

Part 1

Hypothesis of orbital structures in all levels of nuclear physics

Direct Structure Model of matter

Concept of a new basic physics

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Abstract

Even the summary of all present experimental results concerning the substructure of nucleons still allows a different interpretation of the internal structure of matter. The up to now ignored and since decades forgotten alternative, investigated within this paper, assumes non-elementary quarks with substructure units and results in a Direct Structure Model of matter. That means this model considers only structure units that are indeed set free during experiments and possible to investigate in a direct manner. Prerequisite for a realisation is a general principle of orbital formation that holds for any atomic or sub-nuclear dimension. The great advantage is a model with logical structure that uses only photons, electrons, positrons and neutrinos in contradiction to the Standard Model (with 30 basic units). 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 gravity. Strong and Weak Interaction will be shown to be only effects related to the inner dynamics and structure of quarks. A model that considers orbital structures in any level of matter allows the prediction of the quark size with $4.1127 \cdot 10^{-17}$ m. Monitoring the peak of the strength of wide-angle scattering at quarks by electrons with energies close to 30 GeV could prove this (measurement of the quark size). Contrary 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 and realises again the quantification of charge with entire numbers of the elementary charge. Introducing a space-filling medium with some kind of elasticity explains Dark Energy, the mechanisms of gravity and its relation to electromagnetism and the general basics for Quantum Mechanics. In addition first crude models of photon and electron were achieved.

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1 Introduction

The progress in high-energy physics (use of Bi-Jet-collisions, electrons with protons) has shown that also nucleons, equally well as atoms, 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 within the nucleons. 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 [F. Abe et al. Physical Review Letters 77 (1996) p. 5336]. 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) [R.E. Taylor, H.W. Kendall, J.I. Friedmann, Review of Modern Physics 63 (1991) p. 573-620]. 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 has to be expected and therefore actually they should not be assumed as being elementary (for truly elementary particles only an extremely small upper limit of size can be obtained).

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 (elementary) 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 one 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 the 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 $2/3$ with spin $1/2$ each) to the total spin $1/2$ of the proton where Down-quarks show no spin. It created the so-called 'spin crisis' of the Standard Model and forced the invention of a dynamic version see e.g. [M. Düren, Physik Journal 7 (2008) nr. 11, p.18]. Despite of all efforts to include even the angular orbital-spins of an assumed highly complex quark-antiquark-gluon-structure the new Standard Model is up to now unable to give a satisfying explanation of the total spin of the proton (thus there persists a permanent spin crisis of the model). Because both kinds of quarks are orbitalised within comparable dimensions, a compensation of the spin by the

angular orbital-spin for Down-quarks should cause a comparable compensation for Up-quarks too. However, this was never detected.

Furthermore there seems to exist a non-explainable problem concerning the measurement of the proton charge radius of about 0.85 fm that possibly differs clearly and sufficiently for hydrogen and muon-Hydrogen (see chapter 4). With the assumed dominating positive-charged and elementary Up-quarks within the proton their motion has to be influenced by the action of external negative charges (for instance in case of the negatively charged electron shell). This had to influence the size of the 'charge radius'. Compared to ordinary Hydrogen within Myon-Hydrogen those negative charge carriers of the shell come now much closer to the proton by orders of magnitude. This had to attract the Up-quarks much stronger and effectively to increase the charge distribution radius. But just the opposite was measured and published - the alleged charge distribution seems to become smaller and demonstrates that there could be something wrong with the Standard Model. The position variation of charge carriers within the proton (measured via the width of spectral lines or Lamb-shift) thus could only be related to position changes of negative charges. Therefore the corresponding measurements should not concern the expected so called charge distribution radius that is presently interpreted as the proton size (and this is in contradiction to the experimentally determined sizes of heavier nuclei).

New theoretical considerations to the spectral distribution within the lines indicate however that the published data probably have to be corrected and give rise to values comparable to those obtained by help of Myon-Hydrogen (Inclusion of unoccupied levels). This means the influence of the shell on the relativistic orbitals within the proton should be insufficient with respect to the measurable size. Thus probably only the enormous difference of the charge distribution radius to the results using electron scattering at protons within the 1 GeV range (see chapter 3.1, fig. 2) as well as the measurable size of atomic nuclei allows hints for a proton structure different to that assumed up to now (chapters 3.1 and 4). The present model STM ignores the experimentally observed 'shell' structure of the proton (reaching proton radii up to 1.9 ... 2.2 fm) obtained by scattering experiments with electron wavelengths being in the order of the proton size.

With the development of accelerator techniques at the end of the 1950s, electron wavelengths in the fm range could be achieved for the first time and used for scattering on free protons (hydrogen nuclei that are not deformed and compressed in the nuclear compound by strong interaction). Using electron wavelengths of approx. 5 ... 0.5 fm, three internal shell structures were observed, whose outer 'shell' has its maximum at a radius of about 1.8 fm (structure sizes can be determined from the given momentum/wavelength and the scattering angles). Only a few years later, the development of the Standard Model (STM) began with the basic assumption that quarks should be elementary - initially for many years

without direct evidence of their actual existence. It is a normal procedure to look for confirmatory experiments and practically only these are cited in the following or further new experiments for the newly developed model have been launched.

Since the development of the STM took place over many decades, this ultimately results in an (unconscious) permanent selection with regard to the consideration of the experimental database. The scattering experiments mentioned here were to be understood as 'neutral' or not relevant for several decades, as there was initially no serious significance for the development of the STM. Thus, for new generations of physicists in this field, they ultimately remained ultimately unknown and practically completely lost from view. After it became possible to determine the influence of the proton interior on the passing shell electrons from the high-precision measurements of the Lamb displacement, a charge radius or proton radius of 0.84 fm could be determined - but only based on the assumption of elementary quarks and the assumed reality of a vacuum fluctuation - and these experiments from a long time ago suddenly become now serious importance. Its impossible that a proton with such a small radius of 0.84 fm could cause scattering effects at a radius of 2 fm and beyond!

Since the STM could in principle not interpret internal shell structures and the proton size for elementary quarks can only be given directly by the quarks' habitat, these early scattering experiments (especially with the essential comparability of wavelength and proton size) cannot be explained in any way with the STM. In contrast, the alternative Direct Structural Model of Matter DSM considered in this text (now on the basis of the remaining alternative: quarks are composite structural units) can explain both these shell structures and at the same time the occurrence of an inner spherical shell orbital for the relativistic exchange electrons now required (with a shell thickness of about 0.85 fm) and thus also explains the Lamb shift and its strength in an understandable way. For shell electrons that have to reach or pass through this shell during the transfer of the proton, there will necessarily be a transfer of momentum and energy to the exchange electrons (see section 3.1).

For the estimations regarding the observed shell structures mentioned in this text, only mean value calculations for the orbitals (via generalized Bohr radius) were used for the sake of simplification, as already used by de Broglie via standing waves for the (semi-classical) Bohr atomic model. But such simplifications are only usable for radial symmetric cases (doubtless given for nucleons or quarks). Of course, particles within orbitals must move on concrete, individual paths at all times and will thereby take all conceivable paths (given by the energetic framework conditions), forced by the permanent, disturbing and path changing influence of the density-fluctuating substrate of everything. In this process, all orbital forms with all spatial directions up to angular momentum-superimposed oscillations with crossing of the nuclei will occur for shell electrons, which ultimately results in an extended area of stay, an orbital. Such an overall description of all orbital movements (probability of residence) is

provided by the Schroedinger equation describing the energetic framework conditions (in general, there are at least 10^{21} orbits around the nucleus per second). In the case of relativistic or highly relativistic 'stiffer' orbits, however, the orbital description will have to come closer and closer to the mean value representation (decreasing relative proportion of the influencing energy of the substrate (dimension h) to the now relativistic electron or quark energy).

In addition the reverse conclusion to the above considerations to the internal spin contributions within the proton gives now rise to the statement that down-quarks (effectively without spin contribution in contradiction to the used assumptions) should be bosons (i.e. with spin 0,1, ...). All mass-carrying bosons that were investigated in reality up to now rendered to be composed structure units. Thus at least down-quarks should have a suitable substructure. This may give rise to an intended new solution with respect to a singularity-free cosmological model (part 2). This goal demands a secure (non-degenerated) accumulation within Black Holes (SL) that is achievable solely by bosonic nucleons. Furthermore those nucleons have to be balanced-composed of particles and antiparticles to get a complete annihilation (Big Bang) reaching a critical pressure due to gravity and the collapsing of the matter core of a corresponding Super-SL. Quarks that are composed (of fermions) can be bosons or fermions depending on their state of excitation and thus correspondingly excited nucleons too (unthinkable within the Standard Model).

According to their decay products (leptons and photons) and their spins, mesons (knocked out of nucleons, being always bosons) are presently described in general 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 \leftrightarrow 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 both kinds of particles can still be interpreted with the help of 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 (composed) quarks with even number of sub-quark-units (leptons) instead of being two-quark-systems.

Another problem arises for the Standard Model with the interpretation of a different kind of mesons, kaons (bosonic half-nucleons), having about half the mass of protons or neutrons.

Assuming a structure with only two elementary (indivisible) quarks (e.g. Strange/Anti-Up) the frequent kind of decay into three particles (pions) is hardly to understand and this indicates them actually to consist of three bosonic quark-fractions (e.g. three half-quarks) instead of the two-quark-system assumed within the Standard Model (see chapter 4).

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. There should be a non-understandable asymmetry between matter and antimatter due to which the matter of the universe is built up only with the extraordinary tiny residue of the former matter-antimatter-annihilation in the early beginning. This asymmetry cannot be sufficiently understood up to now by help of the Standard Model. Within this context a ratio of antimatter to matter of $10^9 : (10^9+1)$ has to be assumed and it is expected that only a tiny residuum is forming the matter surrounding us today. Thus the majority of matter should have been transformed within the starting universe into photons by annihilation. However, the observed average ratio of photons to particles in the universe is clearly smaller than $10^9 : 1$. It has to be accepted in addition that with a good probability the universe is expanding accelerated which needs the description of this evolution by a far-reaching mysterious Dark Energy, representing the majority of the total mass or energy of the universe and allowing such an expansion phenomenon (against the inevitable decelerating gravitational attraction between the galaxies).

Furthermore there is the very important problem to interpret the structure and origin of the radiation-decoupled Dark Matter. This dominating matter represents a multiple of all stars and dust of the universe together and can be detected essentially by its gravitational influence on the motion of galaxies and galaxy clusters, due to different actions as gravity lenses (e.g. within cosmic filaments) but also via the interpretation of the cosmic microwave radiation (inhomogeneous regions caused by gravity already in the early universe; impossible to create with usual matter interacting with radiation). Their constituents 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 described as far as a generally different up to now ignored and sorted out basis is assumed with a description of nuclear physics with orbital structures in all levels - with structured, non-point-like, non-elementary quarks. Such a solution should be a first choice for the interpretation of those quantum mechanical systems, because it creates a Direct Structure Model (DSM) that avoids the problems mentioned above. The present Standard Model (STM) is an indirect one, i.e. it assumes structure units that on principal cannot be set free during experiments and that are therefore not observable in a direct way. The concept presented here shows that it is possible to develop a Direct Structure Model too. It 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 (leptons), indicating to be composed of them (or emission of Gamma-rays in case of their annihilation). By help of the Direct 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, this has never seriously been taken into consideration.

Due to the extreme electromagnetic repulsion effect between protons, the construction of atomic nuclei is only possible because there is an even stronger 'Strong Interaction' between the nucleons (137 times stronger, but only short-range). For their explanation in the two only possible models (elementary quarks yes or no) there are basically different solutions. In the Standard Model, a field-like effect (mediated basically by gluons respectively neutral pions) is assumed, in the alternative Direct Structural Model, an exchange interaction by exchanging a true substructure unit between the quarks or also between different adjacent nucleons (see Chapter 3.1). What clues do the findings of atomic and particle physics provide?

In the case of an exchange interaction, two different nucleons can easily be bound to each other. However, it is also conceivable that a second neutron can be bound to a proton if an alternating bond can be established with only short interruptions in the time of bonding - i.e. very rapidly changing bonds - (3 quarks or 3 nucleons among each other). The bond of further neutrons to a proton can only be very unstable. If it were a short-range field-like effect, all structural units that can be attached close enough (assuming sufficient supply of such units) could be bound. Since up to 12 neutrons could be 'touched' to a proton (nucleons are not to be understood as rigid spheres, but as cloud-like structural units), hydrogen isotopes with a higher number of nucleons should also be observable for a sufficiently long time. However, only deuterium (^2H) is known with a stable nucleus and tritium (^3H) with some years of stability.

Thus only an exchange mechanism (no field action) can be taken into consideration for the binding of nucleons within atomic nuclei. In order to realize such kind of binding within the Standard Model, it is mandatory to implement the experimentally unproven hypothesis/assumption of vacuum fluctuation and introduce two completely different types of Strong Interaction between quarks (via gluons) and nucleons (exchange of neutral pions), respectively. This is not required in the Direct Structural Model and is realized there by one and the same structural unit (see Section 3.1). The Standard Model necessarily requires the real existence of vacuum fluctuation - both for the formation of these neutral pions and, for

example, for those of the 'sea quarks'. The hypothesis of vacuum fluctuation is based on the use of the uncertainty relations, i.e. the laws of quantum mechanics, the laws for small amounts of matter. These laws are transferred without hesitation to the 'physical vacuum', whereby this vacuum can have nothing to do with matter and should therefore be determined by its own, completely different laws (see chapter 6).

A further questionable item of the presently accepted Standard Model is the (actually arbitrary) seemingly necessary 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 and with different excitation states). Now there isn't anymore an asymmetry between matter and antimatter in the early universe; within the new model our matter is no tiny residue. In addition within this context a so-called 'hurting of parity' can be simply understood by the inner structure and dynamics of quarks.

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 or electron momentums (much shorter wavelengths and higher resolution) a Delta-function at $x = 1/3$ appears that is smeared out however into a broader peak due to the inherent impulses of the three 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. [A.D. Martin, Physik Journal 6 (2007) nr. 8/9, p. 73].

Assuming quarks to be elementary (Standard Model), the strong increase of the structure function towards small x -values for very high relative momentums 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 (due to vacuum fluctuation 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 perhaps 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. But there should be at least some doubts that a cloud of virtual particles gets a total effect with defined extension that could initiate wide-angle scattering. 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 because there should exist an at least comparable cloud formation also within pions.

Accepting quarks to be non-elementary (Direct Structure Model) - i.e. there is a real substructure of quarks - 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. A high-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 as an equivalent alternative.

For thousands of years mankind knew only one elementary structure unit - atoms - the 'indivisible'. However, with the development of sciences they showed to be non-elementary, to be composed structure units. Their nuclei rendered to own also a substructure composed of different nucleons. With the large progress in high-energy-physics now also nucleons proved to be composed. They are definitely build up by three sub-units named quarks differing in some way to each other. At this point it had to be first of all an open question if those quarks represent now final elementary structure units or if they still are composed units. At this point a strictly scientific procedure demanded the parallel investigation of both possibilities; to elaborate with their comparison an optimal and complete description. But the simpler solution of elementary quarks was chosen - actually per definition - and alone this sight was developed further despite of different opening problems (e.g. fractional charges, spin of the proton, proton size, Dark Matter, matter/anti-matter asymmetry ...). The present paper tries a first step to clear off this deficit though with nearly six decades delay. However, the impulse for this investigation came from a completely different field, from cosmology. The laws ruling the universe and its possibilities of development are necessarily determined by the inner structure and properties of matter.

The evading of an on principle non-acceptable singularity in the beginning and the preventing of an eternal thermal death as the future of our part of the universe seem strongly to demand the up to now ignored second possibility for the interpretation of the structure of quarks (see part 2). To achieve a correct description of the experimentally observed reality with this second possibility (Direct Structure Model) the highly localised high-relativistic electrons within the quarks have to take on within their orbitals a mass of 137.036 times the one of their rest mass. With this it is now also possible to get an immediate and direct understandable interpretation of the probably best known equation of physics (more than 99% of all matter surrounding us is now alone given via kinetic energy as relativistic mass increase; chapter 7 indicates that the still missing rest mass of the leptons should be finally caused by rotation energy):

$$m = \frac{E}{c^2}$$

The Standard Model - historically originated much earlier - was developed over decades by the contributions of thousands of physicists to a stage that realizes today a model seemingly consistent in itself and its 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 quark-energy), needs no asymmetry matter/antimatter in the early universe and has an essentially simpler basic structure with only two kinds of elementary particles and only one kind of quarks with different excitation states and needs now only two basic fields/forces (gravity and electromagnetism). Furthermore the well known quantification of charges is realised only using integer numbers of the elementary charge. Compared to this the Standard Model has to use experimentally not directly verifiable fractional charges. Finally always dedicated experiments have to decide about the validity of models.

2 Nucleons as quark orbitals

Within the field of nuclear physics any statement is usually obtained in an indirect way because of the validity of the indeterminacy relation - the closer a (micro-)system is investigated the stronger it is influenced - the results vary with the 'resolution'. In consequence there is a very strong dependence on the related models. Once inconsistencies seem to arise using the presently accepted Standard Model, possible new ways should be tested. A general description of nucleons and quarks based on orbitals also within non-elementary and composed quarks should be actually a reasonable idea though until today orbitals are known to exist only in connection with a central force.

According to the present state of art there are corresponding solutions for the possible orbitals of quarks with fractional charges within the nucleons on the basis of the Standard Model, which cannot be used within the search of 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. on the basis 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) as 'averaged path'/averaged orbital. A symmetry that holds for leptons, mesons, nucleons and obviously also for quarks. Such a solution is used here to obtain a suitable model using a generalised Bohr radius, 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 with standing matter-waves 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 Schroedinger 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 of 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 nuclei larger than hydrogen (nucleon distances, see chapter 4) and the fact that within scattering experiments with electrons starting with wavelengths smaller than about $2.5 \cdot 10^{-15}$ m already

'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, fig. 2) to involve surely also the third outer 'shell'.

The experimental data contained in fig. 2 are the only known **directly** obtained data with respect to the proton size (i.e. being independent of the used model of quarks), as all the different wavelengths used for electron scattering were comparable to the proton size. A size specification of the proton using the lamb shift (as much more precise as it may seem) is purely **indirect** and necessarily requires the **assumption** of elementary quarks. In addition, in this case, the further assumption of vacuum fluctuation as a reality must be demanded, which forces the laws for the physical vacuum to be equated with those of small amounts of matter in a very questionable way. Thus the starting size of the proton chosen within the iteration procedure within this text using fig. 2 represents much more likely a realistic 'measured' value. As discussed somewhat later in chapters 3.1 and 4 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 created by three quarks, the mass of a quark as a whole in the basis orbital is in a first approximation one third of the one of a neutron (including the relativistic 'kinetic mass' due to the relativistic motion within 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 total rest mass) i.e. a binding energy - Strong Interaction - via particle exchange between the quark-sub-orbitals of different quarks. 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 smaller or medium nuclei. The de Broglie- or matter-wavelength of such quarks is obtained from:

$$\lambda = h/p \quad \text{with} \quad p^2 = E^2/c^2 - (m_0c)^2 \quad (1)$$

(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 the 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:

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

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

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

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 double slit or 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):

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

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

Because the circumference of a spherical basic orbital is simply given exactly by the wavelength (condition for standing waves; $\lambda/2\pi$ represents the generalised relativistic Bohr radius), 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 quarks considered here 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 'state' of quarks determining

the distance between nucleons is indeed given by the 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:

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

Combining equations (4) and (6) results in

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

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 end of chapter 4). The resulting orbital speed is $v/c \approx 0.448$. Thus the mass increase ($m_0 \rightarrow m$) according to the relativistic motion of the quarks within their orbitals is about 11.8%. An important statement is the fact that at least about 12% of the mass surrounding us (and of the gravity related to this mass) is due to a relativistic effect (orbitally 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/necessity of excited states. The first higher excitation of the quark circulation orbitals within nucleons is generally known as the Δ - excitation for protons and should occur in an analogous manner for neutrons. 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 they increase their relativistic mass. The density of this matter clearly exceeds now the one of usual nuclear matter.

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, but 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) has 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 both papers, becomes a realistic goal if indeed a substructure of quarks appears to be a possible alternative or can be even demonstrated (compare part 2, cosmology).

3 Orbital substructure of quarks

Everything that comes out of a complex closed system had to be inside before - otherwise it needs some magic.

At medium electron wavelengths in the order of 10^{-17} m quarks do 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 our 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- or 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 the possible generation of matter following the Big Bang. (Energy, as high as it may be, is no 'substance' that could be transformed or transferred into particles.)

Both mentioned mechanisms need the preservation of momentum and therefore the Gamma-ray collision with a particle or the collision of two photons with each other. Though within our present environment the probability for photon-photon-collisions may appear as much too small, at the moment of Big bang exists such an extremely high photon density that this mechanism is able to give rise to sufficient numbers of events. Furthermore it has to be taken into account that besides 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 the consideration of electrons and positrons within the substructure of quarks.

Before checking somewhat later the demands with respect to energy and generation possibilities of quarks in chapter 4, the most important criterion is the discussion of the suggested general quark structure with respect to a suitable building-up of the structure of nucleons and this first of all has to be investigated in chapters 3.1 and 3.2.

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 below 10^{-16} m (according to the scattering phenomena even at some 10^{-17} m), while the wavelengths and expanse of the 'fields' (amplitudes) of the photons existing during or following the radiation-dominated beginning is in the order of about $10^{-12} \dots 6 \cdot 10^{-15}$ m (the presently accepted model, forced to use a singularity, necessarily expects completely different higher energy ranges, compare chapter 3 of part 2).

