Quantised structure of nucleons
The nature of nuclear forces

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This article was published like chapter 5 in the Leonov's book: Quantum Energetics. Volume 1. Theory of Superunification. Cambridge International Science Publishing, 2010, pp. 352-420. To solve the problem of nuclear forces, I had to destroy part of quantum chromodynamics (QCD). None of the physicists directly measured the fractional electric charge in QCD. Only an entire electric charge of physics was measured with the highest accuracy. Elementary electric charge **e** is the most stable constant in nature. Only entire electric quarks with a charge of ±1e make up the structure of nucleons to create a sing-alternating (sing-changing) shell with alternating charges in sign. The presence of a sing-alternating shell for nucleons provides spherical deformation of quantized space-time and the formation of mass. The sing-alternating shells of the nucleons create short-range electric forces, regardless of the presence of an excess charge on the nucleon. These short-range electrical forces are equivalent to nuclear forces.

In 1996, the structure of nucleons with the sign-changing shell with integer charges – quarks was proposed in the theory of the elastic quantised medium (EQM). This concept proved to be fruitful for the Superunification theory and enabled the nature of nuclear forces to be investigated as contact forces acting between the sign-changing shells of the nucleons. These forces act over short distances and their magnitude and nature correspond to the nuclear forces, but they are characterised by electrical attraction of shells and their anti-gravitational repulsion.

5 .1. Introduction

In chapter 4, we investigated the quantised structure of the electron and the positron within the framework of the Superunification theory, where the generalising factor is the superstrong electromagnetic interaction (SEI). To continue the development of the Superunification theory, in this chapter we examine the quantised structure of the nucleons (positron and neutron), because the nature of nuclear forces cannot be explained without knowing this structure. The chapter is based on the study by the author ‘Electrical nature of nuclear forces (Agroprogress, Moscow, 2001), supplemented by information on the zones of gravitational repulsion of the shells of the nucleons.

The criticism of the modern physics of elementary particles and of the atomic nucleus has been reduced to concluding that the number of successes in this area of scientific investigations is very small, regardless of the huge means spent by the government of various countries to this area.

The atomic and hydrogen bombs were constructed, but this was done by purely empirical methods because of huge investments necessary. These are not achievements, these development are the misfortune of mankind because modern physics does not know the nature of nuclear forces, and has not explained the structure of any of the elementary particles, including the main ones: proton, neutron, electron, positron, photon, electronic neutrino. Energy generation in nuclear physics is based on the mass defect. However, the nature of formation of mass of the elementary particles during their nucleation could not be explained.

Without understanding the problem, work started on nuclear power energy. Finally, we had the Chernobyl accident and other technogeneous failures. The fact that the nature of nuclear forces is not known does not enable us to deactivate charged zones, etc.

Why is my criticism of such an elite area of science as the physics of elementary particles and the atom nucleus so fierce? It is because these problems are answered by the completely new theory of the elastic quantised medium which I developed in the period 1996–2000. The theory of the elastic quantised medium is the theory of the united electromagnetic field (TUEF), which describes the structure of elementary particles and nature of nuclear forces. The Superunification theory was the first theory which can combine all the known interactions from the single viewpoint: electromagnetic, gravitation, strong (nuclear) and weak (neutrino) [1–15].

At present, the Superunification theory is the most powerful analytical means of investigating matter. The theory combines the theory of relativity and quantum theory and represents a new stage in the development of quantum theory. It has been proven that the principle of relativity is the fundamental property of quantised space-time.

The origins of the theory of the elastic quantised medium date back to January 1996, when I discovered a new elementary quantum of space - quanton, establishing the static electromagnetic structure of the quantised space-time for discrete space-time. The electromagnetic quantisation of space is based on the discrete geometry and the physics of interaction of monopoles: electrical and magnetic. In order to separate a minimum volume in space, it is necessary to have only four points from the viewpoint of the geometrical minimisation of the volume. In transition from geometry to physics, the four points are replaced by four monopole charges – quarks: two electrical ones ($-1e$ and $+1e$) and two magnetic ones ($-1g$ and $+1g$), forming the further indivisible quantum of space-time.

