \cdot 10^{-31}$ Nm and the corresponding action

within this time therefore about $6.4 \cdot 10^{-34}$ Js, very close to the Planck constant h. No doubt that the electron is moving sufficient smoothly and not in jumps of such or comparable lengths. Increasing the starting distance to 10 m the action becomes even 100-times smaller. Refusing sub-h field quanta thus either the electric field would be finite and limited, or the electron had to move stochastic with considerable jump lengths [17]. The field quanta of the static electric field should be characterised by sub-h-actions.

It shall be demonstrated in the following chapters that there is a corresponding alternative consideration with active emission of sub-h-quanta by the elementary particles - a consideration that allows determinism and causality also within very small dimensions - and gives an equivalent description of the physical reality. As soon as vacuum fluctuation is considered to be invalid as the basis of all low-level explanations the only possible demands have to be developed that alone can now give rise to a full agreement with the observed physical reality. It has to be shown that this can be done without contradictions and allows a better and deeper understanding of various observations.

To the fundamental physical basic processes belongs the generation or better emanation of static electromagnetic fields that have to be described also by the suggested general structure of electrons or positrons in the last chapter. Photons are characterised by a spatially restricted action (particle character). Thus the generation of an ‘infinite’ far reaching field by localised photons as part of an elementary particle has to be described by the excitation and emission of spatially restricted but extended states or collective excitations of individual states of the physical space. They should move away of the source friction free into all directions of space. This is the only alternative, as far as vacuum fluctuation is not at disposal any more for the explanation of static electromagnetic fields.

The transfer of forces between particles by help of static fields necessarily demands the exchange of ‘messengers’ with an action, i.e. structure units that carry and transmit momentum. In the case of static forces acting between (resting) charge carriers those messengers cannot be photons, as far as vacuum fluctuation is out of scope. Photons are usually created due to interactions with acceleration of elementary particles relative to each other (Bremsstrahlung) and cause a further, different, dynamic interaction between charge carriers. With an emission of field quanta of determined strength and number into any space-angle, necessarily this results in a reduction of the density of the ‘collective excitation states’ with the square of the distance (the area enclosed within the space-angle grows with r^2) and describes on principle the properties of the electric field.

If a description of electrons with localised photons or photon pieces via pseudo-orbitals (orbitals are given by multiples of the wavelength) might have a real chance, it is necessary to explain in a plausible way the electromagnetic fields and gravitation straight forward out of

the direct following properties. Pre-assumption has to be a space with smallest individual, excitable states or 'particles' or ‘cells’. With respect to their main properties and dimensions more ideas have to be developed in the following. Obviously their dimension looked for should have a preference at the smallest possible structure size of space, the Planck length (about $2 \cdot 10^{-35}$ m). According to the probabilistic character of the quantum world and the absolute equivalence of all directions of space those ‘space elements’ or excitable states or ‘particles’ cannot be arranged in a lattice but only irregular, amorphous (gas-like?) and in addition not ‘determined’ within space and time, but preferably always in permanent motion to each other.

On principal it has to be stated that photons are mainly characterised by a transversal oscillation of/by individual or collective excitation states. Due to the permanent change or transfer between the electrical and magnetic kind of status orthogonal to the direction of motion the transversal oscillation has to be spatially restricted (at least limited by the speed of light). If a photon or piece of photon is forced into some kind of (pseudo-)orbital and localised (formation of leptons) there exists to the ‘outer world’ or any radial direction instead of a transversal now a radial (longitudinal initiating) oscillation. A fundamental consequence of such a model of the electron is thus the necessity that there has to be the emission of structure units of longitudinal character, collective excitation states - longitudinal photons, LP - into the surrounding space. The declaration as photons or some kind of photons for those longitudinal structure units (LP) is suggested by similar properties with respect to true or transversal photons. They carry momentum but no rest mass, they move also through physical space with (their) maximum speed and should show the property or character of bosons.

The longitudinal photons with an action below the Planck quantum (some analogy to virtual photons) emitted into a certain direction can own solely a restricted spatial size. The initiating, exciting half waves running through all the azimuth-directions of an electron perform a ‘three-dimensional’ motion inside of the elementary particle with the speed of light and rapidly deform locally its surface. A perfect spherical symmetry of the field is impossible due to the spin and magnetic momentum of the elementary particle. In addition it has to be seen that there should be something like a complex spectrum of circulating harmonics and therefore various sizes of longitudinal photons are emitted. Considering a selected radial direction with a least distance away of the particle the running through of longitudinal photons has to be expected with stochastic varying sizes (far-field).

With respect to a radial direction that follows the motion of an exciting/emitting transversal photon-half-wave the formation of an irregular, possibly continuous band or tube-like excitation region might result around the particle, which moves away with the speed of light. This holds for all the harmonics and especially the contrary oscillation modes. Thus all those

‘bands’ or ‘tubes’ cross, penetrate and interact with each other in a very complicated, stochastic manner (near-field). The generation mechanisms of the longitudinal photons should thus be very complex and chaotic. For elementary particles closely approaching each other a deviation of the interaction with the square of the distance has to be expected as well as a strong indeterminacy of this interaction. This gives rise to in-distinguishable particles, to the loss of the possibility to trace back or predict the individual paths of the elementary particles colliding or interacting.

At any given position in the neighbourhood longitudinal photons (LP) seem to occur and to vanish in an arbitrary manner with various ‘sizes’. Though they represent a very real phenomenon the LP might be confused with ‘virtual photons’, but it would be very misleading. They simply represent longitudinal structure units with an action and momentum below the Planck quantum that are not bound to the constraints of the indeterminacy relation. They cannot influence material objects of our world (such as electrons) in a direct manner, but only act collectively, with the electromagnetic field more or less as a unity.

The emission respectively excitation of longitudinal photons cannot remove energy out of the orbital system ‘electron’. Thus their interaction with other elementary particles cannot introduce energy into their orbital system (no change of the rest mass). The LP carry a momentum of sub-h energy-level, however, that is positive (compression) or negative (depletion) depending on the kind of exciting half waves moving inside of the elementary particles. The generated LP with very small dimension are characterised in their interior by a density of primary states or ’particles’ of the physical space or ’substrate’ being either higher or lower than the surrounding density (longitudinal states), giving a first idea to an understanding as dynamic local space warp. With their collective action they are able to accelerate the orbital systems as a whole relative to each other - static electromagnetic field. An electron is emitting longitudinal photons with densities of the states or ’particles’ of ‘space’ in the interior of the LP of both signs (enhanced or lowered), but due to the asymmetry of the internally circulating transversal photon pieces in an electron (effective odd number of half waves) there exists a dominating sign or ratio of the LP-types for any elementary particle. It is effectively exactly reverse for the positron.

Thus matter with an exactly balanced number of charge carriers guaranties in the statistical large-area-average the elimination or averaging. This is especially true along the connecting line between an electron and a positron, such that there will be a reduced energy density compared to the outer regions. Between equal charge carriers there will be an enhanced energy density (dominance of one kind of longitudinal photons without a possibility of elimination) - the particles repel each other. With this immediately the dual character of the charges becomes obvious and the two different kinds of interaction. To get an idea of the dimension of longitudinal photons the presently most precise measurements to the size of

electrons should be taken for an estimate. This was achieved by high precision measurements of the gyromagnetic ratio g at single electrons over long times giving a diameter lower than about 10^{-22} m [18]. With this the dimension of the longitudinal photons has to be expected smaller or close to about 10^{-23} m.

As a very important hint to the fact that the ‘fluid’ or ‘medium’ called physical vacuum is an energy-containing medium serves the Casimir effect. Between two parallel plates with nanoscopic distance develops for instance a force pulling the plates together, even in a perfectly screened vacuum. This experimentally confirmed effect serves at the same time as a proof of the so-called vacuum fluctuation, the spontaneous emission of ‘virtual’ photons (zero-point-oscillations). While outside of the plates photons with any possible wavelength were generated, between the plates a certain part of the wavelengths is suppressed. This seems to cause the mentioned force that can be well measured and calculated.

With respect to the explanation of the Casimir effect it doesn’t matter, however, if photons are spontaneously generated or exist between the plates, or if LP are permanently emitted by the plate-surfaces, by the elementary particles. However, within the emission model the origin of the forces is modified in such a way that the emissions from the outer surfaces of the plates occur without any influences, while between the plates the majority of LP eliminates each other inclusive the impulses. Because such individual longitudinal photons on principle are not detectable experimentally there arises a conflict of belief. This can be solved solely by a higher plausibility or by an explanation for further similar effects. If longitudinal photons are recognised and accepted as real, there will be no question that they could follow similar indeterminacy relations. But in this case there should be a lowest quantum of action that is considerably lower than h. Recognising our macroscopic or material world as a ‘world of transversal photons’ - limited by a universal law, the indeterminacy relation - it should be obvious that their non-adapted transfer to a ‘world of longitudinal photons’, a world of dynamic space warp, has to result in misinterpretations.

In a direct consequence to the consideration of emitted longitudinal excitation states around elementary particles it should be obvious that similar phenomena have to occur also with (free) photons. In contradiction to the localised photons (elementary particles) with a stream of longitudinal photons (with finite size) here a non-intercepted collective longitudinal excitation has to be expected. Photons have to be understood as a moving wave package with averaged constant width and length - a ‘light particle’. In a completely analogous way to the phenomena at elementary particles the transversal oscillations of the individual wave-parts should transfer collective longitudinal excitations to the environment with states or ’particles’ of the surrounding space. They move away in the direction of oscillation with the speed of light while the photon is moving forward with c, continuously initiating those longitudinal excitations.

Thus any photon has in addition to be characterised by a far reaching kind of ‘ship bow wave’ (trail) that could provide a ‘communication’ between photons (all this can only be a very simplified imagination, because it has to be a very complicated three-dimensional oscillation phenomenon that cannot be described with a simple ‘quasi-two-dimensional oscillation’, compare chapter 8). One of the leading density-trails generated by a photon has to be characterised by an enhanced density of states or ’particles’ and the opposite (leading) one by a reduced density, forming altogether a complex set of analogous trails along the wave train of a photon. Due to the spin of the photon (with defined helicity) some kind of spiral structure of the photon trails has to develop forming probably a cone with finite thickness. (Photons can be precisely localised/registered along their direction of motion but not orthogonal to this direction.)

Within the view of the up to now considered phenomena there seems to be no possibility for a further force, dominating the universe (magnetic effects due to the motion or accelerated motion of charge carriers can be understood in a simple way by the asymmetry or deformation of the fields of longitudinal photons and the related orientation of spins, see chapter 7). Gravitation (with about 36 orders of magnitude lower strength) could be an accompanying effect of the longitudinal photons emitted by the elementary particles or be given by some emission with lower probability causing only little effects. There might be a first idea that sometimes for short times the simultaneous emission of longitudinal photons could occur generated by two or more harmonics. In this way different ‘additive’ and ‘subtractive’ combinations might be imagined (in a perfectly dispersion free medium such excitation-combinations could move in this state till infinity). However, if electrons and positrons represent with respect to their properties exactly ‘anti-symmetric’ particles, any combination should occur with exactly the same probability in the reversed combination, such that there would be no net-effect.

It needs a weak asymmetry between both kinds of anti-symmetric elementary particles. This indeed occurs if transversal photons with an odd number of half waves are locked within the elementary particles. In the electron there would be for instance two positive and one negative half waves directed into the interior and in the positron vice versa. Accordingly there had to be a modification of the inner spectrum of harmonics. While in one case the radial oscillations give rise to a (relative) slightly enhanced density of states or ’particles’ of space in the interior of the particle - this should give rise to a slightly additional enhanced emission of longitudinal photons of increased density - in the other case there would be a (relatively) lowered internal density and a slightly reduced emission of LP with low density. By this effect of second order there is now a net effect, which may act only into one ‘direction’ and causes a force that acts only in one way. While individual longitudinal photons are emitted perfectly balanced, those with combinations of photon-harmonics could cause a net-effect. There is

now a non-zero annihilation-sum if high-density-LP are emitted slightly stronger and those of low-density less stronger. The emitted spatial distribution around elementary particles again would follow the inverse square with the distance and might represent the well-known description given already by Newton for weak gravitation fields.

Close to massive matter concentrations the deviations of the above suggested law of gravitation - that can only be described by the equations of General Theory of Relativity, i.e. by space warp - should be more plausibly caused by the above given inherent property of the longitudinal photons (LP). Because there is effectively the emission of a certain rate of longitudinal photons with always (relatively) enhanced density of states or 'particles' for both kinds of LP (in addition and above the 'balanced emission'; additional density inside LP with 'overpressure', reduced density-reduction for the 'low-pressure'-LP) it should be immediately obvious that such LP transport the carrier medium or 'space' or substrate itself away. Reaching an abrupt border of (physical) space longitudinal photons with enhanced density of the medium will shift this border by about one longitudinal photon volume ahead. In case there is a gradual transition to a region with lower average density the border of the region with higher density will be shifted forward. Within the frame of this model the mechanism of gravitation were inherently related in some way to the mechanism of expansion of physical space.

The other way round, the weak asymmetric emission of longitudinal photons with additional density (the sum of annihilation of both types of LP results in a positive excess different to zero) causes a depletion of states or 'particles' inside and around of massive objects. There has to develop a static gradient of the states or the 'particle' density, which can only be brought into a relative, distance-dependent, static equilibrium by an athermal diffusion or back-stream of the states or 'particles'. It is obvious that this equalising process has a limitation, which we usually have to call event horizon, as soon as the possibilities of streaming back are by far lower than the ones of the 'pumping away' by all the involved (active) elementary particles.