The motion of photons as well as the transversal oscillation starting from the central region of the photon (with whatever physical quantity or units) is given by the speed of light. The photon translation across $\lambda/4$ thus is related to a maximum extent $\lambda/4$ of the transversal oscillation process. Then this process breaks down to restart again after the motion to $\lambda/2$ 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 $\lambda/2$. Taking this relative relation into account there are extremely 'wide spread fields' (electron and quark sizes relative to the dimension of the photon amplitudes). Thus on principle photons are able to accelerate additionally both particles (electric field) against each other, give the resulting orbital complex through 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 created in general via pair creation within the new model, 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, if a concentric arrangement of the orbitals of the charge carriers of different kind is assumed. 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.

(Due to the extremely strong forces between electron and positron over such small distances an orbiting with the same sense would mean a synchronisation of the motion, resulting into an annihilation. Thus a long-time stability is only thinkable with opposite sense orbiting.) The quarks produced through electromagnetism (different charges within the same field are accelerated into different directions) have definitely the advantage of opposite sense orbiting (no resulting total angular 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 of exactly 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 an 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, angular 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 3 of part 2). Here the intermediate annihilation does not mean any loss. The 'construction material photon' is still available for the next try obviously under the dictate of an 'electronic world' (with excess of electrons as free or weak-bound particles).

Summarising a four-particle-two-orbital-system (with particles = electrons and antiparticles = positrons) is taken for the quarks, having two slightly different, concentric orbitals due to neutrino absorption/coupling. It is the task now to construct within the next chapters 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 our 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 positrons is already strongly reduced. The fact that the only production possibility of 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-out' which of course needs very high energy.

Obviously the main path of quark formation is based on the generation of 1 orbitalised concentric pair (half-quark). Afterwards the half-quark fills its orbitals within an environment with a high density of electrons and positrons resulting in a complete and neutral quark, being such as half-quarks a boson and presently non-accessible to any direct experimental investigation or detection.

Because there exists an estimate for the rest mass ($0.5 \cdot 10^{-27} \text{ kg} = 548 m_e$) of one kind or state of quark 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 'standing 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 their nucleon-orbitals; 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 $4 \cdot 10^{-17} \text{ m}$. 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 a wavelength of $6 \cdot 10^{-17} \text{ m}$. It has to be emphasised that this quark size has solely been 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 α).

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

$$F = - \frac{1}{4\pi\epsilon_0} \cdot \frac{e^2}{r^2} = - \frac{\hbar c \alpha}{r^2} \quad \text{with} \quad \alpha = \frac{e^2}{4\pi\epsilon_0 \hbar c} . \quad (8)$$

Here α is the Sommerfeld fine-structure constant or electric coupling constant, respectively. The latter relation becomes even more understandable considering the correspondingly defined electric potential term $(-e/r)$ e.g. within the Schrödinger-equation of the hydrogen atom and α representing the strength of coupling to the proton. Equation (8) is valid within this context independent 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 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 of Hydrogen (e.g. the Bohr radius $= h/2\pi m_e c \alpha$ or the ratio of the average speed to the speed of light in the ground orbital, $v/c = \alpha$) are determined by the electric coupling constant α .

For the expected quarks described within this paper there are now four moving, localised, interacting charge carriers. Thus it is also here no surprise that again the constant α should have considerable 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 $m/m_e = 1/\sqrt{1 - (v/c)^2} \approx 1/\alpha = 137,036$ allows the determination of the quark-diameter (λ/π) via equation (5) for the highly-relativistic electrons (moving in the outer orbital) as:

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

With eq. (9) $d_Q = 4.1127 \cdot 10^{-17}$ m is obtained (41.127 am). Thus optimum wide-angle-scattering of electrons at quarks has to be expected for energies close to 30 GeV. Unfortunately just this range belongs to a gap within the experimental investigations. Due to experimental and financial limits the energy of electrons reached by linear accelerators ends at about 27 GeV. To get further into the high energy region the Bi-Jet-technology was developed with its main goal to achieve energies even beyond the TeV range. The smallest energy used with this technology started however with 50 GeV.

The most surprising result with this kind of structure formation is that more than 99% of mass of baryonic matter (and therefore of the resulting gravity) 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 within core and shell. 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 relativistic mass-increase within a concentric high-relativistic two-orbital-arrangement. Again three of those quarks move now with low-relativistic speeds within other orbitals to generate the nucleons.

Within the frame of a Direct Structure Model there will be in the very beginning of a Big Bang solely the generation of individual quarks via pair-creation-mechanisms. They need the additional gain of the correct 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 angular momentum or magnetic momentum and also no total spin, free quarks are presently 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 occur to be effectively completely radiation decoupled.

As far as quarks represent indeed under normal conditions stable structure units composed of electrons and positrons, means of matter and antimatter, there has to be an upper limit of matter concentrations. As soon as the pressure via gravity within a considerable matter concentration crosses an upper limit, then those quarks are forced to penetrate each other and thus to initiate a tremendous electron-positron-annihilation-reaction that we had to call a Big Bang. A universe dominated by gravity thus offers over long times the possibility of matter concentration and therefore a pre-history for such an event.

3.1 Proton structure

Protons carry a positive charge and this necessarily demands within the DSM a deficiency in one of the outer electron orbitals of one of the the three quarks. With respect to the instability of free neutrons (they transform 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 a 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; this is only related to down-quarks). If the electron exchange takes about one sixths of an orbit of the three quarks (electrons and fields have nearly twice the speed of the quarks with only 0.45c) the developing electric (total/acting) field has solely a time in the order of 10^{-23} s before it breaks down again. Thus the maximum expanse of the permanent and complex varying **regulating** electric fields is only in the order of few 10^{-15} m within that time (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 and 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). This means that protons and neutrons can solely exist as free particles or in hydrogen. Within nuclei with several nucleons there exist only nucleons that take on the status of a neutron or a proton for a very short period of time, with a rapid and permanent interchange of this status. All this is related to a reconstruction of the inner orbitals of the nucleons (of the orbiting quarks). This fact is known already for very long times and resulted in the introduction of the term 'Isospin'.

While the binding between atoms (strength in the order of 10 eV) 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 bonding and so the strength of such bonds is correspondingly stronger and should be in the order of keV, as experimentally found (much more energy is exchanged). Here it is essential that due to the smaller dimensions within

nucleons (ca. 10^{-15} m) all electromagnetic forces are about 10 orders of magnitude stronger than with the typical distances within molecules (ca. 10^{-10} m).

Contrary to chemical bonds between two atoms (complexes of orbitals), 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) causes 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 a further possible constituent 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 or by X-Ray-emission with the destruction of the bonding that has to be expected as relatively weak.

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 only give rise to a reciprocal proportionality of the strength of the electric field:

$$\frac{1}{(R_0 + \Delta r)^2} \approx \frac{1}{R_0^2 + 2R_0\Delta r}$$

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 can result 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 di-quarks and are in effect experimentally 'experimentally invisible' (in contradiction to the instable half-quarks that decay via annihilation (2 Gamma-quanta) or setting free of one electron and one positron and this way 'visible'; up to now known as neutral pions, see also chapter 4).

The release of an outer quark-electron (during the exchange of a relativistic electron) reduces within the proton the mass (momentum) of the considered quark 1 considerably and necessarily forces different path parameters, the motion of quark 1 into an outer region of the proton (up). 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 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 building up electric field of quark 1 reaches quark 2 and once the field is strong enough it forces the jump of an electron from quark 2 coming now closer. The electron moves with nearly c to quark 1 which falls back again (down) 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) forces already the 'relativistic ionisation' of quark 1 again.

This appears to be some kind of wave-like motion of the two positive charged quarks always above the basis orbital, while the electron is moving inside the basis orbital most of the time. For the individual quarks 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 inside of the basis orbital fading radial and overlapping with an orbital of the positively charged quarks outside of 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 (basis orbital).

Already the definition of the term 'size' of the proton seems to be very difficult. If the measurement of the size uses a procedure that is mainly related to the effects of the inner part of the orbital of relativistic electrons, a radius up to about 1 fm has to be expected (presently interpreted as proton charge distribution). If mainly the action of the rigid neutral quark orbitals has a dominating influence (nucleon distances in ('small') atomic nuclei), about 1.2...1.4 fm should be determined. With a strong influence of the positive quark orbitals a value of the radius of about 1.9 fm could be realised and should already the intense electric field gain sufficient influence is even a 'measurement' in the order of ca. 4 fm (elastic electron scattering) thinkable.

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

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

The indeterminacy of the momentum with a 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 one quark and causes a corresponding 'spreading' of the orbitals. With respect to the relativistic 70 MeV-exchange-electrons this indeterminacy of the energy ($\Delta E = \Delta p \cdot c$ for $v \approx c$) 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 [Th. Udem et al. Phys. Rev. Letters 79 (1997) p. 2646] or chapter 4.

It is not the generally assumed vacuum fluctuation that causes the Lamb-shift, but the permanent variation of the position and distances of the charged quarks and the exchange electron relative to each other as well as their permanent distance changes relative to any position inside and outside of the proton. The same holds also for the Standard Model where also three charged units should move inside. With respect to the clearly smaller dimension of the electron compared to the one of the proton (carrying the same charge) the energy density of its field should therefore be much higher and thus with assumed vacuum fluctuation around an electron it actually should show fluctuation much stronger than the proton. The explanation via vacuum fluctuation thus seems to be unrealistic and the generated variations of the summed up field of the three-particle-fields close to or inside of the proton cannot be a prove of the existence of vacuum fluctuation there.

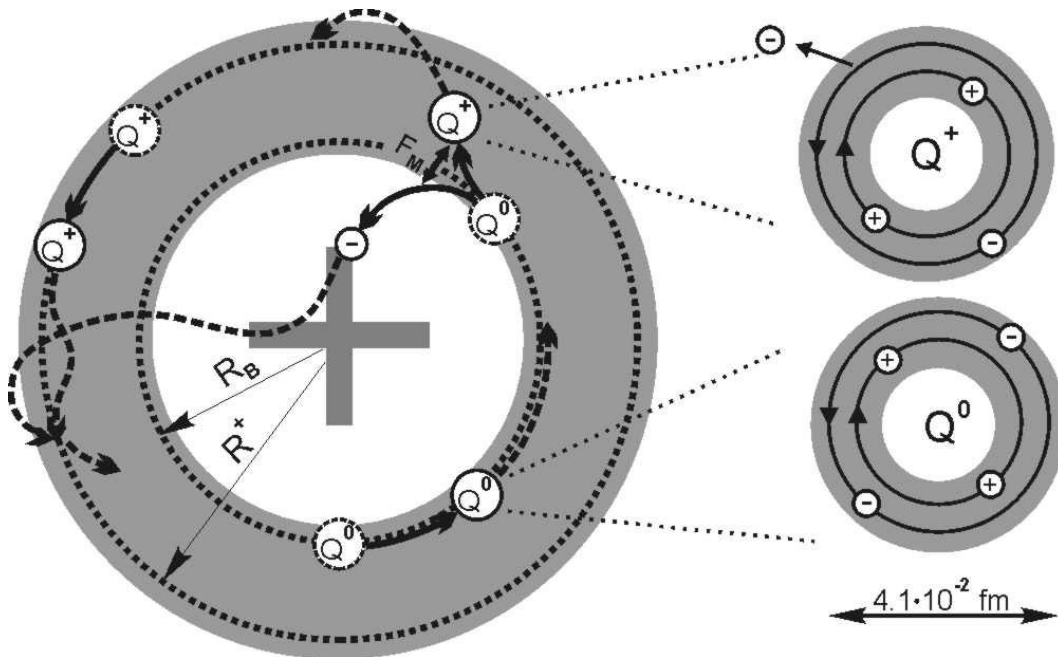


Fig 1: Two-dimensional schematic drawing of the paths of the three proton quarks (ground state, without quantum fluctuations); 'dashed quarks' at the moment of electron jump; the three quarks (full circles) at an intermediate state; dashed arrows show the most probable further paths; F_M strong magnetic repulsion forces (arrows); R_B basis orbital (about 1.4 fm); R^+ standard path of the two positively charged quarks (about 1.9 fm); on the right hand side the corresponding schematic detailed quark structures

First essential ideas about the size and structure of nucleons could be gained during the fifties/sixties of the last century by electron scattering in the 1 GeV-range (wavelength about 1 fm). Such experiments are of special importance because the electron wavelengths are now in the order of the proton size. Because at that time the understanding to a substructure with possibly clearly different masses was not a point to be considered, the interpretation was essentially based on the charge carrier density ρ according to the ideas and method 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 summarising example of such early measurements is given in fig. 2 [Grimsehl text-book of physics, publisher: Teubner Verlag Leipzig 1968, vol. IV, p. 210].

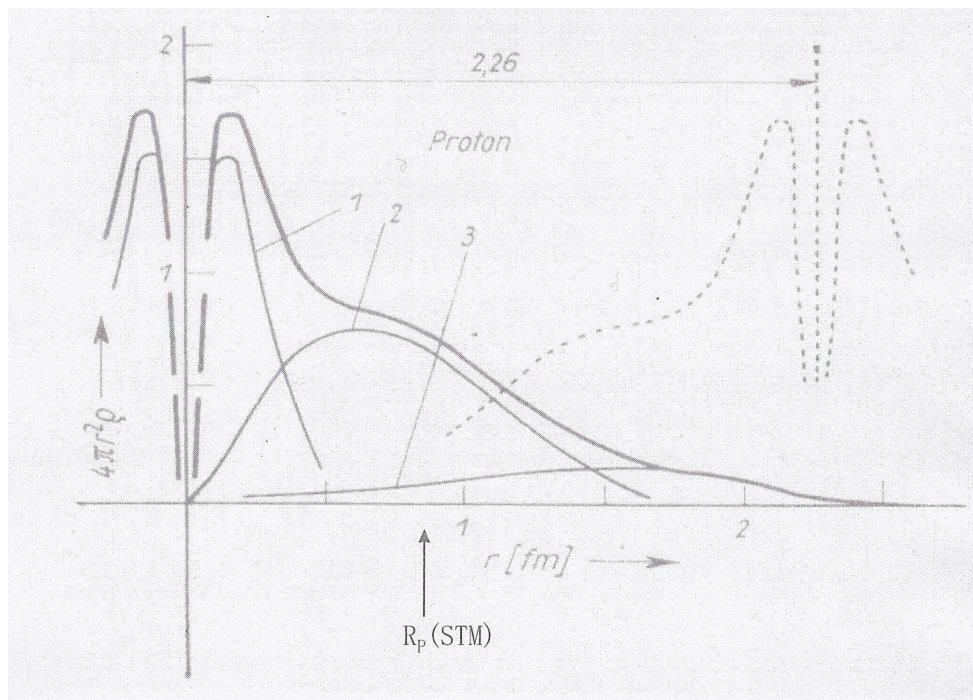


Fig. 2: Electrical charge carrier density of a proton in the ground state. Graphs 1 to 3 seem to represent internal charge shells (see text). Added the charge or proton radius R_p according to the assumptions of the STM

With the above-discussed orbital structure of quarks and nucleons it appears to be difficult on the 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 charged '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 facts cannot be simply differentiated by help of investigations using scattering alone.

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). However, the wide extension of curve 3 towards the centre should be a misconception here. The essential effect of scattering in Fig. 2 is actually only given by the relativistic orbital of exchange electrons.

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 exchange electrons have to move in the beginning into the same direction, i.e. the generated strong magnetic fields cause a force repelling them from each other (compare arrow F_M in 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 the maximum should 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 and the neutralization of the up-quarks. 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 being always nearly close to c). 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 possess a higher momentum or mass. While in Fig. 2 graph 2 is probably representing the dominating effect of the charge carrier density or 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' (third maximum) of the probability of stay of the exchange electrons due to the final stage of the electron exchange

between the quarks dominated by the strong electromagnetic fields (neutralisation of the positive up-quarks) beyond radii of ca. 2.0 fm.

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, direction-depending action of a usual charge. They are characterised by a comet-like 'charge cone'/field cone. Their action as a charge is a 'retarded' action, run-time-effects.) The dashed graphs in fig. 2 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' within the proton the author concluded the used transition of non-relativistic radial-symmetric orbitals for 'simple atomic shells' such as e.g. hydrogen with 'centre-filled, radial-fading full-spheres' into true sphere-shells for non-central-field relativistic high-mass quark-orbitals that are even further 'narrowing' in the high-relativistic case inside of the quarks. This expectation is further supported by the high explanation power achieved in chapter 4. However, most important is the fact that a proton radius of ca. 0.85 fm predicted within the Standard Model is completely incompatible with the experimental results of electron scattering in the important 1 GeV range (fig. 2).

The value R_p given in Fig. 2 for the charge radius can only be determined relatively inaccurately with 0.89 fm from the measurement of the spectral line width of hydrogen orbitals with a probability of residence in the nucleus/proton different from zero (angular momentum quantum number $l = 0$) and indicates internal charge shifts in the proton in exactly this magnitude. Since, according to the Standard Model (STM), protons are supposed to be formed exclusively by three elementary quarks, this radius must necessarily be identical to the proton size itself. Scattering phenomena beyond a radius of 1 fm or even in the range of 1.8 to 2.2 fm cannot be explained at all with such a small proton radius. By means of much more precise measurements when measuring the Lamb displacement (displacement and thus splitting of the lines of degenerate energy levels as a result of the core passage, e.g. for levels of hydrogen $2s_{1/2} / 2p_{1/2}$), more precise values of 0.85 and 0.84 fm respectively were obtained (meanwhile also adopted by CODATA). It is striking, however, that this alleged charge radius can instead be used very well as a measure for the interpretation curve 2 - which corresponds to the dominant distribution/residence probability of the exchange electron in the DSM.

With the help of the fiction of a vacuum fluctuation or vacuum polarization in a physical vacuum, it is possible to calculate the above-mentioned values (energy levels of the

corresponding spectral lines) for the Lamb shift with high accuracy with the help of quantum electrodynamics QED, which is currently also considered the most important proof for the existence of such a fiction. Three main contributions are considered: the so-called self-energy of the shell electron (as a result of the interactions with the vacuum fluctuations in the nucleus or proton, proportion approx. 98%), an influence by the effect of a vacuum polarization (proportion approx. 2%) and a small correction due to the anomalous magnetic moment of the electron.

In the DSM, too, three interaction components would have to be taken into account: the shell electron that crosses the proton is slowed down by the central orbital part of the exchange electron and then accelerated asymmetrically with respect to the direction of flight, which should produce a weak reduction in energy, because momentum transfers to the exchange electrons would also be possible. In addition, the motion of the shell electron inside of the fluctuating spherical shell of the positively charged up-quarks is influenced. Third, a very weak perturbation will arise for the electron due to the crossing of the orbital of the neutral down-quarks (basis orbital) twice. In this case, however, only close approaches will be able to have a weak effect, because the neutral down-quarks would also have a weak deceleration effect due to an outer orbital - occupied by electrons - only at a sufficiently high approach. In the case of a purely elastic interaction of the shell electrons, all the manifold acceleration and deceleration effects of all charge-bearing orbitals would completely balance each other out when they cross them twice.

The model of vacuum fluctuation/polarization is based on the use of the uncertainty relations of quantum mechanics, the physics of small amounts of matter, which are undisputedly experimentally verified. But for this fiction, these laws of matter are transferred without hesitation to the physical vacuum, the substrate of everything, though this substrate definitely cannot be matter and has to be something completely different. Thus independent laws are to be expected for this substrate. No physicist would ever think of using e.g. the laws of gases to describe liquids or solids just because they have been experimentally verified. The fact that this unhesitating transfer cannot be useful becomes apparent when an attempt is made to calculate the vacuum energy with this hypothetical model. This results in a value that is 120 orders of magnitude greater than the estimates based on astronomical possibilities regarding the vacuum energy in our cosmic environment. Furthermore, the QED succeeds in calculating the correct values of the Lamb shift, but under the assumption of a proton radius that cannot be reconciled with the scattering experiments on the proton in the 1 GeV range (see also the more detailed discussions on vacuum fluctuation in Chapter 6). Such calculations with extraordinary accuracy should be critically questioned with regard to open and hidden fitting parameters, whereby the length of the distance with which the shell

electron interacts with assumed vacuum fluctuations (STM) or an inner electron orbital (DSM) is to be seen as the most important parameter.

Overall, it can be concluded from the previous experimental findings in combination with the findings of the Direct Structural Model (DSM) that the proton should consist of a central spherical shell area (orbital) with negative charge (dominant residence area of the exchange electrons), a scattering-relevant orbital of the neutral down-quarks and a directly adjacent outer orbital of the up-quarks with positive charge. In addition, there must be a non-disappearing residence density of the exchange electron, which extends beyond the up-quark orbital and is responsible for the neutralization of the up-quarks. The orbit of the exchange electron shown in Fig. 1 is to be understood purely as an example, because it is a quantum mechanical system that will in principle be influenced by the indeterminacy relation. So there will be orbits that pass very close to the centre of the proton and those in which the electrons move further away from the centre. Orbits that are very close to the centre can only be the result of higher kinetic energy, greater momentum and thus shorter (de Broglie) wavelengths.

Paths running directly through the centre are obviously not possible due to mutual influences according to Fig. 2. According to the DSM, about $4 \cdot 10^{22}$ exchange events are triggered every second, whose orbits occur evenly distributed along all conceivable spatial directions and thus determine the probability of residence of the relativistic electron - i.e. produce the corresponding spherical shell orbital. Fig. 2 also shows that there is an optimal distance of the passage past the centre of about 0.6 fm. In addition, there should be another maximum of the density of orbit paths with a distance to the centre of about 0.15 fm. Since the energy of the exchange electrons is different for the different types of paths, they will also lead to different strengths of interaction for external electrons. This applies to both electron beams via scattering experiments and to shell electrons that can enter and cross the proton. The latter are strongly accelerated by the proton charge and slowed down accordingly after the passage.