In principle, the four monopole integer charges – quarks represent new quarks from which matter is constructed, replacing the old hypothesis of quarks as fractional charges in quantum chromodynamics (QCD). In quantum chromodynamics, quarks were compared with the structure of the nucleons in order to explain the nature of nuclear forces. In the theory of the elastic quantised medium and Superunification theory, the charges – quarks (or monopoles) are included in the structure of space-time from which all the elementary particles representing the integral part of the quantised space-time are already constructed with participation of quantons and a surplus of electrical monopoles. Whilst quantum chromodynamics has to deal gradually with greater and greater problems, the Superunification theory has no contradictions.

It is not now necessary to discussing details of the fundamentals of the theory of the elastic quantised medium and Superunification, which have already been published in different sources (more than 50), for example [1–15], because the subject of these investigations is the substantiation of the electrical or, more accurately, electromagnetic nature of nuclear forces. However, it is necessary to publish the main assumptions and the results of the EQM and Superunification theories.

1. Limiting energy $W_{\max}$ (4.28) and mass $m_{\max}$ (4.29) of the particles

$$W_{\max} = \frac{C_0^4}{G} R_s \tag{5.1}$$

$$m_{\max} = \frac{C_0^2}{G} R_s \tag{5.2}$$

where $G = 6.67 \cdot 10^{-11}$ Nm^2/kg^2 is the gravitational constant; $C_0^2 = 8.99 \cdot 10^{16}$ m^2/s^2 is the gravitational potential of the non-perturbed quantised space-time (C_0^2 = const); R_s is the radius of the elementary particle, m.

For a relativistic proton with the radius $R_s = 0.8 \cdot 10^{-15}$ m, the limiting mass is only 10^{12} kg in accordance with (5.2). This is a higher but not an infinite value, corresponding to an iron asteroid with the diameter of the order of 1 km. For a relativistic electron whose radius does not have a distinctive gravitational boundary, in the determination of the limiting parameters it is evidently necessary to take into account the dimensions of the proton with some clarification.

2. The balance of the gravitational potentials of the particle (3.58), (3.71)

$$C_0^2 = C^2 + \varphi_n \gamma_n \tag{5.3}$$

where C^2 is the gravitational potential (potential of action) of the quantised space-time perturbed by gravitation, m^2/s^2 ($C^2 \neq$ const); φ_n is the Newton gravitational potential for the mass m, m^2/s^2, where γ_n (3.70) is the normalised relativistic factor for the particle moving with speed v:

$$\varphi_n = \frac{Gm}{r} \tag{5.4}$$

where r is the distance ($r > R_s$), m

$$\gamma_n = \frac{1}{\sqrt{1-\left(1-\frac{R_g^2}{R_s^2}\right)\frac{v^2}{C_0^2}}} \tag{5.5}$$

where R_g is the gravitational radius of the source of gravitation (without the multiplier 2), m

$$R_g = \frac{Gm}{C_0^2} \tag{5.6}$$

For the elementary particles and non-collapsing objects, the gravitational radius is a purely calculation parameter.

The normalised relativistic vector γ_n (5.5) restricts the limiting energy of the particle to the value (5.1) when the particle reaches the velocity of light.

3. Velocity of light in a vacuum field perturbed by gravitation

From (5.3) we obtain

$$C = \sqrt{C^2} = C_0\sqrt{1-\frac{\varphi_n\gamma_n}{C_0^2}} \tag{5.7}$$

Equation (5.7) determines the velocity of light in the perturbed vacuum in the vicinity of a moving solid (particle) and shows that with the increase of the mass and velocity of the solid, the velocity of light in the vacuum, perturbed in this fashion, decreases. This corresponds to the experimental observations of the distortion of the trajectory of the light beam in a strong nonuniform gravitational field. In a limiting case, the light is arrested completely on the surface of a black hole at $\varphi_n\gamma_n = C_0^2$, does not penetrate into the black hole or does not leave the black hole, making the black hole invisible.