The possibility of streaming-back depends on the size of the area that is passed trough. Approaching the source of gravitation this area reduces with r^2 such that for low mass a change of the local gradient with r^{-2} is developing. With the formation of stronger gradients (very high mass concentrations) the additional equalisation via drift mechanisms might be possible that vary with the strength of the gradients. As soon as the effect of 'pumping away' strongly exceeds also the back-stream inclusive drift mechanisms an event horizon might be formed.

While transversal photons will be strongly deflected or even hold back by an extreme density gradient (event horizon), longitudinal photons are always able to pass (with changes of the

size). Though transversal photons are hold back by the event horizon of a black hole, the effect of gravitation or electric fields is realised outside of it. Thus the carriers of the static electromagnetic field cannot be photons with transversal character. An acceleration of charge carriers with respect to each other is usually connected with an exchange of photons (Bremsstrahlung). Thus it is generally assumed that the carriers of the electromagnetic field are photons. However, they can be only the carriers of the dynamic interactions between charged particles. According to the above considerations only photons of the longitudinal type are possible carriers of the static electromagnetic field.

The action of the density gradients is extremely strong and can give rise to the strongest force possible in the universe. Light that has to pass regions with strong gradients necessarily is forced to move as good as possible along planes with equal density - photons have to follow a warped path. The action of gravity called ‘space warp’ can be understood as the development of static gradients of the states or the ’particle density’ of the physical space, due to permanent emission of LP of the electromagnetic field (with additional, slightly enhanced density of states or ’particle density’ of the physical space for both kinds of LP), causing in addition a permanent ‘pumping away’ and a continuous, but limited, distant-dependant back-stream. There appears to be an eternal stream of a ‘substrate’ towards matter caused by the side-effect of the eternal electromagnetic emission of matter - a seemingly unlimited sink and an unlimited source that both necessarily need permanent energy supply. The alone thinkable kind of energy can be solely Dark Energy that the same way supplies the electromagnetic field of the electron with its enormous total energy while there is only a negligible constant energy-equivalent given by the rest mass.

7 Dark Energy

Up to now the discussion has used the terms vacuum or space with little specification. There should be some more words to get a deeper understanding. Related to the expression ‘space’ is an abstract, essentially pure mathematical term describing distance and angle relations where a ‘gauging’ only makes sense if there is at least one material object. Within our modern understanding of Physics this science can be seen in general as the theory of the laws of motion of physical structure units - of which structure level ever. Thus within physics an alternative kind of definition of space could be nothing else than the existence of the fundamental possibility or occasion for the possibility of the translation of physical structure units. The term ‘space’ represents the basic prerequisite for the possibility of any kind of motion itself.

If, as presently frequently discussed, the generation of space and its expansion is considered, this would represent a contradiction within itself. Any expansion is a special kind

of motion that according to the above definition can only proceed into or within a pre-existing space. A solution can solely be achieved by considering different kinds of space. For example considering the expansion of a physical space with not yet specified content of structure units into a real or true vacuum that is immediately related in a direct way to an infinite mathematical space (continuum). Within a so-called hypothetical ‘non-space’ on principle there is no possibility of motion, change, generation or expansion. A space that contains no physical structure units at all (true vacuum) cannot experience any changes too, but always and everywhere allows the invading of physical structure units. Thus there exists no time and in addition there is no possibility for space warp, rolling up or other changes of space within the ‘absolute nothing’ of the true vacuum. To get the reality of a space-time it needs the filling of the true vacuum with (basic) physical structure units. There exists ‘physical space’ now and the possibility of internal changes and thus also of time. The space warp of a physical space can be achieved either by the local variation of the internal excitation of the structure units or by a local change of their volume density. Any physics that is based on such a ‘physical space’ has necessarily to be characterized by a lower limit of the possible distances within composed physical structures of higher level and of the time (minimal interaction time between the basic space-filling units). A space in the sense of the fundamental meaning, that could be warped or rolled up, had to represent necessarily a true medium. But any medium needs space to reside, to exist within.

The definition of space itself is independent of the existence of something real or material-like in between material objects considered. Contrary to the original definition of vacuum by the Greek philosophers (true vacuum) within modern physics presently a region of space is understood that is part of our universe, contains no matter and should be ascribed to a (not direct accessible) ‘fluid’ with ‘energy content’. If vacuum is set per definition equal to the term physical space, the expansion of the ‘fluid’ has to be described by the expansion of space. Simultaneously also a separation of fluid and true space is thinkable - now the ‘fluid’ should get the term aether. Within the on principle ever and everywhere independent existing space the expansion of a region filled with basic physical structure units, with aether (physical space) can be recognised now.

With the Michelson-Morley-experiments (effectively nothing else than standing light-waves within a rigid mirror-system) often the existence of aether is regarded as disproved. However, if at all it is only possible to exclude an aether that has the ability to influence the motion of transversal photons. A discrepancy to the emission and motion due to a relative motion to the aether (with respect to the achieved velocity) can be imagined only for longitudinal oscillations (coupled with obstruction or compression phenomena). The use of the term aether could considerably enhance the emotional understanding of phenomena such as ‘vortices of space’ (Lense-Thirring-effect, frame dragging) as a vortex or dragging of the

aether by a rotating mass with corresponding changes of its surrounding local density and average speed. Effectively this phenomenon proves the existence of an aether.

Though it is generally tried today to avoid the term aether, to declare it out of date, in effect the assumed filling of the whole universe by Higgs-bosons, to explain the property of ‘mass’, represents nothing else than aether (attraction aether). However, the expected extremely high energies of those bosons (about 110 - 175 GeV) are fairly improbable and an explanation of the property ‘mass’ is much more likely by extremely small bosons (within a macroscopic view with nearly zero-energy of a repulsion aether) balancing instead the low energy by an extremely large number and high density of constituents. It should be possible to explain the totality of all physical phenomena by help of the aether, not only the property of mass. It cannot be solely the carrier medium of photons, but has also to realise the spreading of the static fields and to give those fields their action and properties. The aether has to be also the construction material of the elementary particles and to realise their mass or inertia. Despite of the enormous variety of our material world it should be on principle the most-simple system of the universe that has to be based alone on one kind of interaction of the constituents among each other and containing only one kind of indistinguishable structure units.

Unfortunately the concept of ‘aether wind’, introduced by Michelson and his contemporaries for the motion of the earth through the aether, has brought wide misunderstandings to generations of physicists and sometimes even led to doubts with respect to the fundamental statements of Special Relativity Theory, the motion of light with a constant speed c in all reference systems irrespective of the speed of the source. Already at that time it was experimentally proved that material objects - that alone can be seen as a source of light - can only approach c asymptotic. Any produced photon thus will necessarily immediately escape its source and move independently through a resting aether. The aether is the only outstanding reference system and appears again today hidden as the ‘reference system of the cosmic background radiation’. A real aether wind would be given if there were local streams or turbulences within the aether itself. However, the motion relative to the aether during the process of photon emission results in a deposition of the oscillations within a longer or shorter distance in the aether, which is finally realised as Doppler effect (red or blue shift). Because exactly the same considerations will be valid if the material world needed no aether at all, Einstein stated within his original papers that it will be irrelevant for the validity of his theory of relativity if there were an aether or not. This has nothing to do with prove or disproval of the existence of an aether.

Because the constituents of aether represent the smallest structure units of the universe there exists per definition no possibility to divide them. This means they fulfil the formerly given demand of the ancient Greeks for the term atom (atomos = the indivisible), which is

already in use. Thus here it will be better to take the term Aea (aether atom/s) instead. With the finding that the universe has no preferred directions the Aea should have the possibility to move freely and have no chance to form ’crystalline’ or ’polycrystalline’ structures. A gas-like ’structure’ should be preferred for a model.

The mean distance of the Aea should be accessible to us as the Planck length. It is representing the most fundamental constant of nature and all others will be determined by it (e.g. the speed of light, the gravitation constant, the permeability of vacuum or even the Planck constant h). This implies that there could be regions within the universe that are characterised by other values of the Planck length and thus having modified constants of nature - of course still all accordingly well balanced to each other. In effect this should hold also for each gravitation region, representing predominantly a gradient of the aether density and thus being characterised by a variation of the Planck length. The definition of the Planck length is in effect given by the determination of a smallest possible black hole (BH). Because the generation of a corresponding event horizon is given via a strongest density gradient of the structure units of aether, within a sea of Aea the smallest possible BH is created by the elimination of an individual Aea. Now there is the maximum possible density gradient with the smallest possible extent. Within this view the Planck length represents the average distance between the Aea.

A main demand to the properties of a gaseous aether is the necessity to realise longitudinal and transversal waves - light has to be described by transversal waves (e.g. possibility of polarisation). While in all ‘material’ media (gases, liquids and solids) the formation of longitudinal waves is observed, the generation of transversal waves is obviously bound to special conditions. They occur at interfaces (e.g. liquid surfaces) or in solids. Common to both cases is the existence of back-driving or resetting forces of the medium ‘carrying’ the waves, a medium with at least some kind of elasticity. Thus a fundamental demand to the aether has to be a repulsion force between the Aea resulting even in a gas-like medium into elasticity. There should be no attractive forces at all between the Aea. Therefore no property analogous to that of a liquid or a solid is given. Such a ‘fine-material’ medium might be best compared or described with the properties of a gas (better ideal electro-fluid without charge-action). This elasticity based on repulsion forces would allow the propulsion of photons with predominant transversal periodic oscillation processes.

Trying to assume that the existence of our ‘material world’ is only based on some kind of internal excitations of Aea (with fixed position to each other, ‘solid aether’), which transfer the excitations from Aea to Aea with the speed of light, it is nearly impossible to understand a reflection of such moving internal states by help of identical structural units (realising tranversal oscillations). The only real translation in this case is thinkable by exchange mechanisms known from diffusion processes. They were not well suited to give rise to a high

speed such as the speed of light. Assuming for a solid aether on-average-localised Aea with the property of oscillation (transversal waves were possible by collective oscillation processes) attractive and repulsive forces were necessary to realise corresponding potential trays (preservation of the stationary position). However, such a medium could change its volume solely via the oscillation width of zero-point oscillations and could never realise a permanent, wide-area expansion that is observable following a Big Bang.

If there exist instead quasi-free movable Aea within a gas-like aether, that are repelling each other, any collective, sufficiently fast, synchronised motion of Aea (batch of Aea) into a medium of individual reacting units will always introduce corresponding compression- or obstruction-phenomena. They are causing a resistance or even a turning back of the moving batch (elastic carrier medium, high-speed elasticity). The necessarily building-up, repelling high-density-regions have to move away or have to dilute following the process of reflection. Here it is very essential that there is a finite speed for the transfer of the states of motion and a sufficiently high speed of the ‘batch’. Such a medium is in addition always characterised by an everlasting internal stress and thus contains per unit volume the needed considerable amount of energy (vacuum energy or expansion force).

As soon as such a kind of medium is embedded within a medium of lower density of Aea, due to a process not yet specified at the moment, the inner high-density region has necessarily to expand (compare e.g. Fig. 6 of chapter 10). To any observer within such a region this phenomenon could appear as ‘expansion of space’. Thus a model of a gas-like aether with Aea repelling each other could give a perfect and logical explanation for a mysterious Dark Energy, which directly explains the observed expansion and the motion of galaxies (embedded or dragged). On principle such a medium with permanent internal stress can exist in long terms only, if (a) a finite region is limited by fixed borders, or if (b) the medium satisfies the condition of infinite extend, or if (c) giant, finite, relaxed clouds of Aea create such internal stress for a finite but fairly long period of time via a shock-front during their collision. While (a) has to be seen as irrelevant for the explanation of a universe the situations (b) and (c) probably on principle cannot be differentiated by the application of astronomic instrumentation.

Physicists needed centuries to find out, that forces or fields need the exchange of ‘messengers’ (e.g. longitudinal photons). This is completely impossible in the very special case of repulsion forces between the components of aether, for there are no smaller units available transferring impulses. The mutual repulsion of Aea can only be an action that is connected with a repulsion caused by immediate approaching or interpenetration of each other. Aea thus should possess internal excitation states, oscillation states perhaps such as discussed for instance within the string- or M-theories. However, this would be possible here without high-dimensionality (alone within three space-dimensions). The use of inter-

penetrating aether units (quasi-unrestricted deformation and interpenetration) turns out to be completely equivalent on the first view to a use of ‘quantum foam’ that simply avoids for the ‘substrate’ the actually necessary term aether. The main difference is the assumption or definition of ‘foam’ to represent space itself, transforming space into a medium, whereas the term aether clearly demonstrates its structure units to be space filling and allowing on principle high speeds for the basic units being unthinkable for foam.

The overlapping of such oscillation states during mutual approaching will necessarily cause the repulsion of Aea. There is solely the demand of a perfect reversible interaction between the Aea which gives rise to fully friction-free reactions (necessary result: energy conservation for all composed macroscopic systems based on such an aether). To achieve a field-like action or a gradient of the repulsion force there might be a spectrum of various frequencies and thus of various ‘ranges’ of the concentric arranged ‘strings or Branes’ (any other type of structure enabling the enormous deformation and interpenetration, resulting in an electrofluid behaviour is of cause equally well suited). This view, this concept would reduce the task of those theories to an explanation of the structure and properties of Aea. Involving photons (photon cores) or elementary particles via open or closed strings then makes no sense anymore. (Nevertheless there are several common properties or similarities between those oscillating structures considered by the M-theory and the models of photons and elementary particles discussed here as ‘composed strings’ based on Aea and LP.)

According to the suggested ideas Aea represent the only fundamental in-distinguishable structure units of the universe that interact among each other with only one fundamental interaction force that is repulsive. While the Planck length should describe the average distance of the Aea the term ‘size’ of Aea is fairly indefinite. Because they realise definitely something like ‘vacuum energy’ they do have to overlap and thus should be larger than the Planck length. Their essential high-energy ‘nucleus’ without a definite size will instead be considerably smaller than this length. The more precise the ‘total energy’ of Aea is considered - the more low-frequency parts acting to a wider range are taken - the larger they appear to be. In some sense this resembles the indeterminacy relations of our matter world.