The interpretation attempted more than 60 years ago with three positively charged 'shells' cannot be maintained, whereby the interpretation curves 1 and 2 can be assigned to a common orbital of the exchange electrons with two maxima and on the other hand curve 3 is in reality given by two separate orbitals of the up-quarks and the down-quarks. The scattering in this area probably experiences an additional superposition due to the effect of the exchange electrons - a third maximum of the orbital of exchange electrons - with a significantly lower probability of stay in this region further outside than the one in the central spherical shell orbital. Since atomic shell electrons flying through the proton are predominantly influenced by this orbital at the point of closest approach - the closest position

to the central part of the electron orbital - it should not be the spatial variations over the entire orbital, but only the variations occurring inside of the spherical shell orbital correspondingly turned towards this point that determine there the energy variation of the atomic shell electron (the invading atomic shell electrons are in addition repelled and deflected by the central spherical shell orbital). By measuring the so-called 'charge radius', this should result in an orbital shell thickness starting at about 0.15 fm and reaching up to about 0.15 fm + 0.85 fm for the inner part of the exchange-electron-orbital. It should be noted here that the interpretation curves used in Fig. 2 must be purely fictitious with regard to their concrete curve and therefore only reflect the expectations corresponding to the state of knowledge at that time.

Today the 'charge shells' of the proton (given exemplary in Fig. 2) are usually forgotten and ignored but are based on experimental results clearly demonstrating that there are scattering-relevant phenomena inside of the proton even at radii of about 2 fm and beyond. This is obvious by the distinct and visible 'bulges' within the curves of scattering. On the other hand measurements of the size of atomic nuclei (with many nucleons involved) show touching distances with radii in the order of about 1.2 fm (using dense sphere packing). Both findings are very well explainable by help of the Direct Structure Model simply assuming a more or less 'rigid' behaviour of the basis orbital (orbital of the neutral quarks with a maximum of mass/momentum). Within the Standard Model with assumed (!) elementary quarks the radius of the proton (charge radius) has to be necessarily defined with a value definitely below only 0.9 fm (more precise 0,84 fm) - due to high-resolution measurements concerning the line width or Lamb shift within spectral line investigations. Within this model the determined variations of the positions of charges within space have necessarily and cogent to be interpreted by the width of motion of the quarks itself. However, such a small proton size is incompatible with both above given experimental results. Thus it is strongly recommended to develop new experiments being able to give a clear decision between both structure models. The missing of a scattering peak for $x = 1/(3n)$ even at very high scattering energies cannot give a help of decision in case the quark-subunits have to be extremely strong and in no way quasi-free bound.

In summary, however, it must be said that the determination of the spectral line widths as well as the measurement of the Lamb shifts already give direct hints to the invalidity of the Standard Model. With the alleged nucleon radii of less than 0.9 fm (more precise 0.85 fm) determined by those measurements, the nuclear sizes determined by measuring atomic nuclei of various chemical elements are hardly to explain and therefore strongly indicate that quarks should not be elementary. Constructing larger atomic nuclei using nucleons even with radii of 0.89 fm results in a volume of the nuclei that is almost several times smaller (!) than

measured by experiments for real atomic nuclei containing here now also necessarily compressed nucleons (see chapter 4).

Actually at any time a proton is characterised by two positively charged quarks (in the outer region; Up) as well as a neutral quark (Down, see fig. 1). The corresponding temporary occupied excitation states are changing equally between the three structure units within the Direct Structure Model. Thus within statistics over the time any quark owns a $+2/3e$ -charge (two positive charges for three units). The commonly used exchange electron that is jumping from each quark to each other quark results within statistics over time to a $-1/3e$ -charge for each quark. Thus there are now 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. In contradiction to the Standard Model the Direct Structure Model needs no explanations via particles with fractional charge numbers and the introduction of a generalised charge such as the Hypercharge is unnecessary. Because the only information about the internal structure of a proton can be obtained solely via high-energy electron scattering there is a dominating importance of the used model as basis of the interpretation. Scattering means an integration over all thinkable paths through the proton and all possible states of internal processes during that passage. With other words an integration over space and time. Thus depending on the model there may be seemingly fractional charges - if elementary units are chosen as basis - or the 'appearance' of fields resulting via time-integration into such only fractional appearing summed-up fields. Actually the well proven quantification of charge with entire units of the elementary charge should clearly support the second possibility.

Depending on the kind of experimental investigations 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 within 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/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 the papers as a whole. This central goal is necessarily bound to mass agglomeration of bosonic neutron matter without degeneration (no or entire spin) solely enabling highest-density, non-degenerated and thus stable mass concentrations within a finite volume. If, as a result of long-term gravitational effects, a gigantic black hole with many billions of galaxy masses is formed, the already highly excited nucleons in the nucleus of this extraordinarily high mass accumulation will collapse when a critical mass is exceeded and the electron-positron quarks will be squeezed into each other - abruptly creating a massive electron-positron annihilation reaction with the release of a very high number of photons and an enormously high density of the 'substrate of everything' (set-free the building material of all annihilated elementary particles). This is a common and usual process in the true (all-comprising) universe, which is generally to be understood as a 'Big Bang', but cannot be described by the formation of a quark-gluon plasma (STM).

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 relatively high stability observed. 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 electron-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 to 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 momentum and angular 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 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 stiff 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 narrow 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 extracted from experimentally observed data [G.A. Miller, Phys. Rev. Letters 99 (2007) p. 112001]. Such a shell structure cannot be explained in principle even with the dynamic STM.

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. $\nu_e + {}^{71}\text{Ga} \rightarrow {}^{71}\text{Ge} + e^-$). 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 this kind of 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 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 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 come extremely close together within their matter core, penetrate each other and have to transform via electron-positron-annihilation back into radiation (non-localised energy). In this case relatively seen the 'starting mass' (localised energy = mass) will be reduced very fast. Thus the assumption of a Direct Structure Model results necessarily into an upper limit for mass or mass-concentrations as well as the transformation into radiation after crossing a limit of hydrostatic pressure within the matter core of super-massive Black Holes. The entire concentrated energy will distribute homogeneously with the speed of light over a continuously increasing volume. However the tremendous nearly infinite gravitational field of the former Black Hole can be reduced only with the speed of light in long terms via a kind of half-wave of gravity. Such a system re-materialising in the interior might be characterised by accelerated expansion. All this allows a realistic pre-history of a Big Bang without singularity (Dark energy; see part 2, cosmology).

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 the created neutral pions take on an exceptionally important contribution within such $e^- - e^+$ -collisions. As neutral particles without spin they are also 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 such 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. Those colliding beams realise despite of a much lower density the conditions after the Big Bang - extremely high density of electrons, positrons and high-energy photons.

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 corresponding 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 even create neutrons by reactions among each other. Via direct hits of the created particles by the primary electrons and positrons also destruction products, e.g. mesons, can be formed. Thus within such collision experiments the observed creation 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 (STM) 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. even 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 assigned to the photons. Within that context the creation of e.g. neutral pions (π^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 (DSM) 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 with electrons, positrons and neutrinos only.

It is possible to accelerate elementary particles up to relativistic energies without external fields only by help of photons. In the PHD theses of M. Kaempfe [Martin-Luther-University Halle Wittenberg, 2000] nanoscopic metal spheres embedded in glass were irradiated with a single pulse of a laser (30 fs / 400 nm). Here two clouds of smaller metal clusters were found diametrical positioned with respect to the original 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 be accelerated and moved by the photon 'fields' obviously at least 20 nm or more probable up to 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 ($\lambda/2$, 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 ($M \cdot 0.5 \text{ keV}$) 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 is in addition by many orders of magnitude higher than in a laser. (This is within the Direct Structure Model estimated to be about 10^{50} photons/m³ using the highest possible matter density given in chapter 3 of part 2. However, it is a maximum possible value, which could be quite a bit

smaller. Experimental findings show a mutual destruction of photons when their density becomes too large and the photon distances come to the order of their wavelengths (see chapter 8). Therefore, a value of about 10^{45} photons/m³ could be possible. Alternatively, in the very first phase of the Big Bang, no or no dominant contribution to the photon release and thus only a delayed pair generation/matter creation might occur.) 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 sufficient high energy, speed and mass increase in addition to the mutual acceleration via their own fields. 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 dominating decay two Gamma-quanta. In the radiation of the upper atmosphere as well as within $e^- - e^+$ collision experiments there are e.g. frequently π^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. Within the STM a structure of four elementary quarks should give rise by help of difficult understandable mechanisms to the transformation into an electron-positron-pair or the generation of only two photons. On the other hand it is a more or less trivial expectation to have within the DSM with a concentric orbital-system of one electron and one positron to observe within an annihilation of both particles the emission of two photons or in some cases a setting-free of the two particles contained within the orbital system. Alone this exceptional high power of explanation only for

this kind of particle should it justify to take into consideration suitable experiments proving the validity of the alternative DSM.

The value of the rest mass of neutral pions cited above ($280 \pm \text{ca. } 6 m_e$) is obtained by the very difficult analysis with energy-sensitive plates of 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 $295 \pm 20 m_e$ and is related to the extrapolated starting mass of neutral pions [E.W. Spolski, Atomic Physics, publisher: Deutscher Verlag der Wissenschaften, vol. II, Berlin 1969, p. 620]. Today usually a value of $264.14 \pm 0.011 m_e$ is given for neutral pions in encyclopaedias using the above-cited 1%-decay into elementary particles, which offers a much higher precision of measurements [see also D.E. Groom, et al., Eur. Phys. J. C15 (2000) p. 373]. 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 by the neutral pions, 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; means unchanged continuous paths of the pions), 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 possible within the collision experiments of high-energy electrons and positrons against each other at the CERN with a value of about $273.8 \pm 0.2 m_e$ [J. Lillich, PHD thesis 2004, Albert-Ludwig-University Freiburg i.Br./CERN, p. 46]. 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 $280 m_e$, 2. the mass after emission of the electron-neutrinos with $274 m_e$ (consequence of annihilation) or 3. the mass after the emission of the muon-neutrinos with $264 m_e$ (decay into two charged leptons).

If the quantum world is striving in general for orbital structures, orbitalised (heavy, individual) elementary particles should be found too (with short time of existence). 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; it represents with its basic structure a quarter-quark) 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 (within the STM defined as a further elementary particle) 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 (within the DSM a 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 would consist of 4 charged orbitalised leptons (2 electrons, 2 positrons, 4 muon-neutrinos and 4 electron-neutrinos) and now contain 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) within an orbitalised status (with two coupled neutrinos) and thus being a fermion (3 leptons, spin $\frac{1}{2}$). The charged 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 collision 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 possess sufficiently high momentums. Therefore orbitalised charged 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).

Due to the presently known enormous transparency of even giant mass agglomerations with respect to the passage of neutrinos the assumed and necessary binding/agglomeration to

neutrinos within the DSM appears at first glance as completely incomprehensible and nearly not acceptable. But couldn't it be that such a binding is simply a standard and thus further external neutrinos have to cross neutrino-saturated matter that therefore appears to be transparent? Shouldn't there be a disturbance of this standard for some isotopes (e.g. ^{71}Ga) that offers the possibility of neutrino detection ever? In the STM muons are defined as elementary particles and should 'f l u c t u a t e' within the frame of vacuum fluctuation into an electron-neutrino, a myon-neutrino and an electron. Isn't it much more likely, or at least as likely, that a muon is actually a 3-particle structural unit and decays into its three components by a disturbance? Of course, such bonds between leptons require an acceptable basic understanding. But this demands another paradigm shift, which can only be the subject of the following chapters. The binding as well as the existence of neutrinos at all, in addition to the phenomenon of space vortices, frame dragging, actually represents a direct proof of the existence of an omnipresent substrate (ether); only this way an understanding of the so-called Dark Energy may be achieved.

According to the Standard Model (STM) muons are interpreted as elementary particles with negative/positive charge. But within the alternative model (DSM) they have to be seen as relativistic electrons/positrons knocked out of the quarks and still moving within relativistic orbitals. Thus clear differences have to be expected in case they are forced to precessions within strong magnetic fields. Such high precision measurements (with accuracies up to 11 digits) were performed during the last years within the Brookhaven National Laboratories and the Fermi National Accelerator Laboratory (Fermilab). Both laboratories could show distinct differences with more than four error widths with respect to the expectations given by the Standard Model (measurement of the anomalous magnetic moment; they became well known as the muon $g - 2$ experiments; <https://www.bnl.gov/newsroom/news.php?a=118760>). Within the Direct Structure Model an influencing of the precession due to spin-orbit-coupling had to be expected and thus could possibly explain the observed differences. Due to their size with a dimension of few 10^{-17} m there should appear in addition differing scattering phenomena with respect to the assumed true elementary particles that had to be seen solely as point-like.

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 $\frac{1}{2}$) 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/neutral pions). 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 within the STM 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, as far as 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 leptons (protons) respectively 35 leptons (neutrons). 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 or structure units composed of leptons can be set free. For an overview of such experiments see e.g. [P. Braun-Munzinger, J. Warmbach, Physik Journal 5 (2006) nr. 10, p.41]. 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 substructure 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 mutual acceleration and necessarily their destruction. The acceleration would be driven by the charged quarks, such that it 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 mutual 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 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 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. (With respect to an efficient production of Negatons see the discussion to Fig. 1 in part 2, cosmology)

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) [P. Maksimovic, J. Hopkins University Baltimore/Fermilab Chicago, 2007; Phys. Rev. Letters 98 (2007) p.132002]. 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; a 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; two of such coupled dump-bells create the very stable α -particle). 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 impulse into the excitation of both nucleons and could create for short times especially strong excited bosonic di-neutron-complexes. Di-neutrons of this type could easily gain 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. At this very point again the most important difference between both models should be emphasized. While within the Standard Model all generated bosonic structure units have to

be exclusively interpreted by quark-antiquark complexes (or quantum-mechanical interference states) within the Direct Structure Model structure units with odd or even number of contained quarks may exist as well as bosons or as fermions. Here it is simply a question of the number of contained sub-quark units irrespective of an even or odd number of quarks within such particles. There is no need to define further and new 'heavier quarks'.

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 expected. They should quickly decay into three neutral 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 (reverse photon annihilation) between Gamma-rays and neutrinos (compare chapter 5).

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 (inclusive 'quantum mechanical overlapping states') 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 mass. Those high-energy-excitations cannot be stable, unless they are forced for instance by gravity (hydrostatic pressure) within neutron stars or the matter cores of black holes (see e.g. part 2, cosmology). B-mesons with circulating quarks within smallest possible orbitals (maximum excited bosonic neutrons) have to be seen as the pre-stages of Big Bang.

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 demonstrated and obvious. Thus it is necessary to remove here in a last step the incorrect consideration of equal energies of the particles within the sub-orbitals of the quarks. The orbital splitting necessarily demands different energies and this could be achieved and specified using a second experimental value, the mass of neutral pions π^0 (half-quarks: one orbitalised electron and one positron; ca. $280 m_e = 137 m_e + 143 m_e$), besides of the fine structure constant ($1/137$) relevant for the electrons. 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 $548 m_e = 4 \cdot (137 \pm \text{ca. } 5) m_e$. 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 (ca. $280 m_e$) and the fine structure constant. Because the determination of the (total) π^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 $0.51 \cdot 10^{-27} \text{ kg} = 560 m_e$, 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 $2.8 \cdot 10^{-15} \text{ m}$ (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 (50 years ago) for the radius R_0 (1.4 fm) of the droplet model of nuclei: $R = R_0 \sqrt[3]{M}$ (R core radius; M number of nucleons) [e.g. Grimsehl text-book of physics, publisher: Teubner Verlag Leipzig 1968, vol. IV, p.15]. This suggests a flexible deformation of the outer shell of the nucleons and a rigid behaviour starting with about the size of the basis orbital. Presently a value of $R_0 = 1.2 \text{ fm}$ is favourite applying this equation.

With a value of $R_0 = 1.4$ fm the starting size of the (touching) diameter of nucleons with 2.5 fm (radius 1.25 fm) within the used 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. (measuring the width of spectral lines) in this context (about 0.89 fm) a nucleus-filling-factor of only about 30 to 50% is obtained [Th. Udem et al., Phys. Rev. Letters 79 (1997) p. 2646]. Such a low filling would be extraordinarily incomprehensible in view of the enormous strength of the strong interaction - at least for small and medium-sized atomic nuclei. In heavier nuclei, the short-range strong interaction can be no longer compensating for the cumulative long-range electrostatic repulsion forces. Therefore, shell structures with shells floating on top of each other will now have to form, whereby the strong interaction tends to act within the shells only. As a result, more and more 'cavities' have to be created in the nuclei, whereby somewhat elongated shapes of the nuclei are preferably formed in order to minimise the effects of the electric fields.

The above equation for describing the nucleus size is based on a spherical symmetry of the nuclei and immutable spherical substructures (nucleons). Thus, the relation can only give an approximation, since no general spherical symmetry is found for heavier atomic nuclei and the nucleons (as actually completely 'empty' structural units) should in principle be deformable just like our atomic shells. Under the above mentioned conditions the case $M = 1$ (determined via the experimentally obtained values for various atomic nuclei) results into the adapted size R_0 and gives now a radius of the proton with about 1.2 fm; at least as a reasonable approximation for compressed nucleons.

But the case $M = 1$ actually means a single, unaffected proton. On the other hand, in atomic nuclei in the compound of several nucleons, the nucleons are deformed by mutual force effects acting to each other (by the so called Strong Interaction, 137 times stronger than the electromagnetic effects) and are in particular pressed together, i.e. definitely reduced in size. In principle, therefore, an estimate using R_0 must have a smaller (!) value than it can be measured for individually existing protons (i.e. without compression). There are currently two competing other measurements for the proton radius R_p , both of which have been determined from free protons/hydrogen atoms. Electron scattering in the 1 GeV range results in a value R_p of about 2.1 fm and by spectral investigations seemingly a value of $R_p < 0.9$ fm is obtained. However, the latter value for 'free protons' (!) is well below the lower limit of 1.2 fm. It is based on the assumption (!) that quarks should be elementary (STM). Therefore, this assumption should be possibly wrong.

The same conclusion can be drawn from the estimation of the size of atomic nuclei using the most accurate values for the so-called 'charge radius' (in the STM necessarily identical to the

proton radius). With a charge radius of 0.85 fm the proton volume would be 2.57 fm^3 . For a uranium nucleus, a volume of about $238 \cdot 2.57 \text{ fm}^3 = 612 \text{ fm}^3$ can be estimated, whereby no deformation as a result of the strong interaction is taken into account. However, the experimentally known size (diameter) of the uranium nucleus is about 15 fm. However, the volume including deformations caused by the nuclear forces results at this core size with about 1750 fm^3 . Again this strong discrepancy allows the conclusion that quarks could not be elementary.

Unfortunately, however, these findings are only certain indications and not clear evidence against the Standard Model. Since the effect of the Strong Interaction is only short-range and the cumulative but long-range electrical repulsion effects cannot be balanced having a larger number of protons, it is mandatory that 'cavities' form inside of nuclei with a larger number of nucleons. Thus this should result in a kind of shell formation (with only strong bonds - Strong Interaction - within the shells). Since the electric field effect is also reduced when the charges are arranged, e.g. in a linear chain, the deviation of the shape of the nuclei from the spherical symmetry is also understandable.

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 $< 0.9 \text{ fm}$. 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 in the 1 GeV range (distribution of the charge density) with much larger dimension of the proton 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 [R. Pohl et al. Nature 466 (2010) p. 213]. In this case the shell electron is replaced by a much heavier muon and the shell orbital is now about 200 times smaller and therefore 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 0.85 fm. This is seemingly clearly different and far enough outside of the error-range of the corresponding measurements using ordinary hydrogen (with electron shell) taking the line width.

While those fundamental experimental 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 were 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 muon-shell being much closer now to the nucleus than the electrons in the shell of ordinary hydrogen. The repelling between the corresponding charge carriers (exchange electron and shell-muon) hindering the motion away of the proton centre would result in a reduced 'width' of the orbital of exchange electrons and at the same time giving rise to a small reduction of the effective proton radius.

Within the present Standard Model of Matter the charge distribution is assumed to be given by $(+2/3e) + (+2/3e) + (-1/3e) = +1e$ which is replaced in the new Direct Model by a more realistic $(+1e) + (+1e) + (-1e) = +1e$, maintaining again the quantisation of charges by entire units of e . But while in the Standard Model the quarks/valance quarks are assumed to have comparable masses this is completely different in the Direct Model. Here the exchange electron owns only one third of the mass of the up-quarks. Thus an increased external (negative) charge action of the shell results in a ratio of the shrinking force (for the exchange electron) to the stretching force (for the two up-quarks) of solely $1 : 2/3$ (the 'stiffness' of orbitals is reciprocal to the mass; the ratio is of cause only an approximation, because the relativistic speeds of quarks and exchange electron differ in addition) and therefore this might result altogether in a size reduction. Within the Standard Model the above given ratio were instead $1 : 4$ (purely due to the charges) and could result in an increase of the proton size.

Here it has also to be taken into consideration that the internal electromagnetic forces are about 10^6 times stronger than the external force given by the muons. That the influence of the shell might be indeed too small to be measured indicate new theoretical calculations of the distribution within the lines. Including the totality of all quantum mechanical interactions

might give rise to a new interpretation of those measurements, now resulting into values possibly comparable to that obtained by Lamb-shift at myon-hydrogen (U. D. Jentschura, Physik Journal 16 (2017) nr.12, p. 26). For the comparison between the two proton-models there remains now unfortunately only the large size-difference of the assumed charge density radius and the much larger true effect of electron scattering at protons such as given in fig. 2 (chapter 3.1).