4. Energy balance (3.75) for the particle in the quantised space-time

$$W_{\max} = W_v + m_0 C_0^2 \gamma_n \tag{5.8}$$

The balance (5.8) shows that the limiting energy of the particle (5.1) consists of the latent energy W_v of the quantised space-time and the actual (this should not be confused with the complex number) energy $m_0 C_0^2 \gamma_n$. The energy balance (5.8) shows that the only source of energy of the particle (solid) is the colossal energy hidden in the vacuum field. In fact, the balance (5.8) is a generalised Lagrange function which determines the energy parameters of the moving particle in the deformed vacuum field. The movement of the particle in the vacuum is connected with the redistribution of energy in accordance with balance (5.8).

5. Balance of surface tension forces of quantised space-time

$$F_{vT} = \frac{dW_v}{dR_s} = \frac{C_0^4}{G} - 4\pi R_s^2 \rho_m C_0^2 \gamma_n \tag{5.9}$$

Equation (5.8) can be used to determine the dynamic balance of forces F_{vT} (5.9) of the surface tension of the quantised space-time around a moving particle determined by the spherical deformation of the quantised space-time as a derivative with respect to R_s taking into account (5.1) and expressing the mass in (5.8) through the density of matter ρ_m.

6. Surface tension force of quantised space-time by particle F_T

$$F_T = 4\pi R_s^2 \rho_m C_0^2 \gamma_n \tag{5.10}$$

The surface tension force of the quantised space-time by the particle F_T (5.8) is the sum of all tensions of the forces acting on the surface of the particle from the side of the quantised space-time. This force is spherically balanced and manifests itself externally during movement of the particle by inertia.

7. The tensor of the force of surface tension of the quantised space-time by a particle

$$\mathbf{T}_n = \rho_m C_0^2 \gamma_n \mathbf{1}_n \tag{5.11}$$

The surface tension tensor $\mathbf{T}_n$ determines the effect of tension forces on the unit surface of the particle from the side of the quantised space-time ($\mathbf{1}_n$ is the unit vector normal to the spherical surface of the particle). Tensor $\mathbf{T}_n$ depends on the density of the matter of the particle and its speed in vacuum. For a proton at $\gamma_n = 1$, the density of matter is $\rho_m = 0.723\cdot10^{18}$ kg/m^3, and the tension tensor has a colossal high value, $T_n = 6.56\cdot10^{34}$ N/m^2.

8. Limiting force of surface tension in vacuum

$$F_{T\max} = \frac{C_0^2}{G} = 1.2\cdot10^{44}\,\mathrm{N} \tag{5.12}$$

The force $1.2\cdot10^{44}$ N (5.22) is a limiting force which can only exist in nature as a result of the deformation of the quantised space-time, acting on the entire surface of the black hole or black microhole.

9. The quanton diameter L_q for non-perturbed quantised space-time

$$L_q = \left(\frac{4}{3}k_3\frac{G}{\varepsilon_0}\right)^{\frac{1}{4}}\frac{\sqrt{eR_s}}{C_0} = 0.74\cdot10^{-25}\,\mathrm{m} \tag{5.13}$$

where $k_3 = 1.44$ is the coefficient of filling of the quantised space-time by spherical quantons; $R_s = 0.8\cdot10^{-15}$ m is the radius of the proton (neutron).

Equation (5.13) was obtained from the conditions of tensioning of the quantised space-time as a result of its spherical deformation in the formation of an elementary particle (proton, neutron) from the quantised space-time, and takes into account the interactions of the quantons between themselves in the deformed space.

