Preliminary remarks/supplements

Meanwhile atoms with a size of few 10^{-10} m are accepted as self-evident structure units of matter and can be sized even picture-like with the possibilities of present technology. Atoms consist of an electron shell and a core with a size of 10^{-15} ... 10^{-14} m containing nucleons (protons and neutrons). Still it is difficult to understand the asymmetry in the construction of matter. Protons as positive charge carriers are 1836 times as heavy as electrons and thus nucleons cause about 99% of the mass of an atom.

Because atomic nuclei usually contain several protons with strong repulsive forces there has to be a stronger balancing force, the Strong Interaction. It has a range of about few 10^{-15} m and cannot be realised outside of the nucleus. To explain inner processes such as radioactivity another force, the Weak Interaction, with a range of smaller than about 10^{-18} m is necessary. Thus according to the presently accepted Standard Model of Particle Physics there should be four forces in the sequence of their strength: Strong Interaction > Electromagnetism > Weak Interaction > Gravity. Their strength follows a ratio of about **1 : 1/137** : 10^{-7} : 10^{-38}.

Because of the extremely small size of possible substructures within nucleons the enlightening of this internal structure demands very special conditions for the used radiation. Their wavelength has to be at least comparable or smaller than the dimension of the details to be investigated. Only then a suitable influence on the direction of propagation is achieved. Photons with wavelengths below 10^{-15} m are not available for such experiments; it is necessary to use beams of particles. According to the wave-particle-dualism moving particles have a wavelength (material waves) inverse proportional to their impulse (de Broglie NPP (Nobel Price of Physics) 1929). Thus theoretically their wavelength could be made infinitely small via acceleration. For there is a strong electric field related to protons the investigation of their structure needs neutral particles (difficult to accelerate and to detect) or negatively charged. Therefore predominant a bombardment with electrons is selected. Results with respect to the internal structure of nucleons are obtained either by the angle and/or energy distribution of the elastic or inelastic scattered electrons (indirect enlightening of structure) or by the detection of fractional parts set free.

To achieve very high electron energies effectively only linear accelerators can be used, because with high velocities of electrons within circular accelerators extremely strong electromagnetic radiation, Bremsstrahlung, is produced (accelerated motion of the electrons). The presently achievable technical/financial limit for high-energy electrons via linear accelerators is given by about 27,5 GeV (wavelength about $5 \cdot 10^{-17}$ m). The generation of Bremsstrahlung roughly reduces with the square of the mass of the particles and therefore for protons much higher energies are achieved. To recognize much smaller details with the help of electron-proton-scattering presently very high relative-energies are realised, using the collision of an electron beam and a high-energy proton beam (Bi-Jet). In this way nearly the range of 1 TeV was available (wavelength close to 10^{-18} m), with the new apparatus at CERN relative-energies up to about 8 TeV should be possible.

Investigating nucleons with electron wavelengths of about $2 \cdot 10^{-15}$ m charged cloudy shells ("meson shells") were detected for the first time. Positive 'shells' were necessary for the interpretation within protons and positive and negative shells within neutrons [R. Hofstadter, NPP 1961].

According to the properties or symmetries of the various fragments of collision experiments at and with atomic nuclei ('zoo of elementary particles') it was necessary to achieve an interpretation of the structure of particles and nucleons with the help of smaller units where the term Quarks has come to stay. Due to the results of scattering experiments there have to be exactly three of such larger substructure-units, Quarks, within the nucleons. The real existence of Quarks within nucleons could be directly proved by electron scattering experiments with wavelengths of about $6 \cdot 10^{-17}$ m [J.I. Friedmann, H.W. Kendall, R.E. Taylor, NPP 1990]. With the present state of art protons consist of two UP-Quarks (charge +2/3 e, Spin 1/2) and one DOWN-Quark (charge -1/3 e, Spin 1/2); neutrons contain two DOWN-Quarks and one UP-Quark. Because the experiments are only able to show the existence of the three Quarks within nucleons but cannot decide if they are now finally elementary units or still composed structure units there has to be the necessity to investigate both possibilities and to compare them within a truly scientific procedure. Unfortunately decades ago only the simpler solution with elementary Quarks was developed within a model, the Standard Model. The second possibility with also 50% probability was permanently ignored. Presently this is actually completely forgotten within the community of physicists and shall be made up for within these texts.