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, probably caused by a highly localised frame dragging).

Despite many open, unanswered questions such as the nature of dark matter, the explanation of the proton spin, the proton size or some questionable assumptions such as an initial singularity of our part of the universe, an initial asymmetry of matter-antimatter or the apparent necessity of building blocks with fractional charges, the alternative Direct Structure Model presented here has so far been completely ignored by the so-called established physics and even clarifying experiments are refused. It is assumed that the STM should be at least 99% correct. For this purpose, sometimes unpleasant findings are simply ignored.

The size of our atomic nuclei, for example, can be measured sufficiently accurately despite the inevitable measurement errors and those sizes cannot be explained at all using proton radii of even 0.89 fm. Any alternative model should actually be 99% wrong. So how can it be that the DSM is able to explain so well the structure, decay products and mass of the dominant fission products after collision experiments in the simplest and logically understandable way, why also the experimentally found spin contributions in the proton as well as the shell structures of proton and neutron? And all this with the restoration of the well-known quantification of the charge in entire units of the elementary charge. The DSM

explains the structure and properties of dark matter, requires no initial singularity and no asymmetry matter-antimatter. All of this is far more than just a 1% explanation of the nature of our matter. Actually it should force us to take note of this alternative and try to exclude it through targeted experiments. The simplest way to do this is to investigate the wide-angle scattering of electrons at quarks in the energy range of about 25...35 GeV (checking the predicted quark size).

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 and over decades ignored 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 our 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 now no singularity in the very beginning using a Direct Structure Model (see part 2, cosmology). In contradiction to the Standard Model quarks composed of Leptons can exist as bosons or fermions and thus nucleons too (simply depending on the total sum of the number of contained positrons, electrons and neutrinos being even or odd). 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 ($< 0.1 \text{ fm}$) that allows all charge states inclusive neutrality is a high-relativistic double-orbital-system of electrons and positrons. To achieve the necessary high stability a complete occupation of both orbitals with opposite spin orientations of the contained leptons has to be realised. According to this, quarks are bosons within their ground state, as indeed experimentally observed for down-quarks in protons. Thus with such a model the permanent spin crisis of the Standard Model could be easily overcome. 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 some kind of field-action, there is now the exchange of high-relativistic electrons between sub-orbitals of different quarks and also between nucleons, 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 and cause the experimentally observed strong momentum transfer between the quarks. This also results in a logical explanation for the numerical value of the fine-structure constant. 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 to create this way nucleons (necessity of sufficiently high and correct kinetic energy range) the majority of the originated quarks 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 (electromagnetism and gravity). Strong and Weak Interaction showed to be solely internal interactions related to the inner substructure and dynamics of quarks with substructure. This is accompanied by a reduction of the 'zoo of elementary particles' to solely electrons, positrons and neutrinos. The alternative 'Direct Structural Model of Matter' is now again based solely on structural units with integer quantification of the charge (elementary charge).

5 Basic demands to the structure of electrons - pair creation

Imagination is more important than knowledge, because knowledge is limited.

Albert Einstein

To further extend the Direct Structure Model, the principle of orbitals for the localising of energy might be tentatively applied also to the inner 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, space itself or whatever is considered as the fundamental basis). However, if there exists a further (no longer quantum-mechanically determined) 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, at least with the appearance as gravity. 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/m³ (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 colliding photons or parts of them. However, because they should be created by dynamic interaction mechanisms they cannot be understood as such (but small) Black Holes that are known to us from the universe due to a collapse via gravity - means not with corresponding extreme density of matter. Thus they are not characterised by a strong and far-reaching field of gravity. The weak gravity of electrons is more secondary and develops via emission processes that will be discussed within later chapters (more precise details in chapters 6 - 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) obviously it is 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 'cross-section' of photons due to the pair creation mechanism has to be 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 [Phys. Rev. D69 (2004) p. 124031] 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 during a beginning photon impact the mirror effect abruptly cuts off further energy flow into the forming particle. This indicates at least a first direction to look for, searching for a possible creation mechanism of 'elementary particles' and their internal structure.

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/consumed 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. However, deep thinking should disclose that the annihilation of the elementary particles demands first of all a mutual acceleration increasing the kinetic energy of the particles and the emission of the corresponding 'Bremsstrahlung'. Because both particles are accelerated within the other field both have to create a photon. Only this radiation is to be observed. The true process of annihilation - the direct interaction of the particles itself - is usually at present not considered at all, nor recognised and is neglected.

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 acquainted 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 existence via suitable kinds of space warp. Of course with local gradients of space warp much stronger than the static gradients usually initiated by wide-spread gravity over cosmic distances. It will be the intension of the following chapters to develop some first ideas to dynamic space warp with more details.

There remains a very special case of photon collision with anti-phase orientation - there should be a complete extinction (this simplified representation can be extended with consideration of the helicity). This appears to be a violation of the law of energy conservation. Knowing the mechanisms of photon annihilation it is obvious, however, that this has to be connected with the emission of neutrinos (ν) conserving energy and momentum. In processes involving extremely high densities of electrons and positrons (e.g. supernova) this is observed in an indirect way. Though it appears to be a direct transfer of a pair of elementary particles into a pair of neutrinos. In effect it has to go the not observable roundabout way with photon annihilation:

$$2(e^- + e^+) \rightarrow 2\gamma + \nu + \bar{\nu}.$$

If the process of photon annihilation has a reverse process the problems with our sun neutrinos vanishing partly could get an easy solution. A first hint to this might give the π^0 - meson decay. In the 1% case of de-orbitalisation (setting free of elementary particles) the emission of neutrinos should be expected but Gamma-ray emission is found.

The up to now directly observed photon annihilation

$$e^{-} + \gamma \rightarrow e^{-} + \gamma' + \nu + \bar{\nu}$$

with transfer of a high-energy Gamma-quantum into one of lower energy during the impact at an elementary particle should go via an interim mechanism because there is no possibility of anti-phase reflection. Always there will be pair formation. Thus the quantum energy has to be high enough to allow multiple pair formation. The remaining pieces of the photons can separate the particles or accelerate them immediately against each other - generation of Compton quantum. With suitable conditions during this process the successive pair formation with time-retarded annihilation could give rise to intermediate Compton photons with the necessary phase shift and then to photon annihilation, i.e. formation of a pair of neutrinos.

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The ideas and models discussed in the following sections on the most basic basis of physics at all, i.e. the 'substrate of everything', the internal structure of elementary particles and their 'construction material' as well as the structure of photons (this automatically includes a fundamental basic understanding of electromagnetism and gravity), may at first glance seem arbitrary and pure fantasies. But this is not the case. Of course, the author feels obliged to a strict logic and the general basic principles of physics, which as a basis concerns, among other things, the general conservation laws, but also determinism and causality. Due to several insufficiently understood phenomena in the field of quantum mechanics, today often (under certain restrictions) a violation of conservation laws as well as causality in certain areas is considered as a real possibility and accepted almost without contradiction.

From these questionable assumptions, the idea of vacuum fluctuation was developed, which is a central and indispensable part of the Standard Model. Here, fluctuations, i.e. 'spontaneous' releases of photons or particle pairs, are assumed virtually out of nowhere of the physical vacuum. Even more extreme is the assumption that an analogous fluctuation could allow the creation of 'the' universe and thus the release of ludicrous amounts of matter or energy from nothing. The justifications are the definitively correct and experimentally proven laws of quantum mechanics, such as the uncertainty relations: the smaller a spatial indeterminacy is assumed (high localization), the greater an impulse or energy indeterminacy has to be (for a correspondingly short time of its existence). However, this overlooks or ignores the fact that this implicitly means a questionable transfer of the laws of matter - especially small amounts of matter (including photons) - to the physical vacuum. However, the physical vacuum is definitely not matter and should therefore be determined by completely different, own laws.

The general approach in physics so far is experimental observation, which leads to models and these are further developed into theories, which makes predictions possible and in turn

can be tested for experimental confirmation. In principle, however, this general approach is no longer possible for the areas of basic physics to be considered below, because the smallest possible remaining 'probes' that can be used for experiments are photons and electrons/neutrinos. In order to gain insights into the 'substrate of everything', the construction material of the elementary particles or photons as well as their internal mechanisms, only a constructive scientific imagination based on basic principles remains. To limit them, only consistency considerations and indirect indications or confirmations can be used - essentially trial and error as the only feasible way.

In the following, only a few basic assumptions inspired by experimental findings are used. EM fields have a (quasi?) infinite range and show temporal and local fluctuations. This is most likely to be explained by the emission of an enormous number of field quanta stochastically into all spatial directions starting from the charges. Here, the well-known decrease with the square of the distance is a direct indication of an emission mechanism. Since the fields transmit effects, the field quanta should carry impulses and since there are electrical and magnetic effects, the field quanta should have radial impulses and at the same time angular momentum. Furthermore, it is known that photons are formed exclusively by the relative acceleration of charges to each other. They can therefore only be formed from field quanta with suitable time-stable density structures. No other 'building material' is available. Furthermore, it is known that the collision of photons leads to the formation of electron-positron pairs. Therefore, these fundamental elementary particles can only be formed by the effects of the field quantum structures and parts of these structures, which give rise to the re-formation of further field quanta as a result of localization. Of course, attempts based in this way can also lead to error, but even then the controversy arising will contribute to further progress.

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 some 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 or interactions with sub-h-action on the basis of 'dynamic space warp regions' and reveal a further level of physics between quantum mechanics and the substrate of everything.

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 now (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 strong 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/forces 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 vacuum-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 (for matter). 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 (measurable) 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 even kinetic energy or 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 considered/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 larger dimensions. The same way as in general classical physics cannot show the validity of Quantum Mechanics or disprove this theory again a sub-h-physics cannot be disproved or excluded by Quantum Mechanics.

Determining the vacuum energy by means of General Relativity (GR) 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 GR 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 1m apart, the resulting force is according to the Coulomb law eq. (8) about $2.3 \cdot 10^{-28} \text{ N}$. 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 for the acting static electric field thus either the electric field would be finite and limited to about 1 m, or the electron had to move stochastic with considerable jump lengths [suggestion of B. Kropp]. 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 still very 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. The possibility to describe the electric field effect by means of a dependence with r^{-2} is a direct indication of an emission mechanism.

One of the outstanding results of modern physics is the fact that our world has to be characterised within all fields/parts by upper and lower limits of all physical determination-quantities (there has to be necessarily also an upper limit for matter concentration and amount of matter). Any attempt of a description by help of a continuum can only be an approximation (an up to now open, not yet or never to clarify exception might be the (in)finiteness of space and time). The most important limits besides the upper limit of the speed of light and a smallest structure of (physical) space are given as a smallest action on/within 'macroscopic' or 'material' systems (indeterminacy relation) as well as a maximal possible force/acceleration approaching an event horizon (General Theory of Relativity; see e.g. C. Schiller, www.motionmountain.net). In both of the last mentioned cases it is obvious that 'behind' their limits there has to be some real physics that causes in one case the formation of static fields and in the other case a source of very strong gravity. In both cases by principle reasons direct experimental investigations are completely impossible - as well for of the 'sub-h-physics' (by means of measurements no action smaller than $\hbar/2$ is possible) or the physics inside of event horizons (no direct information to the matter core of a Black Hole - causing the gravity - is able to pass the horizon). Deeper insights unavoidable need a non-experimental 'instrument' - the collectively applied intelligence of mankind. Only in a trial-and-error procedure 'the one solution' can be extracted out of all the findings.

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 as well as the action of gravity by matter straight forward out of the direct following properties. Pre-assumption has to be a space (filled) 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 be related in some way with 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 or fluid?) and in addition not 'determined' within space and time, but preferably always in permanent motion to each other.

Just as we had to recognize that the ability of the matter around us to change can only be explained by an atomistic structure of matter, so today we must draw this conclusion for an omnipresent substrate that fills space and recognize that this medium cannot be a continuum

either and must be constructed also particular. The astronomically verifiable expansion of our Big Bang system shows a permanent large-scale expansion, i.e. change of this substrate - obviously with a decrease in density - and thus forces the realization that it must also be formed from smallest (subtle) structural units. But while for our matter, at least for liquids and solids, beside of the action of gravity attractive force effects (on the basis and in connection with chemical bonds) can be recognized between the atoms, here a general mutual repulsion effect must be assumed for the ether, which is today ascribed to or misunderstood as 'dark energy'.

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 a limit speed/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 (i.e. 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 type, 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 longitudinal) 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 their 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 could be something like a complex spectrum of circulating harmonics and therefore various sizes of longitudinal photons might be emitted. It is thinkable that considering a selected radial direction with a least distance away of the particle the running through of longitudinal photons might 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, could penetrate and interact with each other in a very complicated, stochastic manner (near-field). The generation mechanisms of the longitudinal photons thus could 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 (inner) orbital system (no change of the rest mass). The LP carry a momentum of sub- h energy-level, 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 usual surrounding density (longitudinal states), giving a first idea to an understanding as dynamic (moving) locally restricted space warp regions. Because up to now the term 'space warp' is solely known for the basic model of GRT that is only related to a creation via gravity/mass and related to a r^{-2} variation in case of radial symmetry (for this, however, 'space' must necessarily be understood as a medium that could only be 'deformed'; however, space itself - i.e. true vacuum - in principle cannot be a medium) it needs within this new sight a generalisation. Any cause of dynamic actions of matter (deformations or movement through the 'substrate') should allow a variation of the density of states or of the density of particles of 'space' within any kind of thinkable gradients and should usually not be bound to its initiator. Never dynamic space warp should be confused with a kind of gravity (purely static!) and only in exceptional cases there will be some relation e.g. to gravity waves (macroscopic dynamic space warp).

The rapid dynamic movements of structures/structural units envisaged inside of the electrons, which lead to very rapid changes in the shape of the particle, generate in the

surrounding medium wandering regions of changed density of this medium. However, since significant density changes occur with extremely small extent, possibly comparatively strong gradients are caused, which in the case of gravity are described as event horizons. The migrating density structures emitted by the electron should therefore be expected as very stable migrating structural units.

With their collective action LP 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 guarantees 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 [H. Dehmelt, Rev. Modern Phys. 62 (1990) p. 525]. With this definitely the dimension of the longitudinal photons immediately after their formation has to be expected smaller or up to about 10^{-23} m.

As a very important hint to the fact that the 'fluid', 'medium' or substrate called physical vacuum is an energy-containing medium serves frequently 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 then sometimes 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 of the possible wavelengths 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 (for short distances) 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.

There are strong hints and proofs that the Casimir effect can be equally well described by help of Van-der-Waals-forces. Thus also this effect cannot give any secured proof for the existence of a vacuum fluctuation. Thus the model of vacuum fluctuation stays and remains nothing more than a model, a pure hypothesis. But for the Standard Model represents the model of vacuum fluctuation an essential ingredient, a basis that cannot be given up. On the other hand the new Direct Structure Model is able to completely renounce of the model of vacuum fluctuation.

A similar system compared to the Casimir effect, allowing even the setting free of mechanical energy using the reservoir of vacuum energy, is the Turtur wheel [C.W. Turtur, www.public.rz.fh-wolfenbuettel.de/~turtur/physik]. This is given by a 'turbine' wheel of metal that clearly experimentally proved (also within high-vacuum) is unlimited rotating within the static electric field of a metal plate (above about 200 V/cm) as far as the disturbing friction forces can be overcome. Because the gained mechanical energy exceeds by far the losses, it represents from the viewpoint of classical physics a realised perpetual motion machine that of course receives the necessary energy from vacuum energy or Dark Energy. The direction of rotation is independent of the sign of the charge on the plate (the inclined metal surfaces of the wheel are always moving towards the charged capacitor). From the classical point of view this can be understood as the attraction of the influenced charge towards the causing charge. Unfortunately also this experimental arrangement cannot give rise to a decision between the basic mechanisms of static electric fields according to the two opposing models. The explanation is possible as well with a distortion of the zero-point-oscillations around the metallic wheel as with impulse transfers of the sub- h -field-quanta to the freely movable charge carriers of the metal. In no way a 'reflection' of the field quanta at the metal surface should be expected driving the wheel. With the extremely small size of the field quanta any compact material effectively has to be seen as 'hollow space'.

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 (inside of elementary particles) with a stream of longitudinal photons (with finite size) here a non-intercepted collective longitudinal excitation has to be expected. Photons have up to now 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 predominantly 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. The 'total appearance photon' is given by the action of the kernel and the one of the far extended 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 one 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/deformation or rotation of the fields of longitudinal photons and the related orientation of spins, see chapter 7). Gravity (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 elementary particle - this should give rise to a slightly additional enhanced density for longitudinal photons of increased density - in the other case there would be a (relatively) lowered internal density and a slightly less reduced density for emitted low-density-LP. 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 were usually emitted perfectly balanced, those with combinations of 'photon-harmonics' might 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 than for an undisturbed internal average. 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 gravitational fields.

Close to massive matter concentrations the deviations of the above suggested law of gravity - that can only be described by the equations of General Theory of Relativity, i.e. by (wide reaching) 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 all 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 LP 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 gravity were inherently related also 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 a-thermal 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 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 through. Approaching the source of gravity this area reduces with r^2 such that for low mass (and thus for sufficient distance and radial symmetry) 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 (even very strong) deflected or completely hold back by an extreme density gradient (event horizon), longitudinal photons are always able to pass (with changes of the size). Though (transversal) photons - presently accepted as the carrier of the static electric field - are hold back by the event horizon of a black hole, the effect of gravity or electric fields is realised outside of the horizon. 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, longitudinal photons (LP), are the 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 (event horizons) 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.

They are far reaching static gradients that are caused by a permanent transport away of a substrate and a permanent back-stream, i.e. via a dynamic process. Thus the calculation by help of a model of static 'space warp' is solely given for strict radial symmetry. 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 or expansion respectively that the same way supplies the electromagnetic field of the electron with its enormous total energy while there is only a tiny constant energy-equivalent given by the rest mass.

7 Dark Energy

Summarizing it can be said: According to the General Relativity Theory space has to be equipped with physical qualities; therefore it exists within this sense an aether. According to GRT space without aether is unthinkable, because in such a space there were not only no propulsion of light but also no possibility for the existence of scale standards or clocks, means no space-time distances in the sense of physics.

A. Einstein, Leiden 1920

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 (extended) 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 motion of physical structure units. The term 'space' represents the basic prerequisite for the possibility of any kind of motion itself. The 'only-space' (necessarily without time) offers everywhere positions for such structure units that can be occupied and thus represents first of all the total nothing or 'true vacuum'.

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 of this discrepancy can solely be achieved by considering different kinds of space. For example considering the expansion of a physical space - i.e. with not yet specified content of structure units - into a real or true vacuum (only-space) that is immediately related in a direct way to an infinite mathematical space (continuum). In contradiction to our real surrounding, within a true vacuum a physical structure unit could get an arbitrarily small change of position (as far as it could exist there stable), it could stay there in complete rest and as far as there were sufficient impulse or energy it could achieve an arbitrarily large speed.

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 such an 'absolute

nothing' of the true vacuum. To get the reality of a space-time it needs the filling of the true vacuum with suitable (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 (but in this case they could no longer be elementary) 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 and also of the time (averaged minimal interaction time between the basic space-filling units) because here infinite speeds and thus infinite energies have to be ruled out. 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 again space to reside, to exist within!?

The definition of space itself is independent of the existence of something real or material-like in between considered material objects embedded within space. 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 (and actually making more sense) is also a separation of fluid and true space thinkable - now the 'fluid' should get the term substrate of everything or aether. Within the on principle ever and everywhere independent existing space e.g. the expansion of a region filled with basic physical structure units, with aether (physical space) can be recognised now. In principle, there is no possibility of distinguishing between physical space and aether.

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 or unnecessary. 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 ubiquitous substrate (with respect to the achieved velocity) can be imagined only for longitudinal oscillations (coupled with obstruction or compression phenomena) that cannot develop for transversal waves (there exist no internal forces in the direction of motion). The use of the term aether could in addition considerably enhance the emotional understanding of phenomena such as 'vortices of space' (Lense-Thirring-effect, frame dragging) as a vortex or dragging of the substrate of everything 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 a Higgs-Field with setting free of Higgs-bosons,

to explain the property of 'mass', finally represents effectively nothing else than aether (attraction aether). However, the expected very high energies of those bosons (about 125 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 has to realise their mass or inertia. It's completely impossible to imagine that such heavy Higgs-bosons could represent the construction material of the low-weight leptons. Despite of the enormous variety of our material world the aether should be on principle the most-simple system of the universe that should be based most probably alone on one kind of interaction of the constituents among each other and containing only one kind of indistinguishable, true elementary structure units.

The use of the terms 'elementary' or 'elementary particle' inhibits the danger to block a priori any deeper questioning and actually allows solely the description of properties. Any 'object' surrounding us (including gases) cannot be continua. If they were made by continuum-material all objects had to be called elementary. All those 'objects' are able to change their shape/form in a more or less easy way, are able to stream, can be parted or in the case of solids can e.g. develop cracks or may be destroyed. From such findings it was already very long times ago clearly recognised that all matter surrounding us has to consist of small structure units (Democritus), of atoms (the indivisible). Actually a term standing as a synonym for being elementary and formerly it was indeed seen in such a way.