On a first view the developed models of elementary particles or photons, taken as closed systems, appear to be of perpetual motion. However, they have to be seen as constituents of the total, ‘open system universe’. The aether can be considered as a giant, homogeneous, extremely strong stressed ‘three-dimensional spring’ and thus contains per unit volume a considerable amount of energy - Dark Energy, expansion force. Already little local changes of its density with density gradients result in strong effects (warp of space). The only far reaching, stress reducing mechanism (besides expansion as a whole) is the emission of longitudinal photons. A somewhat comparable behaviour is known within stressed real crystals with permanent emitting dislocation sources. Such sources, taken as closed

systems, would also appear with perpetual motion, but they take the energy out of the overall stress of the whole crystal that is deformed during stress reduction (deformation via one-dimensional defects, dislocations). Elementary particles have a similar task with respect to the ‘stressed universe’ (expansion via three-dimensional ‘defects’). Because stress reduction is impossible within an infinite homogeneous aether, the existence of static fields is necessarily bound to a permanent density reduction of the aether. The basic prerequisite enabling physics of matter with static fields thus is probably at least related to the possibility of an evolutionary development such as the Big Bang. In addition the universe solution (c) should be favoured (any formation of a shock-front via collision follows a pressure reduction).

Within the first modified understanding according to the action of photons there arises a serious discrepancy to one of the basic statements of General Relativity Theory: Any kind of matter and energy (respectively impulse density) is causing space warp. According to the new understanding of the mechanism of gravitation (free) photons cannot give rise to a net effect, to a static local density reduction of the surrounding aether, the development of extended static aether gradients. Thus photons (photon gas alone) cannot agglomerate or being kept agglomerated as far as there is no matter or other kinds of energy related to matter causing a sufficiently strong static gradient of the density of Aea. The experimentally investigated close passages of photons with mutual crossing of their trails (characterised by density gradients) cause a mutual change of their direction of motion but is only in some way related to gravitative action - it is no gravitative interaction in a direct sense. This would not solely be restricted to the meeting of photons but had also to occur with a parallel flight of photons (auto-focussing within vacuum). The crossing of photon trails with aether density changes (dynamic local space warp) under a certain angle has necessarily to cause a change of the photon direction.

The Energy-Momentum-Tensor of GRT needs a restriction to those contributions being relevant for space warp in the sense of gravitation or static gradients. In the present stage of cosmological development the additional incorporation of photons within ‘static considerations’ gives no noticeable difference. However, in the very beginning of our universe the knowledge that photons alone cannot give rise to space warp is decisive. A transformation of matter within the core of a black hole into radiation now is not maintaining the status of the former black hole (gravitation-like space warp). It is the essential point to avoid within a pre-existing space-time the Big Bang with an otherwise necessary singularity.

With all the ideas developed up to now in this paper it should be possible to further enlighten the mechanism of pair creation. It is still a long way to a complete understanding of the most important, most fundamental mechanism of the universe. Though it needs further and more realistic models given in the next chapter the following ideas within the presented iterative approach shall give a starting introduction. If two photons are colliding with nearly parallel

orientation of the oscillations there will be not only an amplification of the ‘fields’ of the kernel but also an interaction and enhancement of the leading photon trails having depleted or enhanced density of Aea (lying opposite to each other with respect to the photon core). The interacting trail regions are interfering spatially restricted within the region of collision because due to the existence of the spin the photon-structure-units rotate effectively with the speed of light against each other (compare also chapter 8). The strength of the depletion or enhancement of such Aea-density-regions depends on the energy (i.e. frequency) of the photons. Thus a higher energy means a shorter wavelength, i.e. a stronger depletion of Aea within also a smaller size of the depleted volume.

Starting with a least energy of the photons the density gradient to the surrounding average density produces a maximum gradient necessary for an event horizon - the generation of an accompanying micro-cavity. This happens without fulfilling the Schwarzschild conditions known for macroscopic (cosmic) black holes. There is a completely different, dynamic generation mechanism. The collision of such cavities might swallow parts of the photons. It creates a pseudo-orbital (forced circulation) of the photon pieces inside of the common cavity and immediately introduces a permanent field surrounding the generated elementary particle spreading out with time and repels the particle from the ‘fields’ (aether-density-gradients) of the creating photons, or it needs an impulse transfer orthogonal to the direction of motion of the photons. Now the following successive generation of the anti-particle is possible.

The creation of a micro-cavity by the collision of photons and their depletion regions close to the core of the photons has to generate a ‘shell’ of Aea rotating around the cavity with at least the speed of light due to the opposite rotation of the initiating ‘fields’ of the photons against each other (some kind of aether vortex). The additional action of ‘spin’ is created. Within this process the opposite photon spins transfer in some way a maximum rotational momentum to the outer regions of the cavity. While the moderately moving or diffusing Aea are characterised by mutual short-range repulsion ‘potentials’ with radial symmetry, the produced spin-shells give rise to a summary, a smeared-out repulsion potential of the shell as a whole resulting from the common action of all Aea involved. This shell is long-time stable because of the totally friction-free motion of Aea. This necessarily prevents the passage of individual Aea from the interior to the outside and vice versa. Thus any density equalisation of the Aea via diffusion through the shell is fully blocked and enables the long-time stability of matter.

In this way the mutual repulsion of Aea is transferred to a large ensemble of them in the ‘spin shell’ with Aea rotating (differential) with at least the speed of light around the cavity inclusive the accompanying frame dragging. Thus for elementary particles this results in a global action between spin-shells against each other - this is a strong contribution to the background of the phenomena related with the Pauli exclusion principle. Therefore the

mutual repulsion force between spin-carrying particles turns out to be a modified collective and multiplied action of Dark Energy. Due to the circulation of the captured photon pieces within an electron or positron in addition circulating quasi-periodical but stochastic internal density variations are generated that deform the spin shell without hurting it. Thus the shell is acting like the membrane of a loudspeaker and modulates the density of the surrounding Aea 'atmosphere' and this way emits longitudinal photons (introduction of the electromagnetic field and gravitation).

According to the suggested models the electromagnetic field around an electron represents an emission field of longitudinal photons (LP). Here the majority-LP and minority-LP possibly have a ratio of 2/3 to 1/3 (being opposite for the anti-particle). There are at the moment no clear imaginations to the real structure of LP (there could be even surrounding toroidal vortex structures) and there could be a soliton-like character to allow always a comparable action over long distance travel. Calculating the total energy within an infinitesimal thick shell of the electric field emitted by an electron and considering the change during travel through space it can be demonstrated that the total energy within this shell is decreasing with growing radius [19]. Here it is sufficient to use the simple consideration with classical electrodynamics. Thus it has necessarily to be assumed that the LP somewhat increase their dimension during travel through the physical space and loose in such a way some transferable energy (reduction of the absolute value of the corresponding wave vector).

Despite of a dimension smaller than that of an electron, LP should have an expanse larger than their main central structure due to further density variations (possibly vortices) in their surrounding. This prevents the mutual approach of LP of the same kind and forces mutual giving way. Only during the annihilation of LP of different kind (of different sources) an individual way of interaction is to be expected. Otherwise there should be a collective interaction of interacting fields giving them also something like a property of elasticity. Local changes of LP density due to interactions - away of the usual statistical distribution - thus would be given to the other LP in the surrounding. So the whole field acts more as an elastic unity, owns for the moving electron something like a total momentum of the field. With a relativistic motion of an elementary particle the field cannot posses radial symmetry anymore. It should be characterised by some comet-like distortion.

With the existence of two kinds of different LP (with enhanced or reduced Aea density/ positive or negative local space warp) giving rise to repulsion or attraction forces (positive or negative impulses) it is possible to explain both kinds of charge in an easy way. The sum of the radial momentums causes the strength of interaction (the force is realised by the sum of the individual impulses on a certain area in a certain time). With an increasing distance to the electron or positron, with a given constant emission rate into a selected space angle, the impulse density necessarily has to decrease with the square of the radius. The well-known

law of electric interaction is thus realised for this model. Because the properties of electromagnetism have to be based on one and the same origin/entity there is the need to understand magnetism by LP too. But in this case the reduction of the strength by only 1/r has to be explained.

The LP and their radial impulses are realised by the stochastic circulation of the captured, modified photon substructure units hitting from inside the spin shell to deform it. Here it has to be taken into mind that this spin shell is simultaneously and independently in rotation with at least the speed of light. Thus any LP has to get an additional rotational momentum from the spin shell (influenced by the necessarily existing Lense-Thirring-effect). Therefore the magnetic action should be understood as the additional tangential or rotational momentum of the emitted LP. Magnetism appears to be the rotational momentum of the electromagnetic field, of the whole field of emitted LP. The general term charge reflects the totality of the radial impulses of the LP-field of an elementary particle, the general term magnetisms represents the totality of the rotational momentum components.

The vector of the rotational momentum **D** is given by $\mathbf{D} = \mathbf{r} \times \mathbf{P_t}$, with $\mathbf{P_t}$ the vector of the tangential momentum/fraction. Due to the always realised perpendicular correspondence the amount of the tangential momentum, the 'magnetic action', is simply given by $P_t = D_0/r$ (D_0 the amount of the starting rotational momentum, depending on the 'latitude' of the spin shell; maximum at the 'equator'), because the rotational momentum has to obey general preservation. The number of LP along any circumference, any magnetic field line, is constant (the number is transferred to the 'next larger one' without any loss or gain). The perpendicular orientation between the electric and magnetic actions within those considerations (tangential <> radial) is revealed by itself. Obviously the emission model allows on principle a perfect description of the physical reality. The great advantage of the emission model is the possibility to integrate gravitation and to deduce with it the structure of photons.

With the experiences related to the technical production of magnetic fields we are used to understand its formation primarily through the motion of charge carriers (see also Maxwell equations). But at the same time it is known that even a resting electron is characterised by a magnetic field (magnetic momentum). This seems to be related or given simply by a quantum property, the spin. With the above gained understanding of magnetism as being part of the rotational momentum of the field of LP, this intrinsic magnetic field can be understood on a purely logic basis. Because both the speed of emission and the speed of rotation should be at the moment assumed as c, the strength of both effects is comparable. As soon as a large number of charge carriers is concentrated within a small volume and the spins of the carriers are not forced to orient to each other the rotational momentums will

cancel on average due to the statistical distribution. Thus only the radial components are realised. It seems to be a ‘pure’ charge (solely electric field).

If the freely movable electrons of a wire are set into motion by an external electrical field there will be an orientation of all spins into the same direction due to the action of the external field (at least within the periods without collisions). Thus all emission fields of those electrons are oriented in the same way, especially the components of the rotational momentum of the LP have the same orientation. There is now effectively a stream or vortex of LP around the wire with the same direction of motion of all LP. This stream is produced with at least about 10^{32} LP per electron and second (circulation with c within a size in the order of 10^{-22} m) and are emanated by about 10^{19} electrons considering a current of 1 A. It is the enormous number of LP involved that results in the veritable strength of momentum or force despite of only sub-h-impulses. Actually it is in some way the same kind of vortex around a current that has already been considered by Faraday to explain magnetism. The lines of the magnetic field correspond to the tangential direction of motion of all LP with the same strength of rotational momentum. The paths of the LP (away of the electron) are only straight lines but their tracing back is not going through the centre of the corresponding emitting electron.

Following the process of enclosure of a restricted region of aether by the developing spin shell and having a changing density level with respect to its surrounding the internal equalisation of still existing density gradients has to be expected (homogenisation of the inner ‘pressure’). As far as during the process of spin shell development parts of the initiating photons are enclosed and separated from the surrounding, as well the inner pieces as the outer parts realise an unrestricted total reflection at the shell. The parts in the interior - necessarily circulating now - should perform radial oscillations instead of the former transversal oscillations. As soon as there is an asymmetry between the oscillation modes of the captured photon pieces directed to the interior and the outward directions (e.g. odd number of half-waves) this would introduce a radial change of the aether density in the interior. If for instance those modes prevail that were directed to the interior the density in the centre becomes enhanced (compare Fig. 3).

Again those ideas can give only a first rough orientation because real oscillations would necessarily and finally reverse the direction of motion. The odd number of half-waves in a direct sense thus would give averaged over time still a value of zero. On principle the intended action can be realised only by the circulation of a ‘static wave’. The second enormous difficulty is the extremely small size of electrons ($< 10^{-22}$ m) in comparison to the expected amplitudes of e.g. Compton-photons in the order of 10^{-12} m. It is completely impossible that those photons could ‘oscillate’ in the interior of electrons. There has to be a

transformation of the oscillation into a travelling static phenomenon that should happen at an event horizon or the spin shell. A deeper understanding can only be gained by a more precise knowledge about the photon structure. This has to be referred to chapter 8.