> The detected wide-angle scattering of electrons in this connection should reach a maximum of intensity for wavelengths that are comparable to the size of the scattering particles. Therefore the experiments indicate a size of the Quarks of about $5 \cdot 10^{-17}$ m because indeed wide angle scattering was observed. Nevertheless Quarks still are considered as being point-like and elementary. However, for elementary structure units there can be nothing more than an upper limit of their size and wide angle scattering is impossible.

All further attempts to find substructures of Quarks with higher and higher energies/shorter wavelengths have failed up to now. With very high-energy investigations seemingly many more 'point-like' scattering centres seem to be found than the three Quarks expected. 'Point-like' in this sense means a size smaller than the resolution - at the moment smaller than about 10^{-18} ...

10^{-19} m. Because of the restricted possibilities of an indirect interpretation those scattering centres could not be related to common structure units. Therefore it is still a fundamental assumption of the Standard Model of Particle Physics that Quarks are 'point-like' and fundamental. This assumption has considerable consequences. Nucleons as 3-particle-systems would hurt the Pauli-principle (within quantum systems only particles that do not agree within all quantum properties inclusive spin can be existent), i.e. Quarks need the assignment of another quantum property, the 'colour atribute'.

Being point-like Quarks are necessarily indivisible and the observed properties within the nucleons have to be the same as the ones of the fractional particles set free with collision experiments. However in such experiments there was never an observation of particles with fractional charges. Thus it has to be claimed within the frame of the Standard Model that it is impossible to separate Quarks at low energies or to find free Quarks (Confinement/Asymptotic freedom). With this statement Quarks are (according to the Standard Model) not to the disposal for the explanation of the mysterious Dark Matter of the presently accepted cosmological model. This dominating matter (presently without explanation of structure or origin) represents a multiple of the amount of matter of all stars and dust together. It can only be sized by its gravitational action and be determined by the motion of galaxies and galaxy agglomerates or by gravitation-lens-effects.

A very important kind of nuclear particles, produced by collisions, are mesons. The term is related to a mass typically being in between of that of electrons and nucleons. They are characterised by a total spin of zero (or entire), are determined by the Strong Interaction and decay after short times (about 10^{-17} ... 10^{-8} s) into leptons (see later) and/or photons. Due to their spin mesons belong to the so-called bosons because they follow the Bose-Einstein-statistics and not the Pauli-principle; in contradiction to particles with spin ½ that follow the Fermi-statistics or Fermi-distribution and therefore are called fermions.

According to the Standard model mesons consist of Quark-Antiquark-constructions, which explains charge, spin and decay fairly well. But the model causes contradictions to the observed mass. For instance a charged Pion with a mass of about 140 MeV should consist of an UP-Quark (+2/3 e) and an Anti-DOWN-Quark (+1/3 e). (The use of a measure for the energy instead of that of the mass in nuclear physics is related to the equivalence of both quantities according to the well known Einstein equation $E = mc^2$.) With this Pion mass measured the upper limit for the rest mass of a Quark could be only about 70 MeV as a maximum. A nucleon consisting of three Quarks should then contain a rest mass of less than 210 MeV which is only 22% of the true total mass (about 940 MeV) measured (protons: UP-UP-DOWN; neutrons: DOWN-DOWN-

UP). This means the necessity to explain the largest fraction of nucleon mass effectively by help of relativistic effects and is in contradiction to the true nucleon size (see chapter 2 in part 1).

A further problem to the Standard model is arising with the interpretation of Kaons, another kind of mesons, which have about half of the mass of nucleons. Assuming Kaons to consist of two indivisible Quarks an important kind of Kaon decay into three particles (Pions) is actually unthinkable.

Today spin-less particles heavier than nucleons are classified as mesons too. So the Standard model has to invent further kinds of Quarks. According to the symmetries existing in nature also the number of Quarks has to follow certain rules and the necessity of a new kind of Quark forces the definition of others. The existence of missing links is then proved by the existence of even heavier mesons. Due to the possibility of relativistic effects causing considerable changes with respect to the mass of a particle (already excitation states could give rise to a mass multiplication) such a chain of proves should be seen with reservation.