However, very soon it turned out that there are different kinds of atoms with differing properties. Thus it was obvious that also atoms (contrary to their naming) cannot be elementary. As well known they consist of electron shells and atomic nuclei. But also atomic nuclei exist with different structures and thus cannot be elementary; they consist of nucleons (protons and neutrons) of clearly different kind. So also nucleons cannot be elementary and as we know consist (dominantly) of quarks. Now we know that there are also different kinds of quarks or structure units that at least have to take on different kinds of excitation. At this point any physicist should pause and get thoughtful, because the present Standard Model defines despite of this the clearly different quarks as elementary!

To achieve consistency the present model has to use more than 20 different elementary particles and at least as many constants that can be solely determined via experiments. Very complex basic mechanisms are assumed to produce all those different particles in nature related with the local energy density. But actually everybody agrees that the highest

probability for a realistic model should be given with the model that owns the highest simplicity possible (principle of economy; Ockhams razor). Therefore the present paper investigates (according to the above given considerations) the obvious assumption of non-elementary, composed quarks (with concentric relativistic orbitals of two electrons and positrons each, to achieve correspondence to the experimental observations). To realise such orbitals neutrinos have to play an important role. Here solely electron, positron and neutrinos are used as elementary though they clearly differ to each other and thus should be finally considered as non-elementary due to an obviously differing construction plan. They have to be thought constructed in a suitable way via a truly elementary construction material, the aether, consisting of 'aether atoms'.

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 the theory of relativity, the motion of light with a constant speed c in all reference systems irrespective of the speed of the source or receiver. 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 substrate (at least seen relative to our direct cosmic environment). The aether is the only outstanding reference system and appears again today hidden as the 'reference system of the cosmic background radiation'. A true aether wind would be given if there were local streams or turbulences within the aether itself. However, the motion relative to the substrate during the process of photon emission results in a deposition of the oscillations within a longer or shorter distance, 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 disproof of the existence of an aether. However, effectively the postulate to the independence of the speed of light irrespective of the motion of the reference systems is equivalent to the statement that there exists a (resting, with all systems interacting) substrate - such as the existence of the (resting) air guarantees at least the independence of the speed of sound irrespective of the speed of any source or receiver of sound (as far as $v < c_s$). Both the speed of sound and the speed of light are realised and determined solely by the special properties of their carrier medium.

An occasionally expressed 'proof' against the existence of an aether is also the apparently by Maxwell's equations 'proven' possibility of the propagation of electromagnetic waves

within vacuum, i.e. apparently without any carrier medium. However, this can only be achieved by using natural constants that are different from zero - the permeability and permittivity of the 'vacuum'. These are also directly related to the independence from the speed of sources or receivers and linked to the vacuum speed of light ($c = 1/\sqrt{\epsilon_0\mu_0}$). However, the constants given within the vacuum (of course the physical vacuum and not a true vacuum) can only be different from zero if this vacuum is filled by a medium or alternative if the vacuum or the space itself represents a medium and therefore needs space to be enabled to stay in it. Much more realistic, however, is a filling of space (true vacuum) with 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 however 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 [æ iə a:] should have the possibility to move freely and have no chance to form some kind of crystalline or polycrystalline structures. To start first of all with a 'gas-like structure' should be the preference for a possible model. That an aether has to consist of structure units and cannot represent a continuum follows immediately also out of the fact that there do exist obviously smallest space and time structures (Planck units) within the physical space.

The mean space/time distance between the Aea (their central points or centres) 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 gravity 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 gravity 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.

Within the present understanding Black Holes (BH) seem to own the property of a true singularity. Of course any point of the horizon is a point of no return for matter, inclusive photons - as can be directly observed in the centre of our galaxy. But accepting the existence

of an aether it becomes obvious that within BH still there has to be space-time inside, though the substrate density is drastically lowered and furthermore everywhere changing radial towards its centre. This means that within this sphere there are still changes. Time is always varying everywhere and there is still motion inside. The horizon is nothing more than the application limit of general theory of relativity, of our present possibility for description of gravity with a theory. Time going to zero at the horizon has to be an approximation. A theory losing its validity reaching a special region cannot deliver there a correct value. Relativity, the equivalence between acceleration and gravity, implies implicitly the assumption of non-variable constants of nature. This assumption loses finally and now absolutely forcing its validity within the horizon - a region without any constants of nature and the everything determining variation of Planck length.

A main demand to the properties of a substrate is the necessity to realise longitudinal and transversal waves or 'space structures' - light has to be more or less best 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 (3-dimensional) at interfaces (e.g. liquid surfaces) or in solids. Common to both cases is the existence of back-driving or resetting forces of/within the medium 'carrying' the waves, a medium with at least some kind of elasticity. Thus a fundamental demand to the aether had to be a repulsion force between the Aea resulting into elasticity in a first of all apparent gas-like medium. There should be no attractive forces at all between the Aea (no self-agglomeration). 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 or better by an ideal electro-fluid without the effect of charge; any Aea is solely repelling any other Aea - comparable e.g. to a compressed pure electron gas. This elasticity based alone on repulsion forces would allow the propulsion of photons with predominant transversal periodic oscillation processes. By accepting an aether as an (quasi)elastic medium there should be in addition taken into account (like within e.g. solids) that there could be different limit speeds for transversal (light or particle motion) and faster (!) longitudinal mechanisms (e.g. Longitudinal Photons, LP) which is a well known phenomenon in elastic solids (direct and indirect transfer mechanisms).

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/change of direction of such moving internal states by help of identical structural units (realising transversal oscillations). The only real translation in this case is thinkable by exchange mechanisms known from diffusion processes. Within solids 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 the aether, that are repelling each other, any collective, sufficiently fast, synchronised motion of Aea (of a 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, Dark Energy or expansion force).

A medium of smallest in-distinguishable structure units that allows them a motion with an average free length of way obviously has to be called a gas and had to follow the well-known laws of gases. This has to be completely excluded for an aether with electro-fluid action. (But due to the extremely small size of Aea and their lack of mass a completely different new gas constant R were now necessary.) In case of an unlimited expansion of aether into a true vacuum the aether would develop to such an Aea-gas. To transform a compressed Aea-gas into aether all Aea have to come into a state of mutual touching. Because even now the Aea should have the possibility of very high speeds, Aea need the nearly unlimited and reversal ability of compression/'size'-reduction/size-adaptation. An increase of the aether-density with always given mutual touching means a reduction of the distances between the centres of the Aea and increases the energy stored in the medium (within the Aea). A mutual compression of Aea appears to be comparable to a mutual repelling of the structure units and realises some kind of electro-fluid behaviour. This energy can be regained due to density-reduction if the aether is locally expanded or expands and with this also the Aea. A mutual compression of Aea appears to be comparable to a mutual repelling of the structure units and realises some kind of electrofluid behaviour. This kind of energy is generally ascribed as Dark Energy. The local variation of the aether density is described within the GRT with the static model of 'space warp' (however without considering the dynamic behaviour of streams necessary for the creation of those density-gradients and therefore getting problems for GRT the in case of non-radial-symmetric arrangements).

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. 2 of part 2, cosmology). To any observer within such a region this phenomenon could appear as 'expansion of space'. Thus a model of an electro-fluid aether with Aea repelling, pushing each other away thus could give a perfect and logical explanation for a mysterious Dark Energy, which explains in a straight way 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 (or giant streams?) of Aea create such internal stress for a finite but fairly long period of time via a shock-front during their collision within a tremendously large region. 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 LP). This is completely impossible in the very special case of repulsion forces between the components of an aether, because there cannot be smaller units transferring impulses between the Aea. Thus the mutual repulsion of Aea can only be an action that is connected with a repulsion caused by immediate approaching with touching/deformation or interpenetration of each other. Aea thus could possibly possess internal excitation states, oscillation states (e.g. radial-arranged oscillating Strings with nearly unlimited folding possibility) perhaps such as discussed for instance within the string- or M-theories. However, this would be possible here without high-dimensionality (only within three space dimensions). The use of interpenetrating aether units (quasi-unrestricted deformation or interpenetration of each other) - that are permanently and fluctuating in motion - 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 or penetration 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 also as a further possibility a spectrum of various frequencies and thus of various 'ranges' of e.g. alternative 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 of the author Aea represent the only fundamental indistinguishable 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. With a complete expansion of the aether the aea achieve their maximum extend and move now with a corresponding free path length within an aea-gas. Because they realise definitely something like 'vacuum energy' they do have to overlap/contact each other within our part of the universe and thus should be clearly larger than the Planck length in case they exist (within the aea-gas) individual. 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 material world. The only possible wide-area relaxation processes of the aether are the expansion within a surrounding region of reduced Aea-density and the more local density reduction due to the reversible, dynamic mechanism of gravity.

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 (of our local surrounding region) 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, also somewhat stress reducing mechanism (besides the dominating expansion as a whole) is the emission of longitudinal photons with some excess of Aea. 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 as permanent energy supply. The basic prerequisite enabling physics of matter with static fields thus is probably related at least to the possibility of an evolutionary development such as a Big Bang. In addition the universe solution (c) should be favoured (any formation of a shock-front via collision follows a pressure reduction), because EM-fields and gravity have to be acting also within the 'periverse' (the physical space between and around the many comparable Big Bang systems) after the final stage of the Big Bang to generate there new Big Bang possibilities. I.e. also within the periverse (at least billion times larger than 'our [partial] universe') a permanent relaxation of the aether is necessary there to realise the maintenance of the action of gravity. In our part of the universe - that cannot represent THE universe - presently the part of energy given by Dark Energy is determined with about 70%. With proceeding expansion (reduction of the aether density) this percentage has necessarily to decrease permanently. As soon as in far future this percentage has reached 0% for our(!) partial universe the aether density will have adjusted to the one of the also and further expanding periverse.

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 momentum density) is causing space warp. According to the new understanding of the mechanism of gravity (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 gradient of the density of Aea. The experimentally investigated close passages of photons with mutual crossing of their trails (characterised by density gradients, dynamic local space warp) causes 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 therefore also to occur with the parallel flight of photons (even across cosmic distances no auto-focussing within vacuum noticeable). 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 gravity or static gradients. In the present stage of cosmological development the additional incorporation of photons within 'static considerations' gives no noticeable difference, is negligible. However, in the very beginning

of our universe (our Big Bang system) 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 (no gravity-like space warp), despite of the enormous energy concentration. This is one essential aspect to avoid within a pre-existing space-time the action of a Black-Hole-singularity after the Big Bang and to allow expansion despite of the enormous energy density.

With all the ideas developed up to now 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/last chapter of this text 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 chapter 8 for more details). The strength of the depletion or enhancement of such Aea-density-regions depends on the energy (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 - the borderline to Gamma-rays is crossed. 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 common cavities might swallow parts of the photons. It creates a pseudo-orbital (forced circulation/localization) of the photon pieces inside of the cavity and immediately introduces an intrinsic field of LP-emissions 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 common micro-cavity by the collision of two high-energy 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 with extreme Aea density). The additional action of 'spin' is created. Within this process the opposite photon

spins transfer in some way a maximum angular momentum to the outer regions of the cavity and by the extreme forces at the horizon of the cavity a maximum density of the Aea is forced. While the moderately moving or 'diffusing' Aea are characterised by some kind of mutual short-range repulsion 'potentials' with radial symmetry, the produced spin-shells give rise to a summing up, a smeared-out repulsion potential of the shell as a whole resulting from the common action of all involved high-compressed Aea. 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 created accompanying frame dragging. Thus for elementary particles this results in a global action between spin-shells against each other (especially their frame-dragging-effect) - this is the essential 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 (inside of electrons) with stochastic occurring hits against the spin shell within an electron or positron in addition circulating quasi-periodical but also 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 gravity).

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 [C.W. Turtur; [http:// arxiv.org/abs/0710.3253](http://arxiv.org/abs/0710.3253)]. Here it is sufficient to use the simple consideration with classical electrodynamics. Thus it has necessarily to be assumed that the LP increase somewhat their dimension during travel through the physical space and loose in such a way some transferable energy/energy per volume (reduction of the absolute value of the corresponding wave vector).

Despite of a dimension comparable/smaller than that of an electron, LP should have an expanse larger than their main central structure due to density variations in their surrounding (possibly they are vortices). This prevents the mutual approach/repelling of LP of the same kind and forces mutual giving way. Only during the annihilation of LP of different kind (necessarily of different sources) an individual way of interaction and elimination for near-field-LP (restoration of the usual aether density with slightly local enhancement of DE) might 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 possess 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 strength of the caused interaction should be given by their radial impulses. 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 momentums 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 angular momentum from the spin shell. Therefore the magnetic action should be understood as the additional tangential or angular momentum of the emitted LP (influenced in addition by the necessarily existing Lense-Thirring-effect). Magnetism appears to be the angular momentum of the electromagnetic field, of the whole field of emitted LP. The general term charge reflects the totality of the radial momentums of the LP-field of an elementary particle, the general term magnetisms for the totality of the angular momentum components.

The vector of the angular momentum \mathbf{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 impulse, the 'magnetic action', is simply given by $P_t = D_0/r$ (D_0 the amount of the starting angular momentum, depending on the 'latitude' of the spin shell; maximum at the 'equator'), because the angular 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 \leftrightarrow 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 - as will be visible somewhat later - the possibility to integrate gravity and to deduce with it the structure of photons.

With the experiences related to the technical generation 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. Due to the above gained understanding of magnetism as being part of the angular 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 angular 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 angular 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 (diameter of circulation within the order of 10^{-22} m with c) 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-momentums. Actually it is in some way the same kind of vortex around a current that has already been considered by Faraday to explain magnetism. It is not the expected current flow, the movement of the charges, but the number of aligned charge carriers within the beam that causes the strength of the magnetic field. The lines of the magnetic field correspond to the tangential direction of motion of all LP with the same strength of angular momentum. The paths of the LP (away of the electron) are actually only

straight lines but their tracing back (extrapolation) is not going through the centre of the corresponding emitting electron.

In the model proposed here, the electron is a real gyroscope and the alone acting source of both the electric and the magnetic field by emitting the field quanta (LP) into infinity, always with radial momentum and at the same time angular momentum. The field is always a field with both effects and its realized effect depends only on the frame of reference and its relative movement to the field. Both types of the field are never separate or independent of each other. The field quanta, once emitted, can undergo 'changes in intensity', but cannot change from one 'type of field' to another, even if this has been proposed as a model by Maxwell using his corresponding equations. What we call electromagnetic waves thus cannot be generated or transferred by a direct change of one kind of field into the other.

The common view that feasible and usable magnetic fields are produced by the movement of charge carriers is only partially correct. It is the initial acceleration that leads to the alignment of the electrons and thus to the normal formation of a magnetic field around a beam or a conductor. In order to demonstrate the formation of the magnetic field solely from the intrinsic action of the electrons, J. de Climont (www.gsjournal.net (2014)) proposed an experiment in which an electron beam in a vacuum has to be deflected by 90° by an external field. (For the first time, such serious deviations from Maxwell's equations were observed during the development of cyclotrons on 'erupting' rays, but the fundamental significance associated with such phenomena was not realized at that time.) However, the expectation that no magnetic field will occur around the deflected beam (because the electrons should remain stable oriented within space being a gyroscope) cannot become reality. Of course, the fields of the electrons are conserved, so that now a (linear directed) field has to occur only perpendicular to the deflected beam and along the beam (not around the beam as usual). Within measuring coils around a pulsed beam, a somewhat reduced signal should still be expected.

For such a deflected beam, the Maxwell-Ampere-equation ('law of flooding') is no longer meaningful. While a later confirmatory statistical description via particle motions was developed in addition to the phenomenological thermodynamics, something comparable has never been attempted or undertaken for electrodynamics. The fact that the above discussed phenomena (linear directed magnetic field) do not also occur for electrical conductors is due to the unavoidably high density of impurities/irregularities in these materials. In the curved conductors, the electrons will suffer collisions quite quickly and must then always be accelerated again by the field within the conductor. The field direction is always aligned with the curvature of the conductor, so that the electrons are generally accelerated along the curved wire. This is the basic cause enabling us to use solenoid coils with the effects we are

familiar with. Since in the 19th century there was no possibility to trace electromagnetism back to elementary particles and their properties (especially their orientation), it was concluded from the experimentally found data that stationary charges must be associated with electrical action and moving charges with magnetic action. Of course, this statement is ultimately correct, but no understanding or cause could be given at that time.

However, as soon as it becomes clear that both effects originate from one and the same particle, it should be the total effect of all the different particles/charge carriers with different statistically varying orientations. Today's possibilities of modern physics have made it possible to keep electrons / charge carriers at rest for a long time and to measure them. In doing so, they show both their electric and a magnetic field, but in the belief in the almost unlimited validity of Maxwell's equations, this is only called a 'magnetic moment' and not the primary source of any magnetism. Since fields should be realized by the emission of field quanta, the experimental finding of both effects simultaneously is to be understood as a strong indication of the reality of the presented model with radial impulses and angular momentum. Since electrons should be extremely small, but definitely have to have a finite size, the spin, which is usually seen as a pure quantum property, can only be seen as the actual rotation of the particle and the electron as a true gyroscope.

Usually, a separation is used to explain magnetism with regard to the magnetism inherent in solids (permanent magnets) and magnetism that is (apparently) caused by the movement of charge carriers (electric conductors, electron beams). However, such a separation actually becomes needless if an electron model with an emission mechanism (as in this text) is assumed. In permanent magnets, the field is mainly described by the directional spin orientation of electrons as a result of their intrinsic magnetic moment, their spin, in suitable atomic shell orbitals. It should be noted that this spin orientation is maintained in the atomic shells during the orbital orbiting, though there is a deflection of the electron motion as a result of the nuclear field. Since this deflection is energy-conserving, the orientation of the spin will be preserved just as in the case above of the energy-conserving beam deflection and therefore the real existence of permanent magnets is actually already a proof of the validity of the expected statements about the deflected electron beam, the effect of which should also be given exclusively by the intrinsic magnetic moment of the beam electrons or of currents in conductors.

The remaining difference between the 'different types' of magnetism is the fact that in solids, only a fraction of the electrons contained can contribute to field formation, while in electrical conductors practically all free charge carriers can be made to align the spins, and thus the efficiency of field formation is generally much greater. In the case of electrical conductors or electron beams, the spin alignment is produced by the process of electron acceleration, which inevitably sets the electrons in motion. The cause of magnetism here is therefore the

acceleration/alignment, but not the necessarily resulting movement of the electrons, the current flow. Though the movement of electrons in the atomic shells through the nuclear field represents an accelerated motion, but the deflection takes place in an energy-preserving manner, no radiation of electromagnetic radiation/photons can be produced in this process.

The Maxwell equations of electrodynamics, regardless of the value system or form of representation used, have a fundamental and general statement: The temporal change of one field quantity leads in a clearly defined way to a corresponding change of the other field quantity. These equations have been extracted in a phenomenological way from experiments by Faraday, Ampere and others and therefore use the basic statement that the two fields (electric / magnetic) represent separate and different fields that must have corresponding relations to each other and/or interactions with each other. All this in the 19th century without an actually necessary knowledge about atomism and the structure of matter on the basis of corresponding elementary charge carriers. For example, we now know that electrons, for example, represent both the starting point/source for the formation of the electric and the magnetic fields, although clearly the latter field is considered to be 'source-free' (with regard to the 'construct of field lines').

It is completely impossible that a particle such as the electron could emit more than one structural different type of field quanta and therefore it should generate only one field, the electromagnetic field, which has to be characterized by two different active components (radial momentum components and angular momentum components). Thus, the basic assumption of two different fields immediately turns out to be wrong. Therefore, in principle, migrating fields detached from the emitting particles cannot be converted from one 'field type' to another 'field type', especially since both active components should be given by conservation quantities. So if this basic assumption does not correspond to reality, how can it be that Maxwell's equations provide completely correct statements in almost all practical applications?

While the pure phenomenological way of interpretation of the experimental data leads to the simple and basic statement: a field-1 change results in a field-2 change. The microscopic, i.e. particulate analysis, however, gives the statement: a field-1 change results in a force effect and influence on charge carriers (acceleration / **spin orientation** / excitation ...) in the matter used for the experiments which thus in consequence leads to a field-2 change. At first glance, this does not seem to make a significant difference to the phenomenological view, but it immediately makes it clear in which areas of application Maxwell's equations must cause problems. 'Technical' physical vacuum is defined as a region of space without, or with extremely low density of matter, and matter effectively consists exclusively of charge carriers. In such a vacuum, therefore, there may not be sufficient charge carriers that can be

influenced. Thus within all applications in high vacuum, serious deviations are to be expected, such as for the above-mentioned redirection of electron beams with beam energy conservation within high vacuum.

Thus a far more fundamental and serious problem arises when Maxwell's equations are applied completely and exclusively in a vacuum without taking into account or knowing the usually hidden microscopic view. From a purely mathematical point of view, it is undoubtedly possible to couple different Maxwell's equations in such a way that a 2nd order differential equation (known as a wave equation) is created. However, in the complete absence of charge carriers that could be influenced, the underlying chain of effects expected in a phenomenological way: field-1 change \gg field-2 change (and periodically vice versa) must fail here! In principle, there can be no 'electromagnetic waves' of this kind. All our areas of application with light or communication technology can only be realized by swarms or 'fields' of suitable photons with suitable relations to each other or with changing field emissions of large ensembles of charge carriers. But just as we will no longer be able to remove the actually incorrect term 'atoms' from our parlance, we will also have to continue to use the actually in some cases incorrect expression 'electromagnetic waves'.