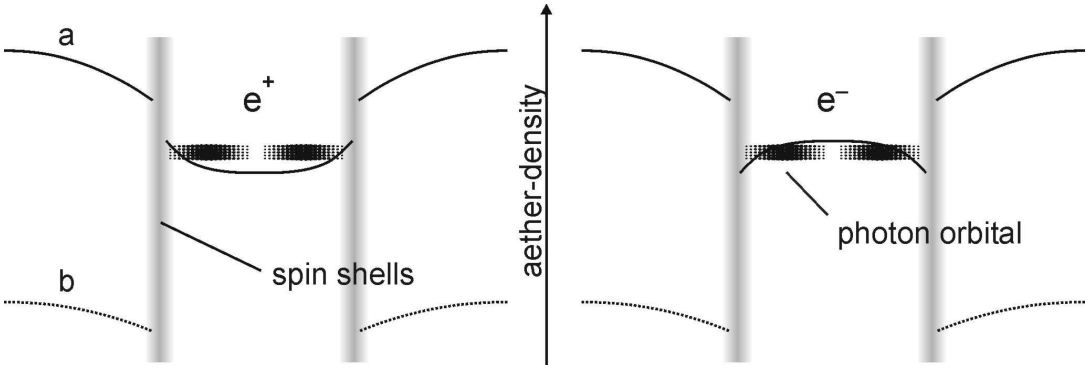

Fig. 3: Schematic drawing of the radial aether density distribution around elementary particles; the outer graph (a) symbolises the gravitative depletion close to the spin shell short time after the Big Bang within the period of matter generation; graph (b) symbolises the situation for electrons within a sub-critical Black Hole short time before the Big Bang (it should be remarked that the correlation of the terms electron, positron, positive and negative charge had to be necessarily arbitrary and accidental; the same holds to the association of charge and central enrichment or depletion)

Nevertheless, due to the formation of internal density gradients the effect of the 'oscillation' modes across the spin shells is slightly influenced in some way. With dominating oscillation modes directed to the outside close to the spin shell an enhanced density would develop (Fig. 3, left) and enables a somewhat more efficient transfer of the dominating modes directed outward compared to a transfer with a homogeneous density distribution in the interior. The result outside of the shell is a slightly over-enhanced compression of the aether during the emission of the longitudinal photons with enhanced density. Within the corresponding anti-particle a depletion zone develops close to the spin shell (fig. 3, right) causing a somewhat less efficient transfer for longitudinal photons with reduced aether density - that represent for those particles the dominating kind of emitted LP. Both effects cause an action 'into the same direction'. While the emission of longitudinal photons with enhanced density effectively causes the transport of the carrier medium away, the emission of the ones with reduced density causes some enrichment close to the emitting particle.

As far as the one kind of emission is slightly enhanced and the other one slightly reduced this results on average in a real net-effect with enhanced transport of Aea away of both kinds of particles. This effect, the resulting force, acts therefore in only one direction, results in an enhanced transport of Aea away, results in a depletion zone around elementary particles or matter that in return causes a corresponding back-stream towards the particles. This is the source of gravitation, the creation of far-reaching static space warp.

The presently accepted Standard Model considers a more or less passive influence of elementary particles on an active vacuum with vacuum fluctuation (permanent, spontaneous,

creation of ‘virtual’ photons or particle/antiparticle pairs). Within the Direct Model the physical vacuum (here represented by an aether filling the ever existing space), is a passive medium but nevertheless characterised by an enormous vacuum energy and is influenced by active emitting elementary particles, creating in this way the fields. The presence of some kind of photons within the vacuum cannot be denied (see e.g. Casimir effect), however, both sights for their generation, type or kind of introduction into the vacuum have at least to be seen as solutions of equivalent possibility. The basic ideas to the structure of elementary particles in this paper arise due to a consequent application of a Direct Model of our world. Because elementary particles stem definitely from the collision of photons, at least parts of them should give rise to an essential basic structure unit within those particles.

The emission of longitudinal photons of both signs (electric field) by both kinds of elementary particles results - averaged over a sufficiently large volume - in a complete extinction and balance (neutrality). This holds at least if both kinds of particles exist with exactly equivalent numbers, realised via their generation trough pair creation; no asymmetry between matter and antimatter. However, due to the mechanism of gravitation discussed above there is now a very tiny asymmetry between the emitted longitudinal photons of different signs having an effect acting into only one direction and being about 36 orders of magnitude lower (compared to the action of the electromagnetic field). This asymmetry is negligible investigating electromagnetic effects, and creates only with a multiplication effect with extremely high numbers and densities of elementary particles (large mass) sufficiently strong effects. Matter concentrations represent something like permanent-working weak ‘aether pumps’ via their emission of longitudinal photons with slightly enhanced (non-balanced) aether density.

The effect of gravitation, that is dominating high particle densities, manifests itself within the ‘cosmic evolution’ over long terms via the permanent trend of mass concentration. With the maximum possible matter concentration a maximum possible pumping activity is given resulting in a minimum possible aether density in the surrounding of this mass (see e.g. schematic graph b in Fig. 3). Simultaneously a maximum possible matter density is created by the increasing pressure in the interior of the matter-core of the corresponding giant black hole. As soon as the orbital system ‘nucleon’ cannot balance this pressure anymore by higher excitation of the orbitals for Quark motion and finally collapses, there has to be a mutual penetration of the electron-positron-Quarks and the general ignition of an electron-positron annihilation reaction. The very special event of Big Bang without singularity is initiated, starting with a finite amount of mass with a finite size. Due to the destruction of the spin shells and particles now the setting-free of aether with considerable density is caused. This appears to be an expansion of ‘space’ but in effect is the necessary reduction of the high aether density in the central region after the annihilation of (nearly) all matter.

With the generation of a (pseudo) transversal-wave orbital the structure unit ‘elementary particle’ will show completely new properties independent of the emission of longitudinal photons (electric field/gravitation). While a photon with predominantly **transversal** oscillations can achieve the maximum speed of propagation (that cannot be influenced by a relative motion of the source with respect to the aether) the orbital construction as a whole always is characterised by **longitudinal** oscillations in any possible direction of motion. This necessarily is related to the development of density gradients within the medium ahead of any direction of particle motion. It introduces equalising, relaxation or obstruction processes (density gradients that have to be overcome) and demands more time for the motion. It introduces something like resistance or retardation with respect to the translation of the particles. This is usually described by the terms rest mass or inertia. Obstruction processes are a direct result of the finite speed for the transfer of Aea motion states. Thus such an orbital system can never achieve the speed of light, the maximum speed of transversal processes.

An extended physical object that is moving through a gas-like medium has first of all to push this medium aside in a transversal way and to initiate a suitable ‘streaming-around’. To achieve a velocity-dependent equilibrium of this streaming-around, it is necessary to introduce an according force or energy to overcome the ‘inertia’ related to the corresponding initial status of streams (it needs the initiation of sufficient pressure ahead and corresponding suction in the rear to maintain a stream). The same holds to a deceleration of the achieved status of motion. Decisive influence on macroscopic streams has the development of a bound layer at the surface of the object (adhesion) that is not evolving in this case. The spin shell of an elementary particle consists also of aether such that the Aea are rejected from the spin shell and this gives rise to an ideal streaming-around. The developing accompanying compression and depletion zones of the moving particles are determined solely by the speed and define the resistance for a change of motion. A reduction of the surrounding aether density lowers especially the compression ahead and necessarily a particle with a given defined impulse is accelerated and gains now higher kinetic energy. Thus the expansion of our universe transforms permanently Dark Energy into kinetic energy of (‘friction-free’) moving particles. This surprising finding is opposed by the experimental observations and indicates the presence of a corresponding suitable emission mechanism discussed in the next chapter, the emission of matter-waves.

A continuous ‘straight’ motion is maintained as long as no external forces are acting and as far as no additional friction forces and irregular motions are created. Friction occurs, if the pure kinetic energy can be transformed into other kinds of energy. If for instance the basic structure units of the medium consisted of sub-units (e.g. representing something comparable to molecules) and do have the possibility to excite rotation around a centre of the

units or the possibility to oscillate relative to that centre. In an analogous way friction may be created, if due to the streaming around within the moving objects itself additional internal oscillations of sub-units or additional periodic deformations could be excited. Within this context the motion of elementary particles with unitary acting spin shells is considered that move through an aether of indivisible and indistinguishable structure units, so obviously the validity of the corresponding axiom of Newton is always fulfilled.

With very high speeds of the elementary particles the equalising mechanisms or streaming around, respectively, become more and more ineffective. Stronger local obstruction or jam phenomena of the medium, considerably changing local Aea-densities and/or deformations of the shape of the particles have to develop which will be recognised as an increase of the initial mass. While in the direction of motion of an elementary particle an enhanced density of aether is developing, necessarily behind a zone of depletion is created. Because the regions of compression/depletion are in contact to the spin shell (with high rotation speed), those regions may get a dragging and develop also a corresponding rotation. Starting with a critical energy of the whole structure such regions could develop to independent structure units representing ‘hollow spin shells’, possibly as soon as 137 times the rest mass of the electron is realised.

In collision reactions it might be possible now to get separated neutrinos. Thus a high-relativistic electron could exist as a three-lepton-system within the aether (neutrino-electron-antineutrino). Dislocations in crystals are characterised by a core and two regions lying opposite to each other with positive and negative strain (material compression/depletion). Isn’t it remarkable that also or just dislocations - as another quasi-equivalent ‘macroscopic’ system - show a relativistic behaviour approaching their maximum speed? In both cases opposing strain fields have to move through an elastic medium, which gives clear hints to the very special properties of the aether.

Due to collisions with external neutrinos there might be an exchange with such of higher or lower energy into the three-particle-system (see orbital ‘splitting’, effect of the electron neutrino). The neutrino collision could also happen such a way that the spins are cancelling each other, leaving behind e.g. a jam-zone without rotation (spin) and results in a three-part-structure being a boson. In effect this might be seen comparable to a neutrino ‘emission’. The consequence for such relativistic triple-structure-units might be the fact that there could be different ‘resistance effects’ or interactions with the aether along the direction of motion and orthogonal to it. Relativistic particles could be characterised by some kind of longitudinal and transversal mass (prediction of Max Abraham, 1875-1922). In modern physics there seems to be only a determination of the transversal mass, typically using the measurement of the path within a magnetic field. However, the relativistic three-particle-structure probably always orients itself parallel to the actual direction of motion or accelerating field and thus on

principle alone the ‘longitudinal effect’ is accessible. Thus the most promising experimental prove for the existence of an aether could perhaps be given through testing anomalous oscillation behaviour excited with high frequencies orthogonal to the direction of accelerated relativistic motion.

In addition it is thinkable that by the influence of external fields, field quanta or collisions the orientation of the three spins to each other is changed and now one or two of the neutrinos are forced to ‘equatorial rotations’ around the particle. The up to now pure translation of the particle would get this way an additional strong relativistic component of rotational momentum. Such a complex would get a warped path and the whole complex would tend to the formation of a relativistic orbital (effect of the Muon-neutrino)?

8 Photon structure - Photon creation

Photons are characterized by seemingly contradicting experimental facts. Definitely they have to be understood as transversal waves, however they may appear as circular polarized. They cannot own mass, however they carry momentum and energy. Despite of transversal character they show spin 1, helicity and in addition transfer into their direction of translation rotational momentum to material objects. Large numbers or fields of photons may show properties like electric or magnetic fields. Photons are characterized by a permanent change between the electric and magnetic status. They do not age and according to the theory of relativity they should have a size of zero, and so on. Thus it is very difficult to give a consistent description of all properties simultaneously and above all this also a plausible mechanism, how they could be generated with the help of considerably smaller electrons and again how those elementary particles could be generated by photon collisions with photons being several orders of magnitude larger than the particles. Therefore up to now photons have to be understood as unique entities without internal structure and mechanisms, simply being ‘quanta’.

With the new understanding of electromagnetism given in the previous chapter arises the possibility of a consistent and detailed model of the photon that explains the seemingly contradicting experimental findings. Using those ideas it is possible to give some first internal mechanisms and structures. Within this understanding the electric field is generated by the emission of mass-less longitudinal photons (LP, tiny regions of dynamic space warp) with momentums, energies and actions within the sub-h-range. The phenomenon of electric action is realized by the radial impulse components of the LP. Radial means in general the motion with respect to a special reference system, which in the case of photons can be only the translation axis. Thus within this context radial means any arbitrary transversal motion with respect to this axis. The ‘electric field oscillation’ of a doubtless spatially restricted

dimension demands the oscillation of a restricted, finite number of LP with new collective properties, the generation of LP-swarms by an up to now unknown mechanism with selection, compression and emission. Unless there exists external strong space warp, individual LP would solely move straight till infinity excluding any oscillation.

Because the magnetic action means within the new understanding the tangential motion of LP (rotational momentum), there should be - due to some collective interaction with the aether - a continuous change to a pure rotation of the LP-swarms around the translation axis of the photons. Within this try only some kind of convection-like motion of the swarms can be taken into consideration, a movement or stream that might be supported or even caused by an internal rotation of the swarms. In general such a continuous change of the direction of swarm motion can be imagined only within a surrounding, friction-free carrier medium, i.e. within an aether having elastic properties (high-speed-elasticity). With such ideas it is immediately possible to combine transversal oscillation with rotation, spin and helicity as well as the possibility of a transfer of rotational momentum and to explain in addition the involved permanent change between electric and magnetic action. The starting pure motion of the swarm away of the translation axis (electric oscillation) will be increasingly bent and continuously transferred into a pure rotation (magnetic oscillation). The further turning round of the swarm motion results again into a pure transversal oscillation back to the photon axis and so on.

According to this understanding the wave train of a photon were given by equidistant LP-swarms (LPS) moving with a displacement of 180° (with respect to the axis) to the adjacent swarms. The individual swarms follow within a plane projection along the photon axis the line of the figure eight, where the ‘crossing point’ of this ‘numeral eight’ is related to this axis. Because the dominant additional motion of the swarms is given by the translation of the photon as a whole along the direction of the axis, the ‘eights’, the paths of the swarms ‘circulating’, have to be seen as extremely stretched and torn apart along this axis. Accompanying a photon during a parallel flight in the way Einstein did in his mind, there is the surprising result that one realizes no standing still of the time, there is no static appearance. During this parallel flight any selected individual swarm undergoes a permanent running through and changing between the electric and magnetic state (transversal motion to the axis <> rotation around the axis) - it is the view of the above projection now seen along the plane of projection. The paradox of the hurting of the Maxwell equations during the parallel flight or within the reference system of the photon is dissolved with this model (within the previous understanding using such a reference system e.g. a static electric wave mountain would be observable that is not created any more by the change of a magnetic field).