Obviously there are some non-understandable or problematic assumptions and statements related with the Standard model that suggest trying the development of an alternative new model. The most probable item for an intervention should be the presently postulated statement that Quarks are ‘point-like’ and indivisible. For there are no suitable or detectable fractional parts after high-energy bombardments or corresponding scattering effects at Quarks the maintenance of a Quark substructure demands 'exotic' components. If for instance the positively charged protons of our matter consist (at least partly) of electrons or even of anti-matter particles no fractional parts would be observable with electron bombardments. It is the aim of the present paper to demonstrate that a combination of both exotic possibilities gives rise to a realistic structure: positive charged anti-particles (positrons) screened by electron shells. The only thinkable presumption is a stabilisation (and prevention of annihilation) by help of orbitals; the assumption of a general principle of orbital formation in Quantum Mechanics. With such a Quark structure there is no necessity any more to have an asymmetry between matter and anti-matter in the early universe (for details see part 2, cosmology).

If Quarks can be seen as compound particles their properties within nucleons are mainly determined by their mutual interaction. It is possible now to have free Quarks with unexpected properties. The necessary screening by electron shells would give rise to particles without charge and spin (no magnetic momentum) and very small size (some 10^{-17} m). In practice such particles will be invisible for any kind of experimental investigation (Dark Matter) and detectable only through their mass or gravitational action respectively (or electron scattering with about 30 GeV; $\lambda = 4 \cdot 10^{-17}$ m).

The early universe is characterised by a very high energy density that has to be reduced as fast as possible. Expansion alone is insufficient; Quark production i.e. generation of rest mass allows a much higher efficiency. Only a small fraction of the (neutral) Quarks can be sufficiently 'heated up' through collision mechanisms (impulse transfers) to initiate a reaction with each other (formation of nucleons). It belongs to the basic statements of the new Direct Model of Matter that there has to be necessarily Dark Matter. The designation is ‘direct’ because the particles set free during experiments are used as true fundamental constituents of matter. Within the Standard Model the expected or assumed structure units can be investigated only in an indirect way; the particles set free are assumed to be generated via ‘transformation reactions’.

Some of the most important kinds of particles are leptons ('light particles'). Due to present definition they are defined to comprise as well electrons or positrons, Myons (’heavy electrons/ positrons’, rest mass about 207 electron rest masses, spin 1/2) and Tauons (about twice the masse of nucleons, spin 1/2) as well as three kinds of spin-carrying neutrinos. This selection is mainly based on the spin 1/2 and the missing influence via Strong Interaction. They all are fermions. Within the frame of the suggested new model leptons should represent elementary particles in the original sense of the term or their excited states. This means to replace Tauons by charged Pions though they have no total spin and initiate nuclear reactions (see chapter 4 of the paper 1).

While in the Standard model charge and spin of a particle is defined by the contained Quarks in the new Direct Model this is given by the kind and number of the involved leptons. While in the Standard Model mesons are described by Quark-Antiquark-complexes that create leptons and/or photons after annihilation, within the Direct Structure Model a substructure of Quarks with leptons is assumed that are simply set free within the decay. This means the experimentally observed emitted leptons are the immediate constituents of the Quarks, the Quark-complexes or the Quark-modifications or Quark-fractions called mesons. In this direct model there will be only one kind of Quark with 12 leptons (two electrons/positrons each and in every case with an electron/splitting- and a Myon/orbital-formation-neutrino, all together 8 neutrinos). The Quarks can exist in a positive (9 leptons) or in a negative 'relativistic ionisation' (13 leptons). The leptons involved show considerable relativistic increase of mass. A neutron would consist of 35 (relativistic) leptons, a proton of 33. During the Beta-decay of a neutron (life-time about 900 s) one electron and one neutrino is emitted.

> Examples: A relativistic electron (spin 1/2) is brought into the state of an orbital by help of a Myon-neutrino - light Pion (meson), spin 0. Further absorption of an electron-neutrino gives a Myon (spin 1/2). The transition into a higher orbital by increase of energy/

> absorption of a further Myon-neutrino gives rise to a charged Pion (meson, 4 leptons, spin 0). The reverse sequence is a typical result after the bombardment of a nucleus.
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> A neutral Pion or half Quark within the Direct Structure Model (meson, 1 electron, 1 positron, 2 Electron-neutrinos, 2 Myon-neutrinos, spin 0) decays via two different mechanisms. With about 99% the two Electron-neutrinos are emitted. The elementary particles loose their orbital splitting and collide => Gamma rays are set free. In the other case the Myon-neutrinos are set free. The elementary particles loose their 'orbitalisation' but cannot recombine. They move apart while the neutrinos recombine into Gamma rays.