When free or quasi-free charge carriers come to rest, they fall into a state of complete disorder of spin orientation in order to achieve a minimization of the total energy. If they are set in motion again, i.e. they have to be accelerated, they are all aligned with the accelerating field. In the first case, all angular momentum of the LP statistically cancel each other out and we observe a state of the electromagnetic field, which we generally refer to as the 'electric field'. In the second case, the angular momentum components intensify and a state of electromagnetic field is created, which we usually call 'magnetic field'. Both are STATES of one and the same field. In both cases, however, the field emission takes place simultaneously from a very large number of charge carriers and individual field quanta (LP) are always emitted. Strictly speaking, the EM field is therefore actually radiation, the emission of field quanta.

With the invention/discovery of the oscillating circuit in 1886 by H. Hertz, it became possible to produce these two above considered states in a stable and constantly periodically changing manner. The field emission of the respective state of the oscillating circuit can be optimised by suitably designed antennas. An oscillating circuit generally consists of a capacitor connected to a conductor, preferably in the form of a coil. During the charging of the capacitor, the free conduction electrons involved increasingly come to rest, the electrical state builds up and the resonant circuit/antenna emits now the propagating field of an electrical state. With the increase in voltage at the capacitor, the discharge and acceleration of the electrons now takes place and subsequently the magnetic state arises, which

expands/spreads out into space at exactly the same speed with regard to the usual field propagation.

For any receiver that is arbitrarily far away, a periodically fluctuating field with a change of state can be detected, which is generated solely by the charge carriers in the resonant circuit and propagates merely as a 'field'. It is not an electromagnetic wave in Maxwell's sense, but a propagating 'wave' of the state of the electromagnetic field, which may be shortened but incorrectly called electromagnetic wave. In Maxwell's equations, it is assumed that a field change directly (without the participation of charge carriers) causes a field change of the other kind and that therefore a wave is formed as a result. But this is an application beyond the limit of validity of the equations, not with the presence of corresponding material means with large numbers of charge carriers, as they were used in the experiments used by Faraday or Ampere, for example. The equations must also fail if, as in quantum mechanical considerations, only single/few charge carriers are present.

It is possible also to prove the failure of Maxwell's equations for this type of emissions with a simple experiment. If a resonant circuit is controlled in such a way that only a single half-wave, e.g. an electric half-wave, with a well-measurable wavelength of at least a few meters is emitted. Then the spreading of the half-wave within space can be tracked by placing several measuring points with electrometers at suitable intervals. (Since the measurement weakens/absorbs the signal locally, the probes should not be arranged in the same spatial direction.) If Maxwell's wave equation were meaningful, a magnetic half-wave (and back again) would have to form immediately afterwards, so that an electrometer cannot receive a signal at the appropriate distances. Alternatively, electrometers and magnetometers could also be used in parallel. But at any given distance, only the migration of the electric half-wave with increasing and then decreasing field strength will be observable.

Even if in the case of radio waves one still calls them 'electromagnetic waves', it is immediately clear that this is no longer possible in the case of light. Light is to be understood exclusively as radiation with light quanta, photons, whereby the periodic structure of the photons and their internal motion structures additionally causes the generation of longitudinal waves and photons can thus interact with each other, since they have to move through the substrate of everything. The emission of the photons, in contrast to radio waves, is carried out by individual electrons and the basic structures of the photons are now given by agglomerates of field quanta (in this section the details will not yet be discussed in detail and must be the subject of the next section 8).

In ignorance of the limits for the applicability of Maxwell's equations, light is still understood as an 'electromagnetic wave' - despite the knowledge of its composition by means of photons. We are therefore accustomed to find in encyclopaedias or textbooks a

representation of the different spectral ranges of radiation separated by frequency or wavelength along a single line. In the future, this will have to be done by two separate straight lines, whereby the range with possible frequency overlap between light and field state waves will certainly have to be specified a bit. Even if suitable 'fields' of photons can cause a phenomenon that appears to show the presence of alternating electric and magnetic fields as an overall effect, this is nevertheless no evidence for a character of light as EM waves. EM fields show their effect by means of the transmitted impulses of the field quanta. However, it does not matter whether many individual, separate impulses create this effect or whether this is done by the summary effect of field quanta in larger clusters. What the types of radiation have in common, however, is the fact that they both ultimately and fundamentally based or rely on the existence and emission of EM field quanta.

An important aspect in the search for a suitable structural model of photons in the following section 8 is the fact that LP (as the only conceivable 'construction material') can practically only perform a rectilinear motion, but a periodic motion within a photon is definitely required. Therefore, a clustering of LP with an additional angular momentum/twist/spin of the entire cluster had to be considered, which now allows a curved motion along its path. However, such cluster formation is only conceivable by a movement within a substrate medium via a compression zone in the direction of movement and must necessarily also be connected to an depletion zone with a suction effect behind the cluster. However, this is precisely the basis for the formation of the property (inertial) 'mass' in the case of the real existence of a substrate of everything. This results in the curious situation of mass possessing structural units within photons without mass. However, since the structural unit photon as a whole cannot cause any further accumulation phenomena, this is still possible. Recent compression measurements at a photon gas have shown that at extreme density the photons should destroy each other (setting free of the LP-cluster), which is noticeable in strongly increasing compressibility, and now the property of weak mass effect could actually be measured (E. Busley, L. Espert Miranda, M. Weitz, J. Schmitt Phys. in unserer Zeit 53 (2022) p. 166).

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Following the process of enclosure of a restricted region of aether by the developing spin shell and having a varying 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 a fully 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 'static waves'. 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.

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 (creation of longitudinal photons with additional enhanced density) - at least compared with a homogeneous density distribution in the interior. (At the same time, such an internal gradient hinders the formation of LP with reduced-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 less 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/substrate away, the emission of the ones with reduced density causes some reduced enrichment close to the emitting particle and thus the transport of aether away cannot be balanced anymore.

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 by both kinds of

LP of both kinds of particles. This effect, the resulting force, acts therefore in only 'one direction' (solely attractive), results in an enhanced transport of the substrate-medium, of Aea, away, results in a depletion zone around both kinds of elementary particles or matter that in return causes a corresponding forced radial back-stream towards the particles trying to equalise the density distribution. This is the source of gravity, the creation of far-reaching static (but dynamic created and maintained) 'space warp'.

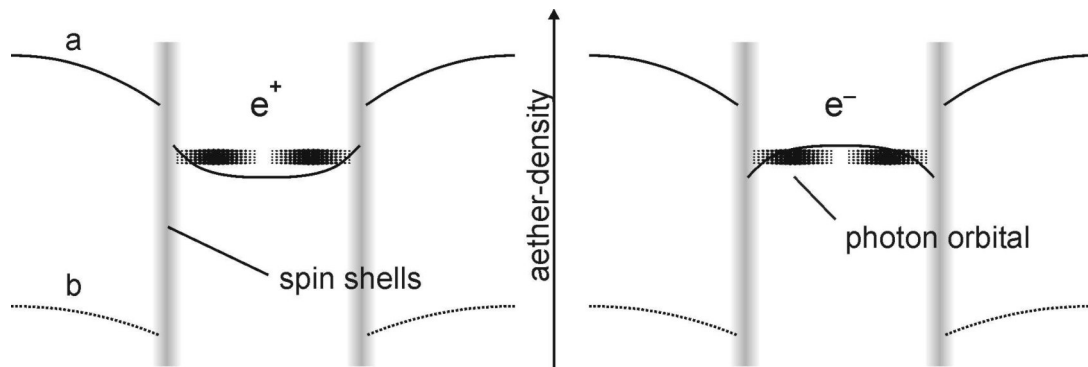


Fig. 3: Schematic drawing of the radial aether density distribution around elementary particles; the outer graph (a) symbolises the gravitative depletion close to the spin shell short time after the Big Bang within the period of matter generation; graph (b) symbolises the situation for electrons within 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)

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 possibly e.g. Casimir effect), however, both sights for their generation, type or 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 (electromagnetic field) by both kinds of elementary particles results - averaged over a sufficiently large volume - in a complete

extinction or balance (neutrality). This holds at least if both kinds of particles exist with exactly equivalent numbers - realised via their generation through pair creation; no asymmetry between matter and antimatter. However, due to the mechanism of gravity discussed above there might be now a very tiny asymmetry between the emitted longitudinal photons by the elementary particles with different signs giving a tiny surplus of emission, 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 masses) sufficiently strong effects. Within this model matter concentrations represent something like permanent-working weak 'aether pumps' via their emission of longitudinal photons with slightly enhanced (non-balanced) aether density. They necessarily have to initiate a corresponding back-stream towards this matter.

Presently there are several attempts to modify Newton's law of gravity and the model of space warp of General Relativity - they are unable to explain some experimental findings and anomalies. All experimental 'proves' of the mentioned theory are founded only on tests with radial symmetry (Schwarzschild metric)! However, anomalies were found exclusively for non-radial symmetries. Among those problems there are e.g. the on principal insufficient-accurate measurements of the gravity constant G by non-radial-symmetric devices, the mine/borehole- G -anomaly (measurements in deep boreholes of the Greenland ice) or the distribution of the rotation speeds within spiral galaxies. As possible solutions of those problems usually one considers on the one hand an empirical modification of one of the Newton axioms (MOND) or on the other hand a replacement of the Newton acceleration field (within GR realised by a model of space warp) by a velocity field, by a fluid-in-flow-system of 'something' towards matter. The last mentioned attempt by R.T. Cahill [see e.g. R.T. Cahill, *Apeiron* 12, nr. 2 (2005) p. 144] has to be seen as the most promising one, because it could find in all up to now known cases of anomalies an experimental confirmation.

Common to both mentioned new approaches is the fact that the description of gravity now needs beside the gravity constant G a new second constant of nature. In case of the fluid-in-flow-model the adjustment to the experimental data clearly results in a further constant that is already well known as electric coupling constant or fine structure constant α . This at least strongly suggests a connection to electromagnetism. For radial symmetry Newton's law of gravity and GR may be developed out of the Cahill theory as a borderline case. With an assumed in-flow and the non-understood relation to electromagnetism this new theory thus represents an already existing direct description of the model of gravity and the generalised field model developed within this text.

With respect to the question 'what' might be there streaming, within the cited text it is referred to the possibility of a quantum foam structure of 'space' - in accordance with the present understanding that there cannot be an aether - such a space filling medium is basically refused. However, therefore now space has to be considered to be a true medium or a 'substance' as such and the model of vacuum fluctuation is seen as being valid. All 'proves' of such a fluctuation (e.g. Lamb-shift or Casimir effect) are equally well explainable by a space filling aether as shown within this manuscript. By deep thinking it is possible to recognise in an easy way that not only the appearance of any wave but also any action and therefore any kind of energy needs a carrier (e.g. kinetic energy/heat) or a carrier medium (e.g. potential energy/fields). Hereby any thinkable 'carriers' by itself represent energy or need energy for their generation. In many cases such a sight (of a carrier medium) appears to be seemingly trivial, but for phenomena within the (physical) vacuum (e.g. EM-waves, vacuum fluctuation or gravity) this appears to be much more difficult. Using as a general solution the 'physical vacuum' and thus making space to a medium we actually do have the serious problem that the now defined 'medium space' again needs space to exist within!? Thus the space surrounding us should be better filled with a suitable medium.

Frequently a first lecture of physics starts with the basic statement: 'Wherever there is a body, there cannot be another one.' On principle this is a definition of a space within that space all physical processes occur, i.e. motion of different kinds. Here we should speak of cause more general about physical structure units. Motion is possible, as soon as there are neighboured non-occupied positions, which can be truly occupied by such moving structure units. That means there exists 'true vacuum' = space. Alternatively motion is possible, if 'perfect' displacements are possible. (Friction free) motion is therefore also possible within a medium with electrofluid-like-acting structure units such as the Aea of a space-filling aether. On principle space itself cannot be influenced at all by something, it can be only more or less densely filled with physical structure units. Within the here described model of an aether on the basis of units like Aea Dark Energy is now very easy to understand as the 'compression degree' of those always mutually touching and repelling structure units. As a theoretical basis of description there is now the need of the development of an Electrofluid Dynamics (EFD) that could be called the physics of aether or of the physics of 'hidden variables'. It is existing beyond the validity limits of Quantum Mechanics. This lowest level of physics has to be understood as the basis of Quantum Mechanics (the physics of small amounts of matter) and cannot be described by the laws of QM. Thus on principle the possibility of the existence of an EFD cannot in general be excluded by the application of the laws of QM.

To prove the given suggestions and especially the existence of an eather it should be tried to influence gravity locally. On the one hand it should be possible to screen or deflect the EM emissions (LP) itself. But this would be no anti-gravity in the true sense and results only into

a very weak change. Also neutral matter is permanently emitting LP, but this is an emission with perfect balance of the LP types. Some of such deflection is possible by superconductivity (Meissner-Ochsenfeld-effect) and might represent the only up to now realised influencing on gravity. Those changes are however very weak and thus are experimentally not truly verified. Because gravity means effectively a local reduction of aether density, now true anti-gravity is solely thinkable by a local enhancement of this density with local setting free of large amounts of aether.

Such a setting free on a grand scale in a single event and with tremendous amounts is usually described as Big Bang (see part 2, cosmology) where within a very short time enormous numbers of pairs of electrons and positrons are annihilating. Aether contained with high density within the spin shells of the elementary particles is now set free. Thus to prove the aether model an easily realisable experiment should be tried, attempting to direct currents of electrons and positrons against each other and bring them to annihilation within a suitable and radiation shielded vacuum chamber to locally influence gravity in a more noticeable amount. Here via the energy of the mutual acceleration of the particles the two photons are created and the energy of the destroyed spin shells enhances the Dark Energy (DE), i.e. increases locally the aether density. Because the photon energy is balanced by $E = mc^2$ this demonstrates, that all present considerations of the Lepton energy is reduced to their inertia and completely ignore their main energy content, the DE.

The effect of gravity, 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 such objects (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 within a finite volume. 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 (compare part 2, cosmology).

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 and gravity). 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 'electron' as a whole always is characterised by **longitudinal** oscillations/emissions into 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's more difficult to row across wavy water than across a flat sea.) 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 during the necessary reactions of transversal displacement. Thus such an orbital system can never achieve the speed of light, the maximum speed of transversal processes.

An extended, completely enclosed physical object that is moving through a 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 permanent 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 the case of elementary particles, because there are no possibilities for dispositions. The spin shell of an elementary particle consists also of aether such that the Aea are rejected by 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 and creates and determines with this the inertial mass.

A reduction of the surrounding density of the substrate/aether density due to the cosmic expansion lowers especially the compression ahead and a particle with a given defined momentum is necessarily now accelerated and gains higher kinetic energy (reduced 'inertia'; the reduction of the accumulation zone of any elementary particle involved within any moving mass effectively reduces the effective mass, which leads to an increase in velocity due to conservation of momentum $p = mv$. The kinetic energy $E = \frac{1}{2} mv^2$ must therefore increase despite of mass reduction). Thus the expansion of our universe transforms permanently Dark Energy into kinetic energy of ('friction-free') moving particles/masses/structure units. The conversion of dark energy (of the action of cosmic expansion) which maintains

electromagnetism and thus also gravity, is given by $dE_{\text{kin}} = p^2/2dm$. This surprising finding is opposed by the experimental observation of constant uniform (non-shielded) motion by absence of external forces (axiom of Newton) and indicates the presence of a corresponding suitable and balancing emission mechanism discussed in the next chapter, the emission of matter-waves emitted as truly existing and truly acting longitudinal waves being the result of the movement of all particles through the substrate.

The electron (/positron), as the most important elementary particle in the universe, has a rest mass of $m_e = 0.511 \text{ MeV}$, but is characterized by a surrounding electric field with a much greater field energy than that given by the equivalent of its mass, which must seem completely incomprehensible at first. From the electric field strength E , the elementary charge e and the electric field constant for the (physical) vacuum ε_0 , the energy density of the field is given by:

$$\frac{dW}{dV} = \frac{1}{2} \varepsilon_0 E^2 \quad \text{with} \quad E = \frac{1}{4\pi\varepsilon_0} \frac{e}{r^2} \quad (11)$$

Using spherical coordinates/radial symmetry, the field energy of an electron can be determined simply by integrating it over the entire volume with

$$W = \int_R^\infty \frac{1}{2} \varepsilon_0 E^2 4\pi r^2 dr = \frac{e^2}{8\pi\varepsilon_0} \frac{1}{R} . \quad (12)$$

Here, the near-field around the electron is decisive and the energy contribution far away is close to zero. The inner cut-off radius R thus effectively determines the achieved value of the field energy, but R is actually unknown, since the electron size cannot be specified at present. If one assumes by means of $E = m_e c^2$ that the field energy cannot be greater than the energy equivalent of the electron mass, a so-called 'classical electron radius' r_e can be determined with Eq. (12), which lies in the size of a few fm, i.e. would correspond to the size of smaller atomic nuclei. This value obtained depends somewhat on the type of 'electron model', whereby a 'smeared out' charge on the surface or within the volume is usually assumed. However, the author rejects such views, since the charge must definitely be quantified in units of the elementary charge and can only occur as an integer and never smeared out in much smaller portions. The term 'charge' should rather be a global description of the overall effects of a large number of individual mechanisms of action of the electron, which unfortunately will never be directly accessible experimentally.

However, high-energy interaction experiments with electrons can clearly show that the size of electrons must be smaller than 10^{-19} m , whereby it could also be proven that Coulomb's

law is still valid even in these dimensions. (Through high-precision measurements for the magnetic moment of the electrons, even a maximum value of a size of 10^{-22} m can be expected.) With eq. (12) and such a small electron size (radius R) it must therefore be accepted that a field energy many orders of magnitude larger than that of the energy equivalent of the rest mass exists, and it becomes clear that this high field energy can only be realized by either a contribution of vacuum energy or by dark energy/expansion effect.

Both in the context of STM and in quantum electrodynamics, space (actually physical space or physical vacuum) is considered as a medium that is subject to the laws of quantum mechanics (the basis used for this, quantum mechanics, is only proven experimentally for small amounts of matter and transverse photons and should not be transferred to the physical vacuum without hesitation). For the interaction between charge carriers, the exchange of photons is considered, although it is left open that they could also be longitudinal photons. The latter, however, are fundamentally and completely different from the structural units of light that are usually understood by them, and the longitudinal photons will have to be afflicted with very different effects. The main problem with these models, however, is the fact that this chosen basis (vacuum fluctuation) results in a vacuum energy that is 120 orders of magnitude larger than the experimentally determinable one and thus indicates/proves that hereby one of the basic assumptions should be incorrect. By assuming the validity of the QM for this 'medium space', vacuum fluctuation or polarization is now thought to be possible, which thus could in principle provide an explanation for the field energy and is presently used in this way so far.

In the counter-model considered and presented in these texts, the current taboo of a supposedly non-existent 'substrate of everything' has been ignored and no description of the medium by quantum mechanics can now be used in this space-filling medium. Of course, this medium must be determined by its own laws. In order to be able to achieve the field energy here - with no vacuum fluctuation at all - it is imperative to include the so-called dark energy, the expansion effect of the substrate. As shown above, however, energy transfer/energy gain due to expansion can only take place by accelerating suitable structural units. For the development of an electron model in the last chapter that follows, the search for a suitable structural unit was therefore of central importance (field quanta agglomerates created by dynamic interactions). Since electrons are only formed by the 'collision' of photons of sufficient energy (pair generation), these structural units must also be a component of photons and thus both structural models for electron and photon cannot be developed independently of each other. The above taboo is essentially based on a misinterpretation of the basic assumption of the theory of relativity, the constancy of the speed of light independent of the reference frames, which also applies equivalently to the speed of sound

as soon as the carrier medium is at rest (but now necessarily $v < c_s$). Here, too, the speed of sound is independent of the movement of the source and receiver. Decisive for this speed are solely the existence and the properties of the carrier medium, both for air or for the substrate of everything in the physical vacuum. The basic assumption for the special theory of relativity thus even indirectly demands the existence of such a substrate and the correctness of the theory (special theory of relativity) is therefore actually a proof of its existence.

A continuous uniform 'straight' motion is maintained as long as no external forces are acting and as far as especially 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 spin shells - that represent completely closed structure units - 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 (no friction).

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 (neutrinos?) 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, the speed of

sound in crystals? 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. This analogy is a direct proof for the necessity and existence of an elastic substrate, where the well known fact of frame dragging actually represents an even stronger hint for the existence of an 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 tree-part-structure being a boson. In effect this might be seen comparable to a neutrino 'emission'. The consequence for all 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 angular 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)?

Within the Direct Structure Model free neutrinos probably represent solely individual spin shells without enclosed photon parts. Thus they are unable to emit field quanta (LP), means they are neutral and in addition cannot cause the slight asymmetry for quanta emission that results usually to a transport of surrounding substrate away of the particles. Therefore neutrinos could not own gravity or 'heavy mass'. But being self-contained regions preventing the entering of surrounding Aea they nevertheless create ahead a compression zone und behind a depletion region and thus a very low inertia via motion or acceleration relative to the surrounding aether. The equivalence or coupling between inertial and gravitational mass usually expected as a matter of cause for all material objects is only given to a limited extent

within this new model. Thus within the universe as a whole neutrinos cannot contribute to the 'balance of gravity'.

With the reintroduction and acceptance of a substrate of everything (aether), the action and mechanism of gravity can be explained for the first time by the necessary development of gradients of the substrate inside of (charged) elementary particles, whereby this evolves into an asymmetry with respect to the formation/generation of enrichment-LP and depletion-LP at, outside or close to the spin shell. However, it must now be added that as a result of the formation of accumulation and suction zones on moving particles, as an effect of the external further local density gradients of the substrate that have now arisen, a second influence in the development of the asymmetry of the two kinds of LP arises. The stronger the external gradients become, especially in relativistic motion, the stronger the asymmetry and thus the effect of gravity. An increased ambient density of the substrate, e.g. in the accumulation area, increases the density for a formed overpressure LP; however, an increased density also reduces the possibility of formation or effect of depletion LP.