It is obvious that the path run through by the swarms is longer than the one of the photon as the complex unit as a whole. Thus it is a necessary demand that the swarms of sub-h-quanta have the ability to travel with superluminal velocity. If it might be possible to force the swarms of a photon to travel predominantly in forward direction the photons modified in such a way would travel with a speed faster than c. Using for instance microwave photons that are forced to move through a strongly narrowed hollow space wire system (‘tunneling separation’ of LPS and accompanying matter wave) it was indeed possible to transfer signals for example with e.g. a speed of about 1.7c also modulated with music-signals that were then received superluminal but strongly distorted [20]. Here one might debate if this was a true superluminal transfer of information. Nevertheless, this transfer is experimentally proved and at least a transfer of energy with such speeds is demonstrated. An explanation within the frame of present physics is nearly impossible (usually a difference due to phase and group velocity with a peak-shift is tried), but within the view of a sub-h-physics the observations can be easily understood by separate, more or less straight motion of LPS and the unchanged travelling longitudinal matter-waves during tunnelling and their later mutual re-coupling (compare also the end of this chapter).

The speed limit of light is a border valid for any motion in the ‘world of matter’ (nature) inclusive transversal photons (as a structure unit as a whole). A different, larger speed limit seems to exist for the field quanta, the longitudinal photons of the sub-h-physics. Thus the speed for spreading of static electromagnetic fields and their quanta should be superluminal too. With those new insights it should be obvious in addition that also the speed of the spin shell rotation has to be superluminal. With spin ½ for elementary particles a restoring situation is achieved by a rotation with 4p. This is usually visualised using e.g. cones rolling over cones, the rotation of a Möbius stripe or of connected belt buckles, all being not truly convincing. If two colliding photons initiated a 2c rotation (appearing necessarily imaginary within our matter world), there is a maximum frame dragging close to the shell and no dragging far away and there is also a distance where the dragging rotation with c is reached allowing now the access within usual physics. Achieving a full rotation of this ‘dragging horizon’ would mean now two rotations of the particle.

Due to the up to now practised education in physics the assumption or acceptance of superluminal velocities appears on the one hand to be completely impossible. On the other hand it seems to be no problem at all to accept for the spreading of sound within all known media that do allow the propagation of longitudinal and transversal waves (elastic solids) different speeds for both phenomena (direct or indirect transfer mechanisms). Here the ratio of longitudinal and transversal speed v_l/v_t is - depending on the special kind of medium - always between about 1.5 (e.g. for Be) and 5.4 (for e.g. Mg). Accepting an elastic aether (being at least pseudo elastic) that necessarily has to realise transversal and longitudinal

phenomena, it should be a trivial expectation that here again the speeds for the spreading of both wave phenomena have to differ in a completely analogous way. For photons as a whole (being essentially transversal wave phenomena) and LP or LPS (representing basically dynamic local space warp regions or aether density changes, i.e. longitudinal phenomena) different speed limits have even to be expected. In no way such superluminal motion has to be confused with that of hypothetical tachyons. Nevertheless such phenomena appear to be 'imaginary' within the frame (equations) of our 'matter-world'.

Usually electromagnetic radiation is emanated via accelerated motion of charge carriers. Excluding photons creating photons, on principle this needs the action of an external force that is available only within the neighbourhood of matter. Any Matter is constructed by charge carriers and therefore permanently emits longitudinal photons, field quanta, irrespective of a balanced (neutral matter) or imbalanced total emission. As far as this acceleration is related to the speeding up or down of free, unbound electrons the external action forces the orientation of the spin to the direction of the external force or field. The accelerated particles are characterised by a surrounding electromagnetic field that during the interaction with the external field quanta gives rise to a dilatation/weakening/'pushing away' of the field at the front spin-pole of the particle and opposite to a corresponding compression, as far as the field quanta do possess the expected mutual interactions. Electromagnetic fields behave as some kind of 'elastic unity'.

The own surrounding field of the accelerated particle shows some (geometrical) similarity to the magnetic field of the earth that preferably allows the penetration of charged particles actually only at the poles. A somewhat comparable behaviour is thinkable for the entrance of corresponding external field quanta at the spin-poles where it should be possible to reach the total-reflecting spin shell. This should be realised at least for such LP that correspond to the kind of the majority-LP of the elementary particle considered. As far as the field quanta reach the accelerated particles with their spin axis exactly ahead they might penetrate and reach the spin shell causing a sliding around it. If the pole is precisely oriented to the external field the dilatation and opening of a narrow channel through the concentration and retroactive jamming of the external field quanta within the 'field funnel' should be possible and thus gives rise to the entrance while a sufficient tilting of the spin axis causes a deformation of this channel and its closure. Due to the interaction of both fields the field compression at the 'rear' realizes a closure at the opposite spin-pole.

The short time 'storing' of the penetrating LP is possible, if it is assumed in addition that the emanated LP-pre-stages in the vicinity of the spin shell (near field) are generated in the beginning without or with low mutual interaction forces. Only after a certain distance of travel and evolution they might develop sufficient interaction possibilities. Despite of the lowered density of field quanta with growing distance to the spin shell the developing mutual

interactions should cause - beginning with a certain distance - a completely ‘dense’ reaction of the emission field (far field). Thus this would force the captured external LP then to be reflected and to circulate around close to the spin shell until there is again an opening or weak spot in the field, allowing the emission. There is a ‘double-mirrored’ near field layer (spin shell <> completely ‘closed’ LP field) with sufficient internal hollow space to allow a certain transparency for the captured external LP. Nevertheless this layer contains large amounts of LP-pre-stages giving rise to impulse transfers, interactions and necessarily causes jamming and concentration of the (one times) circulating external LP in their direction of motion around the spin shell. This is a further step in the formation of a swarm. After the concentration within the field funnel orthogonal to the direction of motion now the compression along this direction is realised.

The retardation force on the penetrated circulating LP and the developing formation of a compressed swarm during the motion over the spin shell surface has to introduce a corresponding reaction force to the electron or spin shell. This results with the growing number of involved entering LP into a growing rotational momentum to the particle orthogonal to the spin axis. The spin axis of the electron is continuously rotated out of the direction of motion. The collecting opening or field funnel starts to close with a sufficient tilting of the axis - depending on the density of the external LP field. This intercepts any further penetration of external LP. Now a swarm with beginning and end has formed that is at least smaller than the electron size. As soon as the fully developed and highly compressed swarm reaches after a complete circle around the spin shell the former entrance opening, the concentrated momentum of the swarm is sufficiently strong to force a breaking through despite of the still tilted axis, giving rise to the emission of the swarm. This removes the cause of the tilt and the axis re-orients towards the direction of motion of the electron. The formation of a new swarm is possible. The emission of the swarms transfers recoil to the electron and the emitted radiation has to be seen as real Bremsstrahlung in the direct sense of the word. The emission into a special, unique direction connected with well-defined recoil is an unavoidable necessity to the explanation of photon emission. The orbiting around the spin shell during the swarm generation along the rotating surface of the shell (effectively an action as magnetic field) should transfer an internal self-rotation to the swarm as a whole.

Because the motion of the spin axis back into the starting orientation is necessarily bound to the property of inertia of the particle, the motion of the axis will go beyond this position and the next swarm that forms has to circle the spin shell the other way round. The result is an oscillation of the spin axis. In addition the particle with its rotating spin shell has to be realised as a gyroscope. Thus the rotational momentum orthogonal to the rotation axis necessarily has to give rise simultaneously to a permanently changing precession of the axis. Realising the resulting complex sequence of the motion of the spin axis to the photon axis

one recognises immediately the line of the ‘numeral eight’. The emission of the LP-swarms, the emission of the Bremsstrahlung is related to the process of spin-precession-oscillation. The only imaginable, plausible low-level mechanism of emission of photons by accelerated electrons results exactly in the photon structure that necessarily has to be expected due to the experimental findings (see above). The necessary extremely high precision with respect to frequency and frequency stability of the emitted photons is realised through the motion of the gyroscope with ultimate accuracy. It has to be emphasized that such a photon model can be valid only with a lower limit of validity of the theory of Quantum Mechanics. Such a limit of validity for very small dimensions of space, to small amounts of matter demands the replacement of vacuum fluctuation by an emission mechanism of longitudinal photons for the formation of the static electromagnetic field.

Though it exceeds the frame of this paper it should be at least mentioned that as well any accelerating field as the surrounding field of elementary particles is generally given by two different kinds of LP (surrounding majority and minority field). In the above given discussion the minority field is neglected but gives rise (especially in case of positive acceleration) to effects that cannot be neglected. Especially this demonstrates that there have to be indeed photons and anti-photons. However, they do differ neither with respect to amplitude, phase or frequency nor with the transferable momentum or energy.

The most decisive item of the emission model is the fact that the source of the photons can be fairly small. Nevertheless the resulting sequence of oscillating swarms, the photon, reaches a spatial dimension that is by orders of magnitude larger. Solely by the interaction with the aether, with its jamming ahead during some kind of ‘projection’ of the rotating swarms into the aether creates the finite, much larger width of oscillation of the emitted LP swarms (LPS). Due to the special two-fold symmetry of the generated (stretched) ‘numeral eight’ there is a clearly preferred direction (fixed within space) with respect to the photon axis or translation axis that appears to be a transversal character, though at the vertex points there exists only rotation of the swarms around the axis. The distance photon axis <> vertex has to be understood as the amplitude of the photon (photon kernel).

Photons seem to act as a unitary structure unit within our material world but represent a very complex system composed of many swarms that itself are realised by numerous synchronised and compressed LP (any LP representing a small region of dynamic local space warp). Those longitudinal photons tend to make way for or repel each other. Thus obviously the flowing apart of the swarms has to be suppressed by the complex dynamic high-speed interaction with the aether that on the one hand jams the Aea ahead but at the same time retroactive holds the LP compressed into swarms. The existence of photons is therefore only possible through the permanent motion with the speed of light. A stream of LP (electric field) gives rise to a total momentum transfer that is unchanged if the field quanta

are arranged inhomogeneous, e.g. within LPS. Thus a field of LPS (within a field of photons) shows the same effect as the usual electric field with individual LP. But while the LP can move solely ‘straight’ lines, the LPS are able to change the direction, to oscillate.

Though photons cannot be influenced with respect to their energy by homogeneous static electric fields just such an interaction with a field definitely exists during the process of their formation. This is obviously demonstrating that photons are build up via field quanta and that a further incorporation of such quanta is possible and indeed happens. Therefore photons cannot be explainable by usual electromagnetic waves which would move away of the generating electron definitely without interaction with the external field. All this may be clearly obtained by the thorough analysis of Kropp’s thought experiment [17]:

> An electron is shot orthogonal through suitable arranged holes within two parallel metal plates. It passes without any influencing. Now a homogeneous decelerating field is applied between the plates and the electron is slowed down. It has to emit a photon. The photon energy is given by the potential difference passed through. The difference may be realised via a longer or shorter distance and with a steep or flat gradient. The electron is decelerated quasi-continuous. Wavelength, frequency and amplitude can be determined solely by the gradient at the very entrance into the field. Photon and electron do not ‘know’ how long the field will act. The photon (at least its leading structure unit) has to separate from the electron and to run ahead. There cannot be an exchange of information between them. With increasing distance passing through the field the number of half-waves is growing. However, not this number is determining the energy of the photon but the wavelength or frequency. Consequently the frequency of the leading photon part away of the generating electron has to increase continuously with the potential difference overcome, till the electron has passed the whole field. If the electron is knocked out earlier or annihilates between the plates with a positron additional photons are created but the photon of the Bremsstrahlung stays now unchanged with respect to the energy or frequency from that point of time on. It has realised a final potential difference, though the photon is still running through the unchanged electric field.

Within the frame of classical electrodynamics a homogeneous static electric field ($dE/dt = 0$, $dE/dx = \text{const.}$) cannot have any influence on the energy of electromagnetic waves and the above given thought experiment with increase of frequency proportional to the passed way through the field cannot be explained. However, the experiment considered above necessarily demands such changes at least as long as the photon is under the condition of generation and ‘coupled’ with the electron. A photon cannot be an electromagnetic wave in the direct sense. A valid model of the photon has to be able to explain the above considerations. As far as the electric field is based on a continuous but stochastic stream of

longitudinal field quanta (LP) and photons consist of units with compressed field quanta (LPS) it is obvious that approaching LP can enter the leading LPS structure unit even through the accompanying compression-zone of LPS and may be incorporated on principle. Due to the high aether density in the jam-zone the LP are strongly reduced in size and compressed.

If further field quanta are incorporated into the leading LPS structure unit, the LP density inside is growing and the ability of the whole structure unit to jam the aether ahead is increased. The interaction strength with the aether enhances, the ability to 'turn round' grows. That means the frequency of the oscillations is continuously increasing. The energy of the photon grows with increasing number of additional captured LP. The only remaining open question arises why this described effect is not realised as soon as the photon travels alone (without the electron generating it), if the separated photon is travelling through the doubtlessly unchanged static electric field.

If the leading structure unit of a photon were able to capture all entering LP and thus to screen completely the space behind the LPS it would be impossible to generate further half-waves or LPS. It would be on principle possible to generate photons with actually any energy. LPS are characterised in the forward direction by a jam-zone. Necessarily this demands in the opposite direction a zone of depletion that gives rise to suction forces. Even if this depletion zone were characterised by an event horizon (Gamma-quanta) the LP (being primary longitudinal aether structure units) would be able to pass it in the outward direction. The standard condition for a LPS should be the equivalence of capture and loss of LP during the travel through an electric field. To enable the incorporation of further LP into the LPS unit it needs a deviation of the equilibrium between jamming and suction.