In the suggested model neutrinos have a considerably higher importance than in the Standard Model. Without neutrinos the formation of matter would be impossible. Because of the very low interaction possibility of such very light, neutral and spin-carrying particles with 'neutrino-saturated' matter experimentalists can gain only little information. Presently it is not even proven if they carry a rest mass at all, though there are strong hints to this fact. This rest mass should be 20 eV as a maximum and is thus about four to fife orders of magnitude lower than that of electrons. The only secured statement is the fact that there are at least three different kinds of neutrinos, where the structural differentiation is not clear [L.M. Ledermann, M. Schwartz, J. Steinberger, NPP 1988].

With respect to the puzzling results obtained by the investigation of the internal structure of nucleons using extremely high energies/high resolution it is questionable if a further increase of resolution could give deeper insights. Perhaps the border given by the Heisenberg relation is already crossed; only experiments can answer this question. If such a supposition should be true, only theoretical considerations could give a further understanding of the internal structure of matter. Such models or theories had to be proved not only by the reproduction of measurable physical quantities. They had to able to explain in a plausible way all the internal mechanisms within nucleons and mesons but also indirect related results given e.g. by astronomy or cosmology.

The presented texts try to solve the last remaining large mysteries of the universe and of physics, questioning on the basis of very strong arguments at the same time fife basic assumptions of modern physics or at least give restrictions to their range of validity:

1. Quarks do have a substructure
2. Quantum Mechanics cannot be applied to the physical vacuum
3. There are (outside of the matter world) mechanisms with actions below $\hbar/2$
4. There are phenomena (outside of the matter world) that spread out much faster than with c
5. There should be indeed an aether as the basis or substrate of all physical phenomena.

It can be shown that all five new or modified basic assumptions do not give rise to contradictions within the observable reality but only a deeper understanding of all basic physical phenomena.

Up to now effectively all gains in knowledge within physics have been achieved by a complex mutual benefit between experiment and theory; via gain of experimental results, finding out of fundamental empiric relations or symmetries, development of suitable models up to the creation of theories as well as their experimental prove by testing of theoretical predictions. Within this context it was necessary to recognise fundamental and sufficiently representative description parameters such as energy, impulse or entropy as well as the recognition or clear definition of basic interaction mechanisms such as the fields, as well as the detection or determination of the fundamental structure units of matter such as electron or photon. Structural relations with respect to the very special construction of matter such as within galaxies, atoms or nucleons can be gained on principle solely via experiments and models. The incorporation of theories is necessary to achieve a sufficiently high precision. However, using theories alone it is impossible on principle to discover the very special construction of matter irrespective of the considered level.

The experimental investigation of matter gets the highest possible accuracy, if the 'instruments' used for this probing are given by the smallest possible structure units of matter (inclusive 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 is the subject of consideration. There are no smaller units for a possible investigation anymore.

At this very point there is only the statement left that either no further recognition is possible at all, or one starts testing unusual possibilities on the basis of 'trial and error' using pragmatic imaginations obeying of cause fundamental principles such as all laws of conservation and basic principles of 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 always be 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 general consistency this might find acceptance as a least possible scientific method.

Despite of enormous progress in physics and astronomy several fundamental questions still remain unanswered since decades indicating somewhere a wrong base. Therefore a requestioning of fundamental assumptions makes obviously sense and might give igniting new ideas. The presently adopted description of our universe is related to an emanation with singularity, needs questionable superluminal inflation and ends up with a non-acceptable everlasting thermal death. All this being a stringent consequence of the Standard Model of Particle Physics based on the idea of elementary Quarks.

Assuming instead composed Quarks the main part of the presented paper explores the arising manifold consequences and results in a more reasonable solution. But replacing this way the Standard Model - essentially founded on the model of vacuum fluctuation - indicates immediately, that also a new understanding of electromagnetism is needed. The achieved new ideas now enable an interrelation between electromagnetism and gravitation and in addition a surprising and promising new interpretation of Quantum mechanics. Obviously such a wide-spanned brainstorming concerning last fundamentals of physics certainly incorporates the danger of the one or the other incorrect item but nevertheless it should allow the intended broad discussion among all interested scientists and perhaps a re-thinking.

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