Thus, while the gravitational mass is primarily generated by internal gradients inside of the electron, the formation of its inertial mass is given by the accumulation/depletion effect as a result of its movement (formation of accumulation and suction zones). The latter, however, causes an increase in the accumulation effect, of the inertial mass, associated with the speed and thus in addition the strengthening of the gravitational mass. Today, a seemingly perfect equivalence of both mass effects is assumed and shown experimentally. However, with the above finding by means of a DSM and an acceptance of the existence of a ubiquitous substrate, there should be a weak violation of this equivalence due to the gravity-free neutrinos, whereby the difference in mass should be less than 10^{-4} . According to the DSM, a proton consists of 11 charged, highly relativistic leptons (6 positrons and 5 electrons) and 22 neutrinos. However, since the neutrino mass (as an upper limit) only accounts for about 10^{-5} of the electron mass, its contribution to the inertial mass is very small, neutrinos have no contribution to the gravitational mass, as indicated above.

What is remarkable about the emergence of relativistic mass (both inertial and gravitational) is the phenomenon that mass increases resulting from relativistic motions adding up additively with different, simultaneously existing directions of motion. Thus, with a negligible neutrino mass, the mass of the proton in the DSM is effectively only given by the mass of the 11 charged leptons, which have a rest mass of only $11 m_e$. However, when the quarks are formed in their relativistic orbitals, they acquire a total mass of $1543 m_e$ ($137,036 m_e$ per electron and about $143 m_e$ per positron, see Section 4). The three quarks continue also to move in orbitals inside of the proton at a speed of about $0.41c$ with completely different

directions of motion, resulting in a further increase of the total mass by almost 12% to a total of $1836 m_e$ (now the total mass of the quarks acts as rest-mass).

If this proton (now the total mass of the proton taken as rest-mass) as a whole is accelerated again relativistic in any direction, its inertial and gravitational mass increases again accordingly. However, this mass is actually generated solely from the increase in mass at or for all the leptons contained as a result of different directions of motion and generally by the formation of corresponding compression and suction zones on the leptons. There are efforts, especially on the part of some theoretical physicists, to 'simplify and generalize' when considering relativistic mass/energy due to the equivalence of both ($E = mc^2$) to no longer use a separation between total mass or energy and rest mass. While this will provide correct results, it completely obscures the underlying mechanisms involved in the creation, formation, and existence of the matter and mass that surrounds us. It is completely impossible to obtain matter and mass if there were no structural units with rest mass, no elementary particles.

8 Photon structure - Photon creation - Pair creation

Fifty years of intensive reflection have not brought me closer to the answer 'What are light quanta?' Of course nowadays every restricted little mind thinks he knows the answer. But he is wrong.

Albert Einstein, 1951

Photons are characterized by seemingly contradicting experimental facts. Seemingly obvious they have to be understood as some kind of transversal waves, however they may appear as circular polarized. Since there can in principle be no electromagnetic waves in the sense of Maxwell (see previous section), they must be constructed from up to now unknown oscillating structural units. They cannot own mass, however they carry momentum and energy. Despite of transversal character they show helicity, spin 1 and in addition transfer into their direction of translation angular momentum to material objects. Large numbers or fields of photons may show properties comparable to 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 (within our system of inertia) a size of zero - objects of dimension zero could not own internal structures or wave trains. 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 having wave lengths several orders of magnitude larger than those 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. (Just as we have to understand that the actual universe only begins beyond the horizons of our Big Bang system, we also have to recognize and understand that below the level of quantum mechanics there must be another quantization on the basis of a substrate of everything.) The phenomenon of electric action is realized by the radial momentum 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 collection, compression and emission. Unless there exists external strong space warp or streams of the aether (e.g. frame dragging), individual LP would solely move straight till infinity and this excludes the possibility of any oscillation.

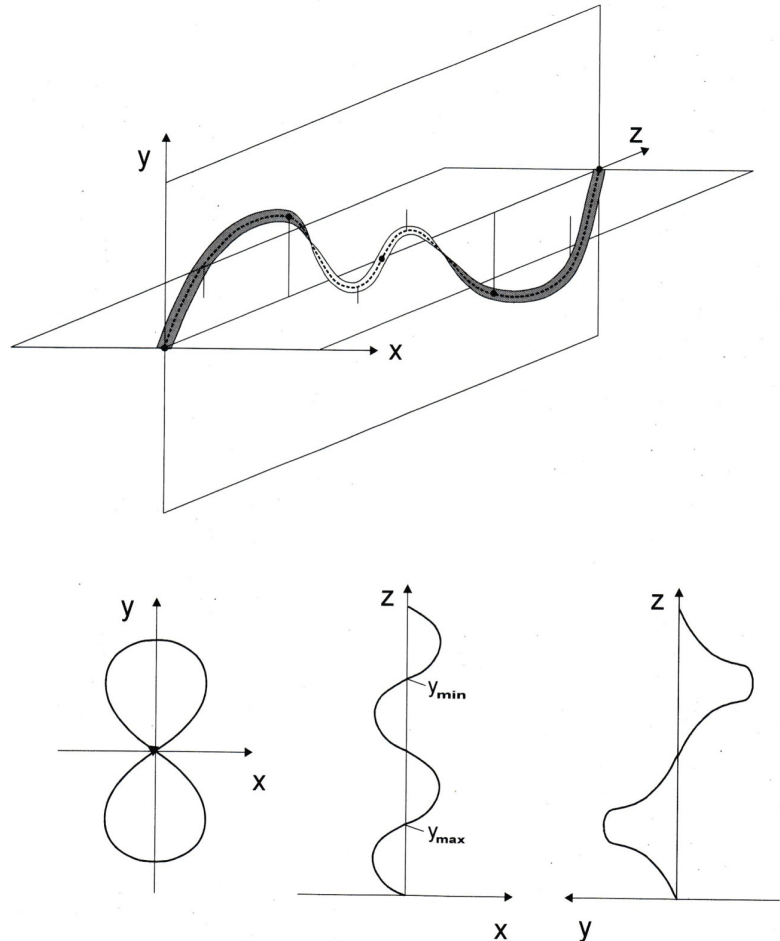
Because the magnetic action means within the new understanding the tangential motion of LP (angular momentum), there should be - due to some collective interaction with the substrate - a continuous change to a pure rotation of the LP-swarms around the translation axis of the photons. Within this try only some kind resembling to a convection-like motion of the swarms (in addition to the general translation) 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 something like elastic properties (at the very least high-speed-elasticity). With such ideas it is immediately possible to combine transversal oscillation with rotation, spin with helicity as well as the possibility of a transfer of angular 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 - due to a suitable interaction with the substrate - and continuously transferred into a pure rotation around the axis (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 (fig.4, bottom left), 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 (see fig. 4).

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).

Fig. 4: perspective view of the path of LPS ('stretched eighths') within a photon. To enhance the impression a two-colour stripe is added and vertical lines visualise the height with respect to the horizontal plane (x,z). Equidistant chains of LPS (agglomerates of compressed field quanta; they are in addition rotating as a whole preferably around the z-axis) are running one after another along such complicated three-dimensional paths. The drawn-in dots give the transition points through the planes (x,z) and (y,z). In the bottom the corresponding three projections along the three axes are shown. They visualise something like an intrinsic polarisation of the structure units.



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 [G. Nimtz, A. Enders, H. Spieker J. Physique I (Paris) 4 (1994) p. 565]. 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 -

here the alleged 'only-quanta' are now again considered as 'only-waves'; light cannot/must not be explained with electromagnetic waves in Maxwell's sense; Maxwell's equations can only be used in connection with large ensembles of charge carriers and not in high vacuum, see previous chapter), 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 (partial) 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 $1/2$ for elementary particles a restoring situation is achieved by a rotation with 4π (2 rotations). This is usually visualised using e.g. cones rolling over cones, the rotation of Moebius stripes (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 with $2c$ close to the spin shell and no dragging far away. But there will also be a distance where this dragging reaches c and therefore outside this position there is again a possibility of detection/access within normal physics. If there is a complete orbit of this 'dragging horizon', this necessarily means a twofold rotation of the particle and thus gives a more realistic explanation for an action with spin $1/2$.

Since a superluminal velocity is currently associated with a kind of dogma (even if there are here purely longitudinal phenomena), the presented explanation may also seem unrealistic at first. But there are experimental and theoretical results on the intrinsic magnetic moment of the electron that could ultimately indirectly prove exactly this interpretation with superluminal rotation of the spin shell. In quantum mechanics, the magnetic moment of the electron is given by $1/2\mu_B$, where the Bohr magneton $\mu_B = eh/4\pi m_e$ is a constant (with e the elementary charge and m_e the mass of the electron). On the other hand, the magnetic moment of the electron can be determined experimentally only with a value of $1\mu_B$ and is thus about twice as high as can be expected in real terms by theory. The difference (quotient) to the anomalous magnetic moment of the electron is therefore usually described by the Landé factor g (g_s for the electron approx. 2.00232).

The measured experimental value of the magnetic moment therefore seems to come from an electron as a rotating sphere (i.e. necessarily with a spin 1) and thus from a real magnetic moment $1\mu_B$ (even though we normally consider the electron to be point-like, it must

definitely be a particle of finite size). On the other hand, we are confronted with a confusing interaction characteristic of electrons with other particles or with each other, which can only be understood by using a spin $1/2$. A resolution of this contradiction can be achieved very easily by accepting the existence of a dragging horizon (if longitudinal structural units are assumed for the field quanta). Longitudinal quanta are able to cross horizons without disturbance. If the emission points of the field quanta are considered to be at the dragging horizon (spin $1/2$), the quanta receive only about half as much rotational moment (magnetic moment) as with the true emission taking place at the spin shell.

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 faster longitudinal and slower 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 the very least pseudo or high-speed 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 transversal displacing moving elementary particles or photons as a whole (being essentially transversal wave phenomena) and LP or LPS (representing basically 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 sub-h-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 through the accelerated motion of charge carriers. 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'.

To realise on the one hand the experimentally observed elasticity of static electric fields the LP have to own on principle the property to make way each other. Because there is also the observation of superposition of the fields the LP cannot give rise to mutual annihilation of LP, not even partially. On the other hand the explanation of the Casimir effect (charge carrier distances < 100 nm) demands the mutual annihilation of LP. Thus there might be possibly concluded that the LP right after their generation at the spin shells and moving a certain distance have to undergo some kind of change of their nature and loose the ability of mutual annihilation (near field \leftrightarrow far field). Having on principle no chance of an experimental investigation of individual LP (with sub-h action) it probably needs computer simulations of their formation within an electrofluid medium to gain a sufficient understanding of their structure and development.

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 within the surrounding own field via the concentration and retroactive jamming of the external field quanta within the 'field funnel' should be possible and thus gives rise to an entering 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 external LP is possible, if it is assumed in addition that the emanated internal 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) close to the spin shell. In case the newly generated LP may for instance be characterised by a somewhat faster growth than the distance growth with r^2 there will be in a certain distance a gapless overlapping of the LP that stops in addition the further growth orthogonal to the direction of their motion. After that the finally developed LP should move now independent into infinity.

Thus this would force the captured external LP then to be reflected at the closed near-field-shell 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 angular 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 compressed 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-orientates 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 ('rifling') 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 angular 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'. A swarm created by jamming should get the shape of some kind of a droplet and is emitted sequentially according to the

varying direction of the spin axis. Thus the fully emitted longitudinal-photon-swarm (LPS) has possibly the shape of a (three-dimensional) curved 'comma' that in addition rotates around its curved axis. LPS following each other run 'opposite' through the 'eights' and rotate at the same time opposite around their curved axis.

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) once an emission model is used as the basis. The necessary extremely high precision with respect to frequency and frequency stability of the emitted photons is realised via 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 mutual influencing by the substrate, with its jamming ahead during some kind of 'projection' of the rotating swarms into the medium creates the finite, much larger width of oscillation (due to complex, spin-like interactions with the aether) of the emitted LP-swarms (LPS). With 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 \leftrightarrow 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 dynamic high-speed interaction with the substrate that on the one hand jams the aether ahead but at the same time retroactive holds the LP compressed into swarms. Thus the existence of photons is therefore only possible through the permanent motion with the speed of light. A stream of individual LP (electric field) gives rise to a total impulse transfer to an area/object that is unchanged if the field quanta are arranged homogeneous or 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 having the same number of LP but here now concentrated inside of the LPS. But while the LP can move solely 'straight', the LPS are able to change the direction, to 'oscillate'. There is no other 'construction material' thinkable than the EM field quanta itself to build up photons. Since the formation of LPS requires ahead compression in the substrate, LPS must also have a low inertial mass within the mass-less photons as a whole.

On the basis of the assumption of the real existence of an omnipresent ether, the model of photons developed here is given by the fact that a finite number of equidistant moving, compressed and rotating (in itself) field quantum swarms (spin 1) 'screw' through this ether as a 'chain' in a complex way. In this case, the leading structural unit must leave a trace of depletion that influences the subsequent LPS in their movement. But all LPS also contribute at the same time to an emission of periodic longitudinal wave phenomena into the environment (matter waves). A photon in this model is thus given by its nucleus (given by the traces of LPS as a kind of 'oscillating' chain) and the emission of long-range three-dimensional-periodic longitudinal wave phenomena.

Photons (with spin 1) as a whole have an impulse that also acts on other photons. Therefore, photons form a kind of gas, a gas of bosons, which leads to a counter-pressure with respect to a compression. With today's experimental techniques this is directly measurable. What would happen if such a photon gas were compressed to such an extent that the photon distances reach the order of wavelength? On the basis of the proposed model there would now be increasingly frequent close approaches of LPS of different photons. The LPS would have to eject each other from their paths, which are given as imprinted by the formation mechanism of the photons. A gas of LPS (ideal boson gas) would have to develop increasingly. Since the LPS are at least ten to twelve orders of magnitude smaller than the wavelength of the photons, this gas could be much stronger/easier compressed still having a comparable size of the volume of the gas.

Exactly such behaviour could recently be observed and measured by means of high-precision experiments (E. Busley, L. Espert Miranda, M. Weitz, J. Schmitt Phys. in unserer Zeit 53 (2022) p. 166). From the current point of view, it must be attempted to assume the observed, rapidly increasing compressibility with volume reduction via the hypothesis of the

formation of a Bose-Einstein condensate. Since the photon gas was introduced by a laser, there is actually generally the same quantum state and since photons have zero mass, no critical temperature would be required, since it depends reciprocally on the mass. However, proof of the formation of a macroscopic quantum state has not yet been proven and previously observed effects of BEC are rather super-fluidity, superconductivity or super-solidity. An explanation with a transition into a gas of substructure units of photons therefore seems somewhat easier to understand and is actually more plausible.

Another surprising finding of these experiments was the fact that such highly compressed photon gases, quasi two-dimensional 'light gases', acquired the property of a mass, although photons have no mass. This mass was very low being in the order of only $10^{-5} m_e$ but clearly observable. In the context of an aether-based physics the property mass is given by the localization of kinetic energy of structural units - structural units of whatever type, complexity or structure level. This results in a general, fundamental understanding of what is probably the best-known formula in physics: $E = mc^2$. The total model presented here would therefore provide an understandable explanation also in this case, but it is ultimately forced by the compression of the substrate ahead of the released LPS.

At this point, it is appropriate to think again about the formation and structure of neutrinos. In chapter 7 it has already been suggested that these could be detached accumulation or depletion zones of relativistic moving electrons, which should also rotate at the same speed via an entrainment effect due to the rotation or spin of the electron (with approx. $2c$). This would also give neutrinos a dragging horizon and give them an effect with spin $1/2$. Since, according to the model presented here, the basic units of the photons, the LPS, are generated by accumulation and interaction phenomena near the spin shell, these would also have to receive a rotation of about $2c$, develop a dragging horizon and are therefore also be formed with spin $1/2$. Regardless of this, the photons as a whole will receive and exhibit an associated spin 1 as a result of the periodic orbital structure of the LPS.

If photons of sufficient energy experience close encounters or collisions, pairing may occur, a preventing of further periodic orbital motion of the LPS (and thus LPS release) or photon annihilation may occur. In the latter case, a suitable close encounter of the self-contained, approx. $2c$ rotating jam zones of the LPS (with surrounding frame-dragging zones) could eject each other out of their normal orbital motion, thus releasing two neutrinos (as actually observed in photon annihilation). As a result, the compressed LPS (the electromagnetic longitudinal field quanta) would be suddenly released and the photon would be 'dissolved'.

Since, as also in the case of relativistic electrons, rotating accumulation zones would have to be taken into account here as a suitable model for the structure or nature of the neutrinos in actually the same and a logically understandable way, such a model has become now much

more probable and realistic. But it is also worth thinking about the release of individual LPS, which represent a completely new type of physical structural unit. Because they can be produced in a targeted manner using the piezo-mechanically controlled optical experiments cited above, they would be highly interesting for communication technology, provided that a reliable detection could be realised. Free LPS (as longitudinal structural units) move superluminal in the 'substrate of everything'. Thus this would enable superluminal communication, especially over cosmic distances.

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 the Kropp's thought experiment:

'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 slower 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 thought 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 around' 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 infinite energy. LPS are characterised in the forward direction by a compression-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 units it need a deviation of the equilibrium between jamming and suction.

This deviation is introduced by the much more extended compression-zone of the electron introducing the needed distortion. 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 of all generated LPS. 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 our 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 gravity 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 gravity is much more than simply static reduction of the aether density (space warp). Gravity 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' for LP into LPS is distorted. The end of the photon moves always within a slightly 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 mutual interaction of both fields has 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 larger part acts as an elastic unity to the total field of the particle and will oppose the tilting of the spin-axis or 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 gravity 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 by a combination of all mechanisms 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 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 (and weak LPS densities) 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 substrate 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 capture/swallow each other, it is possible to capture and localise both swarms within the now common micro-cavity (compare top of fig. 5). The passing through of the swarms through the event horizons outwards is impossible. Photons are hold back by an event horizon and the (with low mass equipped) 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 wavelengths 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 structure unit/LP-swarm is leading the photon.

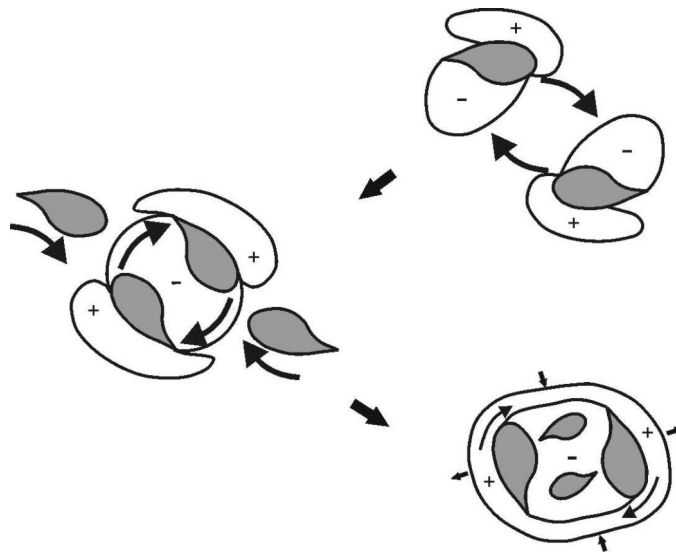


Fig. 5: Schematic two-dimensional representation of the possible interaction of longitudinal photon-swarms (LPS; grey) during collision of Gamma-quanta with possible stages of the electron and spin shell formation. The given signs in the diagram are related to the substrate-density with respect to the usual environmental average density.

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 highly enhanced aether-density accompanying the LPS should very soon separate from the LPS and spread out 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. Any hitting of an LPS from the inside on the shell creates the generation of an LP, the formation of the electromagnetic field. 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 self-field (LP-emission) there might be an interaction with external fields or following LPS of the colliding photons.

The dominating stochastic motion of the LPS in the interior is in addition 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 the generating origin for this behaviour has a completely different cause. 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 momentums. 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; a sum of 1.5 LPS shares would result in a 1/3 to 2/3 effect for the LP produced) might be captured by the micro-cavity (see fig. 5). 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 wavelengths of the creating photons is achieved. In addition there is now the circulation of a stochastic varying but effectively static (only restricted radial oscillating rather jumping) 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. 5, bottom) and those deformations result in a permanent density variation of the substrate 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 gravity (a special kind of space warp; static, but permanently dynamic created 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 momentums 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 the leading fraction of the much longer 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 electrons. 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. 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 a bit like a collision of comparable elastic particles.

Though figs. 4 and 5 give only a rough representation of the structure of photon and electron due to the still missing of an elaborated Electrofluid Dynamics, this supplies at least some basic first ideas which way such tiny elementary particles could be created by photons (particles with a size several orders of magnitude smaller than the wavelengths/amplitudes of the generating photons). But it is decisive that with such a model pair creation now has not to be understood anymore as a kind of 'vacuum fluctuation'. There is a complete renunciation of the highly hypothetical and experimentally not provable 'vacuum fluctuation' within the whole Direct Structure Model. A hypothesis of creation of matter/particles actually out of nothing and in some cases even hurting energy conservation. Despite of this claim the author is sure that there exist a permanent fluctuation within the vacuum, the physical vacuum or space-time (but not THE 'vacuum fluctuation' !). But such fluctuations (with density variations within an aether at any time and place) result solely in a permanent influencing of the motion status of pre-existing structure units within the frame of the indeterminacy relations. The introduction of the hypothesis of the vacuum fluctuation (at former times needed to explain the found strong fluctuations within the electric fields of atomic nuclei) had to be immediately dismissed as soon as it became obvious that nucleons are build up by three quarks moving inside of the nucleons relative to each other - und with this differently charged particles. The generation of an energy equivalent of about 10^{71} Nm during a Big Bang out of a 'fluctuation' or singularity - out of nothing - can be only seen as a hopeless and desperate try, which must also fail due to the expected extremely short existence time less than Planck time. The standard event Big Bang within a very much larger universe than presently assumed needs necessarily a corresponding accumulation process in advance.