This deviation is introduced by the much more extended jam-zone of the electron. It allows the building up of the leading structure units of a photon at all, always starting only with a much lower density of LP inside of the LPS. Even if there are various LPS in between the leading unit and the electron, this distortion is given further across the whole cascade of alternating jam- and depletion-zones. Only after leaving the field (or annihilation), without any support with further half-waves, the photon and electron are finally separated, because the electron has to lag behind with a speed on principle slower than that of a photon. Now all entering LP are built-in only for a short time period and then are given further from LPS to LPS till the end of the photon and are here given back to the field. Thus the photon doesn't undergo any more any changes even travelling through the same electric field.

Reducing the aether density in the surrounding (e.g. due to the expansion of the universe) the ability of interaction of LPS with aether is reducing and their width of oscillation is growing. The wavelength is increasing. This is usually interpreted as the stretching with the

expansion. If a photon is moving into a gravitation field the aether density is reducing too. The photon should show a red shift, but the opposite is observed. This is a clear hint to the fact that gravitation is much more than simply static reduction of the aether density (space warp). Gravitation is initiated by the permanent electromagnetic emission by matter, the radial emission of LP independent of an existing charge balance. Effectively a photon is penetrating even with neutral matter an electromagnetic field approaching neutral matter (with exactly balanced ratio of both kinds of LP) and incorporates LP into the LPS (such as discussed above). However, there exists always in addition a gradient of the aether density and thus the ratio of 'incorporation and loss' is distorted. The end of the photon moves always within a higher aether density than at its head. There is a permanent incorporation of LP and the photon gets a blue shift.

The considerations with respect to the emission or generation of photons given up to now allow already a general first understanding of the basic mechanisms. However, in addition the far-reaching interactions of both fields have also to be taken into account. The creation of the swarms comprises only a small fraction of the LP of the external, accelerating field. The majority acts as an elastic unity to the total field of the particle and will oppose the tilting of the spin-axis of the particle field. The resistance is the stronger the stronger the accelerating external field, the higher its LP-density. Such as a pendulum within a weak gravitation field gives rise to slow oscillations with wide amplitudes or fast and narrow oscillations within a strong field, there is a comparable analogy for the spin-precession-oscillation. High-energy photons are created via strong (or effective strong) external fields with high LP-density. They are characterised by small amplitudes and high frequency and in addition by a high density of LP within the swarms. With this - as experiments clearly demonstrate - obviously a linear relation between frequency and energy is realised (E = $h\nu$).

The discovery of the above given relation represents an enormous progress within physics and is meanwhile well-accepted basic knowledge of any physicist. Unfortunately it never became basic knowledge that this important relation can be only valid if frequency, amplitude and swarm-density occur with fixed relations to each other; achieved solely according to the alone possible kind of 'natural production' of photons. In consequence this means that the above given famous equation cannot be valid anymore for relativistic photons. With this term such photons should be understood that are received by relativistic moving objects. Thus due to this very special reason those photons realise a red or blue shift. A typical example may be the allegedly expected impossibility of relativistic space travel due to unavoidable and basic reasons. The usual argumentation assumes the photons of stars or even the cosmic background radiation to reach such strong blue shifts that the (relativistic) photons become hard Gamma-quanta being deadly or finally destroying any material.

Such an argumentation is at least partly wrong because the relativistic length contraction applies only to the direction of motion. Therefore definitely the wavelength and frequency of the received photons is changed, but the amplitude and the number of LP per swarm remains completely unchanged. Thus there is a somewhat increased energy of those relativistic photons. However, the achieved total energy and especially the cross section for reactions with matter is much lower than the energy and action of naturally generated photons of exactly the same frequency. With respect to the above-discussed kind of space travel this misinterpretation is of fairly low importance at the moment, but a completely analogous misinterpretation with respect to the action of cosmic radiation has recently developed to a seemingly unsolved mystery.

An essential part of the cosmic radiation consists of high-energy protons. Those protons should have (according to the above-discussed misinterpretation) an upper limit with some 10^{19} eV. The sources of such high-energy particles are expected to be placed outside of our galaxy and might most probably be given by far-distant Quasars (AGN, active galactic nuclei). However, protons with higher energy (up to 10^{20} eV) could be detected definitely several times. For such protons the photons of the cosmic microwave background radiation (CMB) gain already such high blue shifts that the frequency reaches the one of very hard Gamma-quanta. Gamma-quanta with the same frequency cause on the earth the excitation of protons (into a higher energy level, Δ-excitation). Thus seemingly also the photons of the CMB should cause those excitations resulting in a deceleration. With the well-known density of the CMB photons a relatively short range (with respect to cosmic dimensions) of high-energy protons is a necessary consequence, such that those protons should never be able to reach the earth. With the above given sight with respect to relativistic photons this puzzle can be easily resolved. The considered ‘relativistic Gamma-quanta’ still own the same amplitudes as the original microwave photons.

Though there should still remain various open questions or even many new open questions arise, the obtained new ideas to the structure of photons should allow a further approximation to the mechanisms of pair creation and in consequence to the structure of the electron. The motion of the LPS within the photons results in a jamming of the aether in front of those moving structure units, which in turn keeps the LP-swarms compressed. But necessarily this causes behind the LPS a zone with depleted aether-density (the real existence of a high-speed-elastic aether taken as a fact). Starting with a critical energy of the photons (0.511 MeV) this zone should be that much depleted that around this region an event horizon has developed, the borderline to Gamma-quanta is crossed.

As far as the leading swarms of ‘colliding’ photons meet each other in a suitable way, such that the accompanying depletion zones of the meeting swarms can swallow each other, it is possible to capture and localise both swarms within the now common micro-cavity (compare

top of fig. 4). The passing through of the swarms through the event horizons outwards is impossible. Photons are hold back by an event horizon and the swarms are their basic structure unit. Important within this try of a model is the fact that the resulting particle has now a size many orders of magnitude smaller than expected considering the amplitudes of the creating photons. Effectively the involved depletion zones represent extremely small but strong and highly local dynamic space warp regions. All LPS of a photon are strictly following the depletion trace left behind by the leading structure unit determining the frequency, path and distance of the following LPS. In addition it becomes obvious that probably only the leading structure unit is able to develop an event horizon. At least as long as a fully developed swarm is leading the photon.

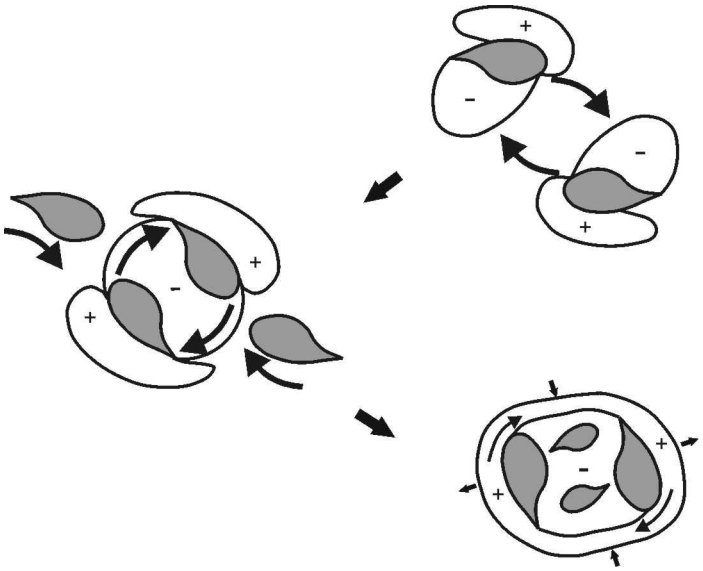

Fig. 4: Schematic two-dimensional representation of a possible interaction of longitudinal photon-swarms (LPS; grey) with possible stages of the electron and spin shell formation. The given signs in the diagram are related to the aether-density with respect to the usual environmental average density of the aether.

The first two LPS of the hitting photons that are captured within the now generated common micro-cavity are forced to rotate along the event horizon orbital-like around the centre of the cavity. The compression zones of enhanced aether-density accompanying the LPS should very soon separate from the LPS and spread around the cavity. They will try to balance the extremely low density existing within the cavity. On the one hand the involved Aea tend to proceed tangential to the cavity with superluminal speed but on the other hand due to the strong aether-gradients they are forced to move towards the centre. Within this context it should be mentioned that the forces existing in the neighbourhood of the event horizon are enormous and belong to the strongest actions that are possible at all within our universe. Nevertheless there might develop a suitable force balance. Thus the formation of a spin shell with maximum possible aether density is conceivable.

Obviously the density exchange of the cavity with the jam-zone is not only prevented by the centrifugal force but is also opposed by the captured LPS. They will occupy any position of the event horizon for at least 10^{30} times per second. By doing so they are pushing the jam-zone-Aea (spin shell) towards the outside. This gives rise to a deformation of the spin-shell locally but also as a whole towards the outside and increases or maintains the cavity volume. Finally there develops a closed spin-shell rotating separate and independent of the stochastic, orbital like motion of the LPS in the interior.

At the beginning the orientation of the spin-shell axis is solely determined by the starting conditions during the first meeting of the colliding photons. After the development of a sufficiently far-reaching LP-emission field there might be an interaction with external fields or following LPS of the colliding photons. The stochastic motion of the LPS in the interior is considerably influenced by external interactions in a direct or indirect way. They are transferred through the spin shell due to the interactions with numerous neutrinos or elementary particles, reflection of uncountable numbers of external LP as well as changes of the local aether-density during the passage of other photons (not even collisions) in their environment. Though the model of vacuum fluctuation (as a cause) is strictly refused within this paper, any volume element of the physical vacuum is nevertheless changing all the time by strong stochastic variations. The picture developed by the model of vacuum fluctuation is in some sense justified, but this behaviour has a completely different origin. The fluctuations are not given by the constraints of the indeterminacy relations. They are simply induced by uncountable physical structure units of usual or even sub-h-energies and impulses. With this understanding the physics of very small regions of the physical vacuum cannot be seen as high-energy-physics anymore.

The complete development of the spin-shell needs a certain time. Thus there should be the possibility for the immediately following LPS to penetrate the cavity too. However, the extremely fast rotation of the spreading out highly compacted jam-zones around the now generated common micro-cavity should allow only a partial penetration and thus a cutting of the following LPS. Merely a fraction in the order of 50% (with respect to LPS-energy) might be captured by the micro-cavity (see fig. 4). The remaining parts of the LPS should slide away or will be reflected by the yet partially closed spin-shell, creating afterwards the antiparticle. The captured partial-LPS have to occupy another inner ‘orbital’ with higher energy because the outer ‘orbital’ close to the spin-shell is already fully occupied. Due to the mutual interaction of all LPS to each other only a common ‘tuned’ but stochastic motion is possible within the ‘orbitals’. With those ideas or concepts not only the extremely small dimension of the electron with respect to the amplitudes of the creating photons is achieved. In addition there is now the circulation of a stochastic varying but effectively static (only restricted radial oscillating) group of LPS relative to the spin-shell. This circulation

necessarily gives rise to continuous changes of shape or size of the spin-shell (see symbolic arrows in fig. 4, bottom) and those deformations result in a permanent density variation of the aether environment - the emission of LP of different kind.

While the deformation of the spin-shell by the outer, complete LPS gives rise to a massive compression of the aether around the electron (emission of LP with enhanced aether-density) the partial-LPS in the inner ‘orbital’ cause a corresponding but weaker indentation of the shell, initiating the emission of LP with reduced aether-density. There exists now a considerable asymmetry between emitted high-pressure and low-pressure LP (realising a certain kind of charge). Within the anti-particle the occupation of the outer ‘orbital’ with partial-LPS has to be expected and the orbital motion of full-developed LPS in the interior. Thus the necessary asymmetry for the emission of LP is nearly completely reversed and the generation of fields through charge carriers with different kinds is realised. The obviously existing asymmetry between inner and outer ‘orbital’ slightly disturbs the symmetry for the strength of emitted minority-LP and majority-LP. A disturbance comparable to the one discussed already in chapter 7 causing the additional real transport of aether away of the elementary particle into infinity, i.e. the generation of the action as gravitation (a special kind of space warp; static long-range aether-density-gradients).

To realise the formation of the antiparticle (positron) the electron has to be pushed away fast enough after its creation by an impulse orthogonal to the direction of photon collision. The simultaneous generation of electron and positron is completely impossible. With a mutual distance in the order of their diameter ($< 10^{-22}$ m) the necessary energy for their separation (potential difference to overcome) would be too large and would be in the order of at least GeV or even far above, while definitely 1.022 MeV are sufficient. Already this fact is speaking against any possibility of their simultaneous creation. It needs a sequential formation with a minimal distance e.g. in the order of the half wavelength of the reacting Gamma-quanta, needs the already existing motion of the electron before the positron is created (that following its initiation also gradually develops/spreads out its field).

Pair creation demands the action of a sufficient component of the photon impulses orthogonal to the direction of collision and this in turn needs a certain minimal tilt of the photon axes to each other. While obviously a tilt in the order of e.g. 10° should be still allow a mutual LPS-capture, the minimal tilt might be estimated roughly by the collision of Compton photons (maximal limit of tilt for the minimal energy of photons creating a pair). During the time for the approach of the second half wave (the corresponding second LPS) the electron has to be moved by at least one diameter. It can be shown that the tilt of the photon axes to each other should be larger than 10^{-8} - 10^{-9} degrees. Though the probability of ‘perfect’ collisions (tilt to each other smaller than 10^{-9} degrees) is very low, in such cases only the

creation of an electron should be possible and the remaining photons might be simply reflected at the generated spin shell. Within this sight there could be a tiny excess of electrons causing a weak negative total charge of our universe and possibly might allow solely the formation of electronic partial-universes.