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. Even the rest mass of elementary particles means finally enormous kinetic energy localised within an extremely tiny region, but it results in a straight way and directly from the formation of accumulation and suction areas in front of/behind the elementary particles as a result of any movement through the substrate of everything.

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 substrate 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 co-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 medium, necessarily resulting in the emission of longitudinal wave phenomena. (Alternatively, the spin of electrons might cause comparable stretched '8-paths' like LPS, however narrower due to the existing mass of the particles.) The wavelength of the oscillations is dependent on the velocity, more precise on the momentum of the electron and usually the corresponding resulting emissions 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 for longitudinal phenomena is impossible at the moment; it has to be expected in the range of at least about $2 \dots 3c$. 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 some kind of 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 usually follow the path of (averaged) minimal aether density ahead. However this will be not always possible in general. Due to uncountable interactions (primary with field quanta of other matter, external influences of gravity, collisions with neutrinos, near passage of electrons or uncountable photons and the totality of all matter-waves) e.g. 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 ψ -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 and backward acting periodic space warp structures (and of course 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 and acceptance of an elastic aether it becomes understandable in general. Every structural unit that moves through a medium in general creates waves, e.g. a ship or a bullet. The reality of the wave-particle-'dualism' should therefore actually be a direct proof that an electron/photon also moves through a medium even in a physical vacuum.

For an electron that is approaching a double slit, first of all its preceding wave of space warp (faster than light) 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 momentum 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 a substrate with corresponding sub-h-properties and the resulting superluminal, preceding waves (indirectly described by the square of the ψ -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 and its LPS of the photon.

Having the superluminal motion of preceding space warp waves in mind (and of course in the same way such ones spreading out orthogonal to the direction of motion 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 quasi-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 quasi-elastic carrier medium, substrate of everything (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 a pseudo-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 substrate, 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 wave-field. With comparably high energy-content a diffracted ‘leading wave’ is able to determine the further direction of motion.

In the course of the 1920s, quantum mechanics was developed in order to improve the significance of Bohr's atomic model, which was fundamentally based on classical physics, initially very successful but only a semi-classical model, with regard to the requirements resulting from various recent existing new measurement results. A first step was taken by L. de Broglie, inspired by the then incomprehensible statement that light (actually understood as a wave) must have also the character of particles (A. Einstein). Then particles could also have wave character - and he combines the equations $E = mc^2$ and $E = h\nu$ to determine an initially fictitious wavelength for electrons ($\lambda = h/p$). However, the calculated wavelengths (and their multiples) actually resulted indeed in the circumferences of the orbits in the atomic model. Later, exactly such electron wavelengths will also be measured in electron scattering at crystals. The idea of a kind of wave-particle duality was born.

A logically understandable, plausible explanation for the fact that fast-moving particles are accompanied by waves during their movement in a (physical) vacuum could not be given by physics at that time (and still not today). The experiments show it. That's just the way it is. But in the end, such an explanation is necessary. Why is the motion of a particle within a vacuum and (seemingly) free of external forces - which should actually result into a purely linear path - characterized by a wave character? An explanation is only possible, if the spin-carrying particles can and must interact with a medium during this motion, with a substrate of everything, that is flown through by them. The experimental determination of this wave phenomenon is therefore a direct experimental evidence for the existence of such a substrate.

In 1925, W. Heisenberg succeeded in creating a first version of quantum mechanics, later further developed together with M. Born and P. Jordan. Only the particle character of the electrons is considered, but only measurable values (spectral lines) are used for a system-descriptive representation, e.g. no positions or velocities of the electrons. Thus, there is no consideration of intermediate processes or the actually required electron orbits - and stochastic transitions between the states are supposed to arise from a spontaneity generally

inherent in nature. The inviolable pillar of cause and effect, causality, which has been used in physics so far, is lost. The introduction of the system description will be realized in this new type of theory via a 'table of observables' - later recognized as matrices - in a form that is difficult to understand and will soon become known as matrix mechanics.

Only a short time later, E. Schroedinger published another, easier to understand and easier to handle description of quantum mechanics, which was inspired by de Broglie's considerations, based solely on the wave nature of electrons - and thus no violation of causality can be seen. Since the description of the atom system in the matrices is given by frequencies of the spectral lines, which can generally be represented in the form $Ae^{i\omega t}$, it becomes easily understandable that here too a wave representation is ultimately created and that it could actually be shown very soon and many times that both representations can be converted into each other. Both representations are equally based on a reference to Hamilton's mechanics. However, there were difficulties in the way of interpreting the wave function ψ , which occurs in the Schroedinger equation, whereby the interpretation of M. Born as a residence probability of the electron, represented by the square of the magnitude of ψ , soon prevailed.

Finally, in 1927, the all-important Solvay Conference took place in Brussels, where all the well-known scientists involved in quantum hypothesis and quantum theory came together to discuss their significance and their foundations. Two camps/positions had emerged, which represented their view of the electron as a particle (in essence W. Heisenberg, M. Born, P. Jordan, W. Pauli from the school of N. Bohr) or rather dominating as a wave (e.g. L. de Broglie, E. Schrödinger or A. Einstein). Right at the beginning of the conference, there was a lecture given by de Broglie, in which he attempted to combine both points of view, to build a bridge between the bearings by proposing a 'guiding' for electrons and thus a motion specification through a pilot or guide wave. However, this was done without any deeper physical justification. It would enable causality and determinism and thus give the particles both types of their effect, i.e. particle and wave character at the same time, without questioning the validity of all theories. A not very factual and hurtful 'discussion' from the side of the representatives of the pure particle view rejected this attempt as completely wrong, so that de Broglie never pursued this view anymore, which was nevertheless much closer to the true reality.

At the end of the conference, the representatives of the school around N. Bohr had completely prevailed and the so-called Copenhagen interpretation of quantum mechanics had emerged, in which the uncertainty principle for complementary descriptive variables found by W. Heisenberg formed a central, essential point. Since all the chairs of quantum mechanics to be filled worldwide came from the school of N. Bohr, this interpretation has

been preserved as a standard to this day. All attempts by Albert Einstein at this conference and also in the following years to question the correctness of quantum mechanics through sophisticated thought experiments have failed. They were bound to fail, because at this time he attacked theory itself or the principle of indeterminacy. But these are definitely correct. His attempts to save the fundamental pillars of physics, causality and determinism, should have been based solely on the field of interpretation. He never tired of summing up: "The good Lord does not toss the dice!" He has always emphasized that quantum mechanics in this form must be incomplete. And he was actually right at this point.

It is not difficult to see that in this text the author has attempted to achieve this completeness of quantum mechanics by introducing (actually one must say the reintroduction) of a substrate of everything, for the necessity of which the author was able to find and cite several justifications for various reasons (the most essential necessities were the requirement of a material for the formation of elementary particles or e.g. the presently inexplicable expansion of our universe, the 'Dark Energy'). It is important to correct the interpretation alone and this enables the preservation of causality and determinism - with the advantage of now being able to understand and comprehend quantum mechanics in principle. It is now the simultaneous existence of particle/photon and unavoidable accompanying wave as it moves through the substrate, the actual and real existence of a kind of 'pilot or guide wave'.

It is therefore **not** the process of measurement and a 'collapse' triggered by it that makes one or the other manifestation recognizable. The preceding wave tries to determine the path, but countless external influences, whose effects are impossible to predict, e.g. by all ambient matter waves, solar neutrinos, cosmic rays or photons of thermal radiation will result in stochastic influences, so that the 'guide wave' can only result in a description as a probability of stay. However, the entire history of the development of QM clearly shows that it is a physics of small amounts of matter (including photons) and that a transfer/extension to the mechanisms of action within the substrate itself, i.e. in the physical vacuum, a non-matter area, must lead to false statements (see e.g. vacuum fluctuation).

A large tanker crossing the wave-moved ocean will experience only faintly noticeable changes in its position or momentum in its locomotion. On the other hand, a ball floating on the waves will constantly exhibit considerable indeterminacies in its spatial position and for its current impulse. The strength of its changes in location and momentum should correlate with the current wave height. Even if this macroscopic image is only partially suitable as an example of quantum mechanical phenomena, it can still be seen that Heisenberg's indeterminacy principle could also be interpreted as a description of a permanent, three-dimensional (density) wave movement in the substrate. In both cases the causal behaviour can be clearly recognised, but in the case of the ball there is the need of a statistical description.

An aeroplane as a 'macro-objekt' is only seemingly a local object. It creates with its motion always a de Broglie-wave-field that is completely negligible with its ratio to the total energy. It creates in addition an accompanying sound-field and thus is again a non-local 'total' object. Because moved within a medium it actually shows something like 'wave-particle dualism' just (like also a moving ship or a bullet). Again the accompanying sound-field may be neglected with its energy content. At least as long as the speed is small with respect to the one of sound. Approaching it the energy consumption for propulsion is noticeable increasing. However, for elementary particles and photons the energy is always comparable to the one of the accompanying 'aether-sound'-field and thus for instance a photon is in general a non-local unit of photon kernel and accompanying longitudinal wide-spread wave-field, an electron being characterised by wave-particle-dualism. They all are moving within a medium! Thus actually the existence of the dualism proves the presence of a substrate. With a comparably high energy the diffracted 'leading wave' of a photon/electron is able to determine the further direction of motion and initiating this way also the formation of orbitals for elementary particles.

If an electron is bound or localised by a proton it cannot be in rest but has to circulate and/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 (e.g. circumference with Bohr radius) is correspondingly related to the averaged 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 (which covers the geometrical and energetic framework conditions). 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. The additional effects that occur are - actually just like in the general theory of relativity - force effects of what we still describe today as 'dark energy'.

The incompleteness of quantum mechanics expected by A. Einstein can be achieved, as shown above, by taking into account a ubiquitous substrate (as a principled and realistic

explanation for the formation of 'pilot waves' envisaged by de Broglie). But this immediately means that the theory of relativity now also needs the elimination of an incompleteness. But while in the case of quantum mechanics this only leads to a different, more advantageous and understandable interpretation of this theory, this addition means a completely new model approach for GRT and also a fundamental extension of the theoretical basis. The previously envisaged static curvature of space itself is hardly comprehensible (the abstract concept of space should actually represent a total nothing) and its 'curvature' is therefore actually not possible in principle. In a fluid medium such as the substrate of everything, however, the basic structural units forming the substrate must undergo a change in density in order to form corresponding gradients.

However, if density differences exist in a fluid medium, this must necessarily lead to compensating flow mechanisms. On the one hand, this means that permanently existing gradients - as in the case of gravity - can only be maintained by permanently occurring emission mechanisms. The structural units of matter must function as permanently working 'aether pumps'. On the other hand, flows will be linked to correspondingly changed transit time effects depending on the special geometry present. Identical results are therefore only possible for both types of interpretation if radial symmetry is present. All 'confirmations' for the general theory of relativity, no matter how highly precise, have always been carried out with radial symmetry. However, deviations, 'anomalies' have always been found in some cases with non-radial symmetry and are thus evidence of a (also) flow-based gravity.

A substrate that allows (must allow) both longitudinal and transverse phenomena must necessarily possess the property of (at least of some kind of) elasticity and thus have two different limit velocities (transversal and longitudinal). However, the previous general statement of the theory of relativity says 'Nothing can be faster than light'. This statement can therefore only apply to structural units of matter, but not to phenomena within the substrate. It is therefore quite possible that faster (longitudinal) 'pilot waves' for relativistic electrons or even photons actually exist and thus also enable something like entanglement.

With the reintroduction of a substrate of everything, it becomes possible to clarify another great puzzle of physics in addition to the explanation of dark energy. At present, there is a general opinion that there is some kind of incompatibility between the two most essential pillars of modern physics (quantum mechanics and relativity). From the above explanations, however, it can be clearly seen that both theories have now been given a common basis via their completion by the introduction of a substrate. The incompatibility resulted from their incompleteness. Now both theories are basically defined and definable by the special properties of this substrate. Gravity or 'space curvature' as a side effect of the electromagnetic field - now mandatory with flow mechanisms - is thus too complex to be described solely by a simple 'field of exchange-structural-units' (gravitons).

Summary of chapters 6 to 8

In general it is presently assumed that Quantum Mechanics is characterised by an unlimited range of validity down to Planck-length (and with this also the indeterminacy relations). The resulting consequence seems to be the apparent possibility of the model of vacuum fluctuation obvious with the loss of the principle of energy conservation. 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 (valid only for matter/small amounts of matter) and thus based on a sub-h-physics that could equivalently be called electrofluid dynamics. 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, deterministic and logically understandable physics again inclusive conservation of energy, 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 actually 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, impulse carrying, dynamic structure units. This is the only alternative to transport actions now. It means a reduction of the density of the emitted structure units 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 can be energetically influenced from outside only in an indirect way, but influenced via expansion of the substrate. This motion with internal impact events is extremely fast and for very short periods of time thus changing the volume or surface shape of the electron. Furthermore there has to be necessarily a surrounding medium where the fast deformations of the surface introduce or excite local variations of the medium density that move away as mass-less, impulse carrying, longitudinal photons with sub-h-action (LP, extremely small dynamic space warp regions) radial into all directions.

Since the beginning of the 20th century, the community of physicists has had to get used to the fact that things are stochastic in the area of the smaller dimensions of our material world, that there is no continuity especially in the transfer of actions, and that indeterminacies always have to be taken into account. The foundations of quantum mechanics had to be

developed, which up to today lead to a variety of misunderstood phenomena despite experimental verifiability. This has led many physicists to state that QM should be incomplete. And indeed, it lacks an essential element which, as a result of a misunderstanding in connection with the development of the theory of relativity, has been subject to a hitherto effective taboo: the existence of an omnipresent substrate, a 'fine-material' medium with unusual properties.

As soon as structural units such as photons or electrons move through such a medium, they must necessarily generate propagating, spreading out waves in it, which are of longitudinal nature. Since the medium must have at least quasi-elastic properties, it must also have two different limit velocities for transverse and longitudinal phenomena (see e.g. sound propagation in steel), whereby the higher velocity is given for longitudinal phenomena with direct transfers of impulses (direction of momentum in the direction of propagation of the waves). This means that even (transverse) photons must be characterized by accompanying longitudinal waves, hurrying ahead faster than the speed of light. If the photons hit a double slit individually, the wave in front is always diffracted first, leaves behind the slits a spatial pattern with a changed substrate density and the photon (or electron) has to follow this space-curvature-pattern after passing through the slit. Photons/electrons do not interact with themselves, but with their diffracted matter waves hurrying ahead faster than the speed of light ('pilot waves'). Phenomena such as entanglement can now also be logically understood immediately.

Whenever we conduct an experiment, we have to influence matter with the help of other matter (including photons) and register the reactions with again other matter. Experimentally confirmed laws can therefore only be obtained for matter and exclusively only for the laws valid in the field of matter. Experimentally confirmed quantum mechanics is therefore proven and applicable for matter only, but not experimentally confirmed for the physical vacuum (see the problem of vacuum fluctuation). If small amounts of matter are used in experiments, it must also be taken into account with knowledge of the above-mentioned longitudinal matter waves that both the object of investigation, the object of influence and the measuring apparatus can all influence each other. As shown in the text, in contrast to phenomena in the field of matter and a quantization with Planck constant h (or $h/4\pi$), now a much finer, i.e. sub- h -quantization, must be used in the field of the electromagnetic field. This results in another new level of physics with significantly smaller quantification and sub- h field quanta. An application of the laws of previous (matter) quantum mechanics to this field should therefore be viewed very critically. In addition, to describe this new level of physics, another level is required to describe the substrate of everything (with the development of an electrofluid dynamics?), which captures the physics at Planck-length-level.

The surrounding medium or substrate - with regard to historical views named aether - has to possess 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; presently 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 (actually, only 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 basic 'fine-material' structure units of aether 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 gravity, 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 (Planck-length, Planck-time) for a matter world based on such a medium. In principle, such a substrate cannot be a continuum and must therefore be made up of smallest possible structural units (Aea).

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 possess - 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 elementary 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 angular momentum and the corresponding transferable momentum components are reducing with $1/r$ and this has to be seen as the magnetic component. So there is only one field, the electromagnetic field, with both effects at the same time. Pure component fields can only be achieved by appropriate alignment mechanisms of a large number of charge carriers. An electric field can therefore only be converted into a magnetic one by changing the orientation of a large ensemble of sources (and vice versa). Therefore, in principle, there can be no electromagnetic waves, where one EM-component field could be converted directly into another.

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 results simultaneously a depletion of the substrate around elementary particles that cannot be completely balanced via a permanent back-stream. It develops a static density gradient - a 'funnel of density' - that can be usually described for radial symmetry also as static 'space warp' or gravity. 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 developed structures of photon and electron (suggested within this paper) have to own necessarily hypothetical assumptions and also 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/wavelengths of the creating photons.

On general it may be noticed that our matter finally and solely exists via kinetic energy, an expression that is also clearly described by the term $E = mc^2$. It is a kind of kinetic energy that creates by help of dynamic mechanisms aether-density-structures existing stable over time that might be called matter. Those structure units may be localisable or not localisable (photons and neutrinos). Only structure units localisable on principle (electrons and positrons) - and more complex matter structures composed of them - are able to generate gravitational mass afflicted with gravity or 'space warp' due to their permanent LP emission. Instead inertial mass should be now given via the formation of compression and depletion zones during the motion through the substrate and not via the presently supposed Higgs mechanism.

With all those considerations it might be possible to give a first general understanding of nature, of our matter world: 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/the universe is able to generate that what we call matter afflicted with mass by localisation processes 'formation of orbitals' of direct or indirect kind. Because all structure units of matter (elementary particles and structures composed of them; photons) 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 or transversal phenomena. The former courageous and manifold indirect experimentally proved generalisation of de Broglie/Bohm with preceding, 'leading' matter-waves or pilot waves could have led us already somewhat earlier to such a conclusion.

Thus the most fundamental description of our world should be:

All that permanently exists within a world of matter is light, are photons, i.e. energy - all that exists there as matter afflicted with mass is localised light, are localised photons (parts of it), i.e. localised energy.

$$h\nu = E = mc^2$$

Within the view presented here there is no more fundamental, no more general, no more all-comprising equation to describe nature respectively our world of matter.

9 Final remarks

Usually quantum mechanical systems are described with operators, equations and wave functions that inherent and a priori consider the aspects of probability/indeterminacy - unfortunately at present with a reduced intelligibility. The procedures used here with 'averaged' processes/orbitals and afterwards an 'overlaying of residence probabilities' can only supply a low accuracy and on principle only solutions by help of numerical approximations. But it offers a quite high possibility to understand the processes bound to the necessity of experimental adjustments. On the other hand the application of the Dirac equation to the many-particle problem of quarks needs numerical approximations too and necessarily a precise formulation of the problem to be solved. This first demands the development of a corresponding suitable model. Prerequisite of the given considerations in the first half of the text is determinism and causality within the systems still being several orders of magnitude apart of the Planck length. The main intent of the paper is the try of a consequent testing of the expected basic principle of nature (general formation of orbitals) everywhere within the micro- and macro-cosmos to finally get a contradiction to reality or to achieve a better understanding of the observations.

The physics of matter demands the answering of two fundamental questions:

First, are quarks elementary yes or no and second, is the basic assumption that the well-known laws of Quantum Mechanics are valid even within the smallest dimensions of space true; yes or no? The presently accepted assumption of physicists has twice a yes. This text tries twice a no and results in the astonishing fact that also in this case a reasonable explanation of actually all experimental facts is possible, no contradictions to reality appear. Moreover, this 'double-no' seems to give a simple understanding of many still open questions of physics: Dark Energy, Dark Matter, integration of electromagnetism and gravity (generalised field model), deeper understanding of electromagnetism, structure of electrons, neutrinos and photons or the mechanisms of Big Bang, just to mention some of the important examples. So it might be lucrative to the established physics to take such a sight into consideration. Nevertheless this means to accept again an everywhere existing substrate.

The experimental investigation of matter gets the highest possible accuracy, when the 'instruments' used for this probing are given by the smallest possible structure units of matter, elementary particles and photons. As far as also the objects of investigation are of comparable dimension as the elementary probes, there arises a considerable influencing and change within the investigated objects during the investigation that cannot be neglected anymore. The achieved results now can only carry a probabilistic character and have to be obtained and described by Quantum Mechanics. A thorough and complete loss of the usually available possibilities of physical investigations occurs, if the inner structure or essence of

the basic physical structure units of matter or of their surrounding fields and the substrate is the subject of consideration. There are in principle no smaller units for a possible experimental investigation anymore.

At this very point there is only the statement left that either no further recognition is possible at all, or there is the need to start testing unusual possibilities on the basis of 'trial and error' using pragmatic imaginations obeying of course fundamental principles such as conservation rules, determinism and causality. If just this could give a realistic possibility can solely be decided, if it is at least tried to go such a way. Nevertheless it will be always a difficult 'walk on the crest' especially with respect to reliability because any 'trial' has necessarily a speculative character. Alone by a thorough testing with respect to developing possible contradictions or via general consistency this might find acceptance as a least possible scientific method. The tried total concept of physics is the product of pragmatic imaginations but it has definitely to be refused to see this simply as imagination products. The possibility of being able to explain many open mysteries of today's physics clearly points to a correct approach.

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