Because with the above given mechanism of pair creation only a fraction of the photons is consumed it is obvious that their residues are necessary for the acceleration and final separation of the particles. To achieve this, the LPS have to excite in a completely reverse mechanism the spin-precession-oscillation of the particles. The LPS have to be dissolved again into individual LP during the circulation around the spin-shell, an interaction with the near-field-LP being somewhat comparable with erosion, and the freed LP will be spit out as a divergent LP-beam. This accelerates the particles away of each other with individual pulses like with a rocket jet propulsion. Within the acceleration mechanism of electrons by photons the erosion mechanism is obviously limited. For very dense and compact LPS of hard X-rays or Gamma-quanta only a fraction of the LPS seems to be eroded. The degree of erosion should depend furthermore on the precise position of the entrance into the near field with respect to the spin axis. The remaining partially eroded LPS are - due to their concentrated momentum - able to pass the opposite spin axis position. Thus the electron is accelerated but in addition a photon of lowered energy but varying direction is emitted. All this is well known and described as Compton effect. Due to the constraints of energy and momentum conservation it seems to be like a collision of comparable elastic particles.

Though fig. 4 gives only a first, rough representation of the structure of the electron, it supplies at least some basic ideas via which way such tiny elementary particles could be created by photons (particles with a size several orders of magnitude smaller than the amplitudes of the generating photons). The created elementary particles are definitely capable of LP emission and formation of a surrounding emission field that in turn allows the interaction with external fields or field quanta to produce exactly those photons of the demanded kind. All this has to be seen in comparison to the present sight with respect to elementary processes. Here the elementary particles and photons are considered as structure-less units that are formed via definite global laws of nature and given energy. A sight tightly bound to the traditions of the school of Copenhagen. Presently - and according to the existing energy-mass-equivalence - energy is here in effect considered as a ‘medium’. A ‘medium’ that according to non-explainable, everything determining laws is ‘transferred or transformed’ into photons, electron-positron-pairs, Quarks or any other pairs of possible physical structure units. However, the abstract and general term ‘energy’ can take on only definite, special forms of energy, especially the intensity or strength of motion (also collective motion) of physical structure units (including aether components) or their spatial relations to each other (potential energy) and can never be a ‘medium’. Of course under the conditions of

energy conservation the transformation of various kinds of energy into each other are possible, but as soon as energy must not be something like a medium, always definite, detailed transfer mechanisms are necessary.

The structure of the electron that was evolving above within this chapter turned out to be a structure unit without any rigid appearance. Within the frame of certain limits it is stochastically changing its shape. Thus due to a very fast motion through the aether the particle has to develop compression and depletion zones in front and rear, that on principle cannot be stable or static over the time. The permanently changing zones have to give rise to a retroaction on the electron and its orientation of the spin axis. After a certain process of initiation there has to develop a stable precession of the spin axis. The contraction and depletion zones represent extremely strong regions of space warp. So their periodic pulsation necessarily forces a retroaction to the surrounding aether, necessarily resulting in the emission of longitudinal wave phenomena. The wavelength of the oscillations is dependent on the velocity, more precise on the momentum of the electron and usually known as de Broglie-waves or matter-waves.

An essential finding for a sub-h-physics, evolving with the considerations resulting from the internal photon structure, is the necessary superluminal velocity for all primary (longitudinal) aether structure units like LP or LPS (structure units of matter are more complex and therefore of a secondary or higher type) being necessarily of longitudinal character and thus represent local but dynamic space warp. The precise determination of this new limiting superluminal speed is impossible at the moment; it has to be expected in the range of at least about 2 - 3c. With such a new speed limit it is obvious that there will be not only (longitudinal) wave generation into the rear direction of the moving electron (there might be an amplification by Karman vortices) but also ahead into the forward direction even for relativistic motion. The concept of a ‘preceding wave’ or pilot wave is not really new within Quantum Mechanics (de Broglie, Bohm) but could not succeed up to now due to the expectation to have no range of validity of Quantum Mechanics and the seemingly necessary restrictions of Relativity Theory. However, the concepts developed within this paper strongly indicate that the statements of the theory of relativity are only valid for structure units of the ‘matter world’ including photons as a whole, where c represents the speed limit of transversal phenomena. The mentioned special longitudinal phenomena of sub-h-physics are able to generate waves even running ahead of photons.

The emitted waves in forward direction are of longitudinal type. That means they generate strong changes of the density of the aether and this has also to be understood as space warp. Thus in retroaction the motion of the electron is influenced and modulated by those emitted waves (Zitterbewegung). In turn again the generation and emission of the preceding longitudinal waves is influenced. The creation of the de Broglie-waves is characterised by

highly complex interactions (mutual feedback). The path of the electron should follow the path of (averaged) minimal aether density ahead. However this will be impossible in general. Due to uncountable interactions (with field quanta of other matter, external influences of gravitation, collisions with neutrinos, near passage of electrons or uncountable photons and the totality of all matter-waves) any electron will be always distorted. The ‘optimal path’ can be only achieved by a permanent approach of this path after the manifold disturbances. The dynamic space warp regions of the preceding de Broglie-wave thus effectively represent and determine solely the residence probability of the free electron. Usually within Quantum Mechanics the influence of this preceding wave is described by the square of the y-function without a chance to realise there on the first sight the inherent ‘imaginary’ superluminal character.

Though any electron represents in reality a particle that is able to interact effectively via its direct impulse it is always accompanied by its preceding or backward acting periodic space warp structures (and of cause its field). Any elementary particle is necessarily acting with both mechanisms; it is always characterised by something like wave-particle-dualism. Depending on the kind of interaction or measurement the one or the other interaction is dominating. This fact is generally well known, but only by the assumption of an elastic aether it becomes understandable in general.

For an electron that is approaching a double slit, first of all its preceding wave of space warp is passing through and is diffracted correspondingly as any other kind of wave. It forms behind the double slit an interference pattern of locally differing space warp. Irrespective of the selected slit the electron is later passing through, it has to follow a further path that fits this space warp pattern. Which actual path is selected out of the optimal paths possible in general depends on the probabilities of the permanent external influences and on the very special but accidental impulse during the passage of the selected slit. Even for a very low density of the electron beam with only sequentially passing individual electrons the destination points on a target are always stochastic, but also always determined by the space warp pattern at the position of the detector. On a photo-plate blackening points will appear stochastically. With increasing time or number of electrons passing through, i.e. with increasing number of used paths out of the possible ones, the space warp pattern will appear more and more clearly with the periodic pattern of blackening points.

Within the present understanding of the wave-particle-dualism of electrons both properties are seen directly related within space and time, i.e. the explanation of the experiments with the double slit demands necessarily the non-understandable interference of the single electron with itself. Only with the acceptance of an aether with corresponding sub-h-properties and the resulting superluminal, preceding waves (indirectly described by the square of the y-function) the double slit experiment becomes understandable in a logic way.

Exactly the same considerations can be used performing this experiment with individual photons. Also the totality of the periodic sequence of travelling LPS (kernel of the photon) can be understood as some kind of particle. The dimension is limited within space and stable over the time. Again those oscillations (transversal) will produce emissions (longitudinal) into the surrounding aether that spread out superluminal. The only difference is given by the on principle alone possible constant speed of such 'particles'/photons and by an identical frequency and phase of the photon and its accompanying superluminal, preceding or surrounding wave. Also in this case the preceding space warp wave is diffracted at the double slit and determines the motion of the kernel of the photon.

Having the superluminal motion of preceding space warp waves in mind (and of cause in the same way such ones spreading out orthogonal to the direction of the photon), mysterious 'far-distant actions' between distant photons can be understood in a simple and logic way (entanglement, via splitting of a formerly common photon field). Already before the splitting of synchronised photons there exists a very wide spread accompanying synchronised longitudinal wave-field that spreads superluminal. Following the splitting this wave-field will exist effectively nearly unchanged irrespective of the now separated photons. They all will equally maintain the field being in phase. It will further 'lead' now all photons irrespective of their separation. Analogous effects are resulting between coupled spin systems following their separation (Einstein-Podolsky-Rosen-effect).

As soon as an elastic aether is accepted, it is a trivial expectation that again as in elastic solids the speeds for the spreading of longitudinal and transversal wave phenomena have to differ (longitudinal [de Broglie-waves] and transversal 'aether sound' [light, photons]). With this conclusion in mind the acceptance of an elastic carrier medium (aether) would force in a direct way that elementary structure units of matter have to show a non-local behaviour, some kind of wave-particle-dualism, via the unavoidable generation of accompanying, coupled, much faster, superluminal, longitudinal wave phenomena. The assumption of the existence of an elastic aether directly forces a non-local behaviour according to quantum mechanical rules for elementary units of the matter world. Thus the reverse conclusion should be also valid: elementary particles can be described solely by Quantum Mechanics, therefore they should move within an elastic aether. The energy of the accompanying longitudinal aether-sound-field (matter-waves) of elementary particles and photons is obviously comparable to their inner energy and thus for instance a photon is in general a non-local unit of photon kernel and accompanying longitudinal wide-spread wave-field. With comparably high energy-content a diffracted 'leading wave' is able to determine the further direction of motion and initiating this way also the formation of orbitals.

If an electron is bound or localised by a proton it cannot be in rest but has to circulate or oscillate in some way around it. All the time it is emitting longitudinal (space warp) matter-

waves that cannot just vanish instantaneously but are again and again overwritten with emissions from other positions and with other wavelengths, depending on the momentary speed and position of the electron. A fading three-dimensional space warp pattern has to develop around the proton. This pattern needs special conditions to be averaged stable over the time. Obviously the frequency of circulation needs certain conditions such that the averaged path length (circumference with Bohr radius) is correspondingly related to the wavelength of the emitted longitudinal waves - the circumference has to be a multiple of the de Broglie-wavelength (being reciprocal proportional to the particle momentum) at least in case of radial symmetry. A situation that is well described by wave mechanics or by the Schroedinger equation. The particle tries to move now along optimal paths or within 'optimal regions' forced by a three-dimensional space region with minimal or strongly reduced time-averaged aether-density supporting the localisation by the binding forces. However, countless external distortions demand corresponding re-adjustments to such paths, giving rise to nothing more than a range of probability of stay for e.g. an electron that we usually describe by the term orbital for localised particles.

Summary of chapters 6 to 8

In general it is presently assumed that Quantum Mechanics is characterised by an unlimited range of validity (and with this also the indeterminacy relations). The resulting consequence seems to be the possibility of the model of vacuum fluctuation. Within this part of the paper such effects are investigated that have to occur for the only other possibility: also Quantum Mechanics is limited by a lower range of validity and thus based on a sub-h-physics. Again this concept is not giving rise to contradictions with physical reality, but results in a thorough and better understanding. In contradiction to the Copenhagen interpretation characterised by philosophical arguments this gives rise to a causal and logically understandable physics where as well local variables as non-local processes are influencing. All this seems to allow the solution for the 'big puzzles' of present physics. The assumption of solely non-local behaviour would exclude the existence of hidden or local variables, but already the reality of wave-particle-dualism is opposing this assumption.

With the chosen alternative point of view it is completely impossible to maintain the mechanisms of vacuum fluctuation. Thus the explanation of the static electromagnetic field demands necessarily the emission of mass-less, momentum carrying, dynamic structure units. This is the only alternative to transport actions now. It means a reduction of their density with the square of the distance. The total energy of the field is exceeding by far the

energy equivalent of the rest mass of the electron and the emission proceeds further continuously without reducing the rest mass. Thus there has to be on principle a ‘decoupling’ of particle and field. There has to be (irrespective of the possible details) a friction-free motion of structure units in the interior of the electron that cannot be energetically influenced from outside in a direct way. This motion is extremely fast and for very short periods of time changing the volume or surface of the particle. Furthermore there has to be necessarily a surrounding medium where the fast deformations of the surface introduce or excite local variations of the density that move away as mass-less, momentum carrying, longitudinal photons (LP, dynamic space warp regions) radial into all directions.

The surrounding medium - with regard to historical views named aether - has to posses opposing, contrary properties. On the one hand it has to allow at least quasi-friction-free motion of matter and also continuous expansion (striving from a state of high density to one of lower density; usually interpreted as expansion of ‘space’). This means it should have gas-like properties. On the other hand the medium has to realise transversal waves (photons) and thus to own the property of elasticity usually solely related to solids. To solve this conflict the concept of high-speed-elasticity is introduced (starting about with near-relativistic motions) with obstruction phenomena and compression/depletion-zones. In contradiction to real gases the ‘fine-material’ structure units have to own real and strong interaction forces between each other. They always have to repel their neighbours. This allows on the one hand the presence or existence of vacuum energy and on the other hand the striving for permanent expansion (Dark Energy, negative gravitation, ideal electro-fluid without charge). A composition with smallest structure units, called aether atoms (Aea), causes necessarily the existence of smallest space and time dimensions (e.g. Planck-length) for a matter world based on such a medium.

Hereby any action is generated primarily via pressure or density changes initiated by dynamic processes. The density changes (dynamic space warp regions) are related to considerable local changes of the vacuum energy. The LP emitted by the elementary particles posses - with respect to the average density of the environment - an enhanced aether density (negative local space warp, LP^-) or a reduced one (positive local space warp, LP^+). Both kinds of LP are emitted with different ratios by the particles being complementary to each other (e.g. 2/3 LP^- to 1/3 LP^+ for an electron) but in each case with a reversed ratio of majority and minority LP for the antiparticle. Therefore in a first approximation the sum of LP^+ and LP^- of an electron-positron-pair is zero (neutrality). The density of the radial momentums reduces with r^{-2} and this has to be understood as the electric action. The emitted LP are emanated from independent rotating spin shells. Thus they are simultaneously characterised

by an additional rotational momentum and the corresponding transferable momentum components are reducing with 1/r and this has to be seen as the magnetic component.

Due to a weak asymmetry within the internal structure of the elementary particles, the LP are generated in such a way that the sum of annihilation of LP^+ and LP^- results in a tiny excess of Aea being clearly different from zero and positive. Thus with the emission of the electromagnetic field-quanta (LP) there is simultaneously a depletion of the aether around elementary particles that cannot be completely balanced via a permanent back-stream. It develops a static density gradient - a 'funnel of density' with radial symmetry - that is usually described as space warp or gravitation. The Aea are repelling each other, so in general any structure unit of matter is forced to move towards the region of lower aether density (action of gravity, moving from a region of higher to lower vacuum energy).

Though the structure of photons and electrons suggested within this paper still comprises hypothetical assumptions and imply various open questions they are already able to enlighten essential and fundamental relations. In a consistent way they allow an explanation of the emission of field-quanta (LP), their compression via electrons into the basic structure units of photons (LP-swarms, LPS), the generation of electrons and positrons by photon collision (and capture of LPS) and also the acceleration or deceleration of electrons via spin-precession-oscillation during photon absorption or emission. Of special importance is here the introduction of tiny LPS as structure units of the photons that allow the generation of electrons with a size more than ten orders of magnitude smaller than the amplitudes or wavelengths of the creating photons.

With all those considerations it might be possible to give a first general understanding of our matter world respectively nature: We probably are living in a world that essentially consists only of photons or their internal sub-components. By a general 'principle of orbitals' nature is able to generate that what we call mass or matter by localisation processes 'formation of orbitals' of direct or indirect kind. Because all structure units of matter have to move through an elastic aether it is no surprise that they unavoidably have to generate accompanying longitudinal waves (matter-waves). In general they will be much faster (superluminal) in elastic media than transversal waves. The former courageous and experimentally manifold proved generalisation of de Broglie with preceding, 'leading' matter-waves or pilot waves could have led us already somewhat earlier to such a conclusion.

9 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 gravitation. 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 gravitation 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 considered 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 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 to occur with the emission of a neutrino (process 1) because in the cosmic reality this process occurs with a collapse accompanied by strong neutrino emission, also 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 (compare 3.1, 3.2). 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 → n_e in fig.5). 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 allows even the formation of nucleons being either bosons (spin = 0, 1, …) or fermions (spin ½ …).

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 → p in Fig. 5 (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 if there are sufficient external neutrinos. The formation of 'true' neutrons should be expected to have priority. Of course 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.

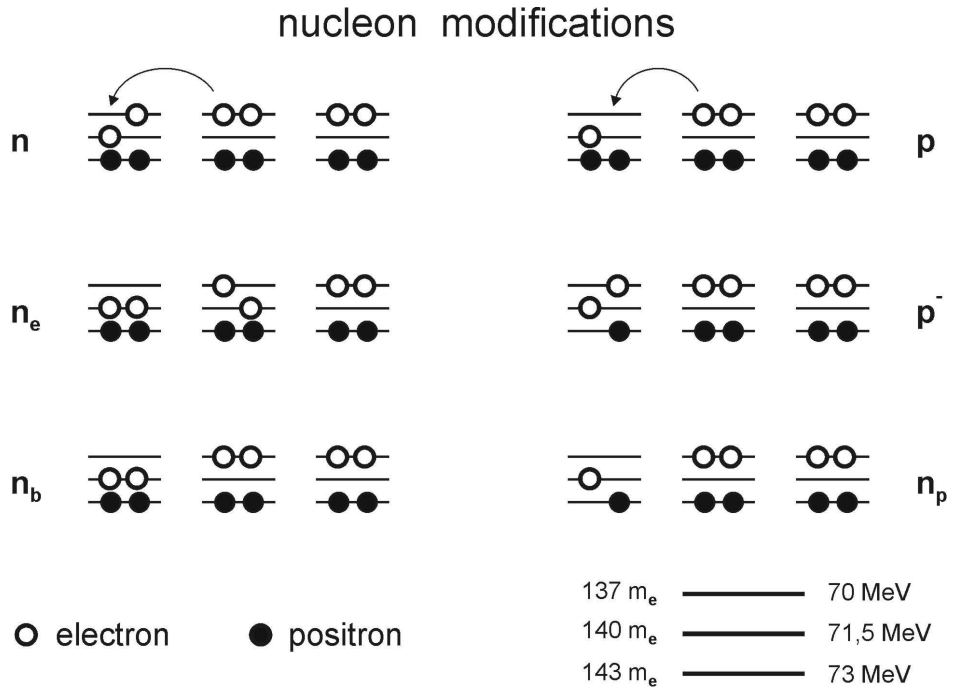

Fig. 5: Scheme of occupation states of the Quark orbitals of the tree Quarks (without spin orientations) within different kinds of nucleons. In the lower right the corresponding lepton energies within the lepton orbitals of the three Quarks are given. The cyclic exchange processes of the relativistic 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 true 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. 5). It can only be transformed into a true neutron or proton by a suitable subsequent absorption of Pions or Muons.

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/total mass the neutrons are characterised by very high speeds. Contrary to the degenerated electron gas the 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 $p \rightarrow n_b$ in fig.5). 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 heavy neutron stars or the matter-core 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.

As a consequence any further increase of the 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 momentum 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 may 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 kinetic 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 [21].

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.

10 Singularity-free 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 billion times a typical galaxy mass) through orbital jumps cannot proceed till infinity. Because the diameter of the outer electron orbital of a Quark was determined with $4.1 \cdot 10^{-17}$ m (compare chapter 3) the size of the smallest possible excited Quark orbital (smallest neutron diameter) has to be in the order of about $5\ldots4.4 \cdot 10^{-17}$ 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 the matter wavelength or orbital diameter. It represents due to a maximum pressure the maximum density of baryonic matter with about $2\ldots4 \cdot 10^{22}$ kg/m^3 (assuming minimum nucleon size and high-dense sphere packing) 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. The previous chapters 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 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 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 13.7 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 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 the 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 the internet presentation [21]). 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.

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 with local static aether density gradient via Aea-transport (permanent ‘pumping’, see chapters 6 and 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 (status of ‘embedding’). The newly developing matter can oppose this expansion 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 (in case of lagging behind of 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 a motion with the speed of light has to be seen as extremely ‘slow’. Any still existing matter in the interior or any re-materialising matter on principle could follow a very unusual field distribution - the ‘gravitation field’ first seems strongly to grow outwards radial with increasing distance to the centre (fig. 6, arrows).

The gradient to the still existing strong outer field is enormous and represents a second, reversed event horizon. 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 inner 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.

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 necessarily distorted presentation of a past (a), the present (b) and a future state (c) of our universe in Fig. 6).

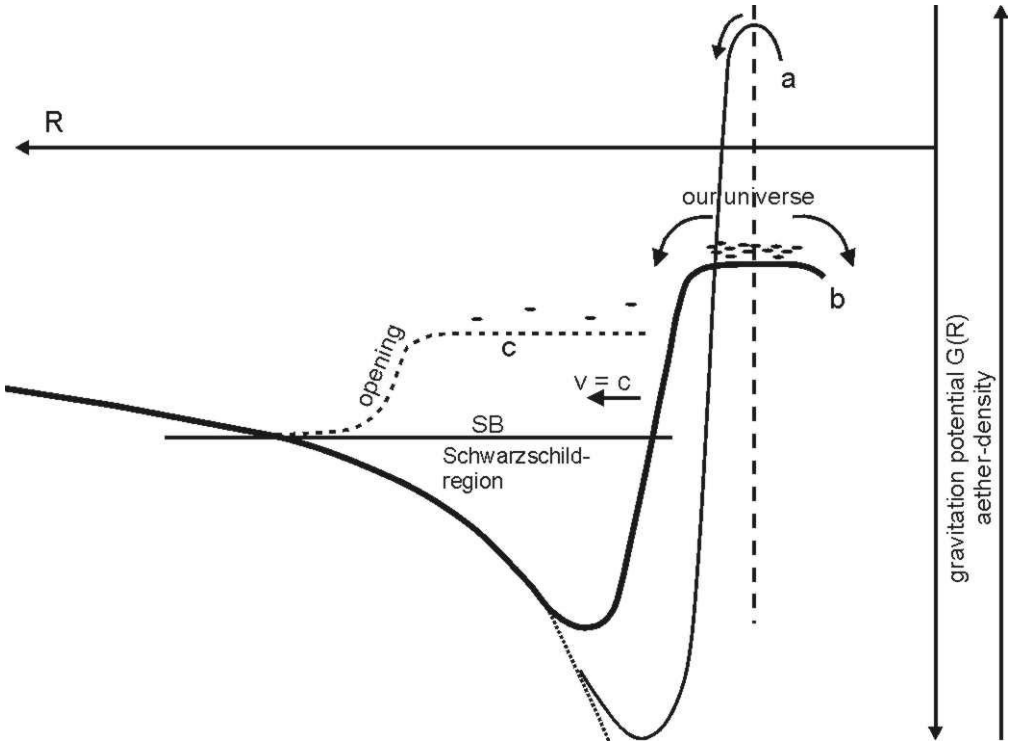

Fig. 6: Purely schematic presentation of the radial gravitation potential G(R) or aether density of 'our universe' in the 'early past' (a), at present (b) and for a future state of 'opening' (c). According to the extreme ratio of the dimension of inner and outer regions, as well the axes as the relations 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.

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 considerably 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 about 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 transformations in its partial regions. This is caused by two basic opposing mechanisms: the everlasting effect of gravitation 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 gravitation 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). The process of annihilation is noticed within experiments solely 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 remains unnoticed up to now.

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 course 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 $E \circ 70$ 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 very early gravitational density fluctuations visible today 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 momentum density. Only a small fraction of Quarks can be heated up adequate. If three Quarks with sufficiently high speed (close to 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 were true the direction of development would be determined in general.

Based on a nuclear physics with orbital substructures it is therefore possible to interpret the experimentally observed expansion phenomena of our universe including Dark Matter and Dark Energy at least qualitatively. Of course 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 these 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 inner 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 matter and energy - necessarily has to cause in long terms 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 still dragging expansion and having now only very weak mutual gravitational interaction they are emitted into the eternity of space. Finally 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 and places within the steady-state-universe. An expansion progress of our partial universe that reaches the average density of BH of the whole infinite universe 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 new matter concentrations over eons due to collisions or capturing of massive BH. They all are usual residues and cogent cause again the formation of extremely massive BH, which are acting as dominating attraction centres.

Because the direct collision of BH has a low probability 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’ having 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 everlasting concentration processes, 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

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 decades, for the first time an anomalous non-understood acceleration of the vehicles into the direction of the sun was detected and measured starting 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 taken as free uncharged Quarks such as discussed in the previous chapters 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 no spin and no 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 about $0.51 \cdot 10^{-27}$ 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 last 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. [22]). Taking all acceleration producing influences into account an increasing deceleration was detected starting about at the position of the path of Jupiter (related to the detection limit at that time) and reaching a final value beyond the path of Saturn. Then it was constant over many years with a value of:

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

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 of the Direct Structure Model - 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 a 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 this 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 over longer distances). A successful impulse transfer is only possible hitting the nucleus. The expanse 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, binding distance) only one is hitting the nucleus.

To get the probability of an impulse transfer of a fast-moving Quark to a Quark in the orbitals of a nucleon first of all the probability of Quark-Quark-hitting is necessary. According to the considerations in chapter 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. Within the basis orbital the circulation frequency is given by $1.4 \cdot 10^{22}$ s^{-1} (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^{-1} should be taken. During one circulation two hits are possible and there are three Quarks in the nucleon. In case the orbitals would fill the whole sphere of the nucleon there will be 7200 meeting possibilities per transit ($1 \cdot 10^{-19}$ s $\cdot$ $1.2 \cdot 10^{22}$ s^{-1} $\cdot$ 2 $\cdot$ 3). In a proton the transit time through the Quark orbital shell represents about 30% of the total transit time, thus in effect there are about 2160 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 Quark-orbitals and a somewhat higher circulation frequency the hitting probability for a neutron is close to 45%. With Quark velocities below or close to 10 km/s (nearly 'thermal', corresponds about 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 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 gain within hot matter that much kinetic energy that 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:

$$F_B = \Sigma \Delta p \qquad (A1)$$

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.

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

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

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

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:

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

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 related to the fast rotation speed of the galaxy as a

whole with speeds higher than the sound velocity of the gas (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 roughly $1.6 \cdot 10^4$ cm^{-3} (1000 atoms/cm^3 · 5 · 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 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 for 36.7 km/s is $N_I = 6 \cdot 10^{10}\ cm^{-2} \cdot s^{-1}$.

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

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

This estimated force of deceleration is smaller than the measured one by a factor of nearly three. As a primary source of error first of all the estimate of the average density of Quarks ρ_Q might be discussed. Taking for instance a size of the radial capturing region of the sun using the average of the nearest neighbours (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 true 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 a constant gas density within long terms the deceleration power has to decline till the constant final speed is achieved. The strength of transferred impulse 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

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

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 $-\ 6{\cdot}10^{-8}\ \mathrm{m/s}^2$, 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 reducing by about 20% between the paths of Saturn and Uranus. However already within this region a constant deceleration was observed. 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 of the probe).

Concluding it is possible to state that using a Direct Structure Model of Matter and an estimate of a least density of 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 Dark Matter of about $1.6 \cdot 10^5\ \mathrm{cm}^{-3}$ 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 attraction. 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 compared 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 a small and more probable a negligible one.

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