10. Quantum density ρ_0 of the medium of non-perturbed quantised space-time

$$\rho_0 = \frac{k_3}{L_q} = 3.55\cdot10^{75}\,\frac{\mathrm{quanton}}{\mathrm{m}^3} \tag{5.14}$$

11. Vector of deformation of the quantised space-time D

$$\mathbf{D} = \mathrm{grad}\,(\rho) \tag{5.15}$$

12. Poisson equations for the deformed quantised space-time

$$\rho_m = k_0 \mathrm{div\ grad}(\rho) \tag{5.16}$$

$$\rho_m = \frac{1}{4\pi G}\mathrm{div\ grad}(C_0^2 - \phi_n\gamma_n) \tag{5.17}$$

where $1/k_0 = 3.3\cdot10^{49}$ particles/kg·m^2 is the constant of the quantised space-time non-perturbed by deformation; ρ_m is the density of the matter of the perturbing mass, kg/m^3.

$$\frac{1}{k_0} = 4\pi G \frac{\rho_0}{C_0^2} \tag{5.18}$$

$$\rho = \varphi \frac{\rho_0}{C_0^2} = C_0^2 \frac{\rho_0}{C_0^2} \tag{5.19}$$

The Poisson equations are written for the quantum density of the medium (5.16) and the gravitational potentials (5.17) of quantised space-time.

13. Solutions of Poisson equations for the spherically deformed quantised space-time

$$1)\ \begin{cases} \rho_1 = \rho_0\left(1 - \dfrac{R_g\gamma_n}{r}\right) \\ \rho_2 = \rho_0\left(1 + \dfrac{R_g\gamma_n}{R_s}\right) \end{cases} \quad 2)\ \begin{cases} \varphi_1 = C_0^2 = C_0^2\left(1 - \dfrac{R_g\gamma_n}{r}\right) \\ \varphi_2 = C_2^2 = C_0^2\left(1 + \dfrac{R_g\gamma_n}{R_s}\right) \end{cases} \tag{5.20}$$

The solutions of the Poisson equation (5.20) are presented in the form of a system for the external region of space (ρ_1 and φ_1) and also for the internal region of the particle (ρ_2 and φ_2), restricted by the particle radius R_s. Radius R_s is the gravitational interface in the medium. This is caused by the fact that the solutions (5.20) were obtained for the spherically symmetric deformation of quantised space-time with the generation of elementary particles in it.

The physical principle of divergence of the gradient of the quantum density of the medium (5.16) may be described as follows. If we define some spherical boundary in the vacuum field and start to compress it uniformly to radius R_s together with the medium, the quantum density inside the sphere increases as a result of the decrease on the external side. This property of the absolutely elastic medium is described by the distribution of the quantum density of the medium and gravitational potentials in accordance with expression (5.20).

The presence of two components: external (ρ_1 and φ_1) and internal (ρ_2 and φ_2) in the solutions (5.20) ensures the equilibrium of the quantised space-time (quantised medium) during its spherical deformation. The internal component compresses the quantised medium, the external component counteracts compression as a result of tensioning of the medium on the external side beyond the radius R_s. This explains the stability of the space-time.

14. Gravitational diagram of the nucleon in vacuum (Fig. 5.1, see also Fig. 3.11)

The gravitation diagram (Fig. 3.11) reflects the distribution of the quantum density of the medium and gravitational potentials in statics (at $\gamma_n = 1$) in accordance with the solutions (5.20) and determines the balance of the quantum density of the medium and gravitational potentials. It can be seen that at the gravitational interface $r = R_s$ there is a jump of the quantum density of the medium $\Delta\rho$ and the gravitational potential $\Delta\varphi$, with the formation of a gravitational well in the medium

$$\Delta\rho = 2\rho_{ns} \qquad \Delta\varphi = 2\varphi_{ns} \tag{5.21}$$

where φ_{ns} is the Newton gravitational potential at the gravitational interface R_s in the medium determined by the decrease of the quantum density of the medium ρ_{ns} on the external side of the gravitational boundary in the spherical deformation of the quantised space-time, m^2/s^2.

The presence of multiplier 2 in (5.21) is determined by the physical model of participation of two components, ensuring the stability of the vacuum space as a result of its simultaneous compression and tension of the elastic medium resulting from the gravitational interactions, excluding also the multiplier 2 from the gravitational radius (5.6) which was erroneously introduced by Schwartzschild because of the absence of the physical model of gravitational deformation of the quantised space-time.

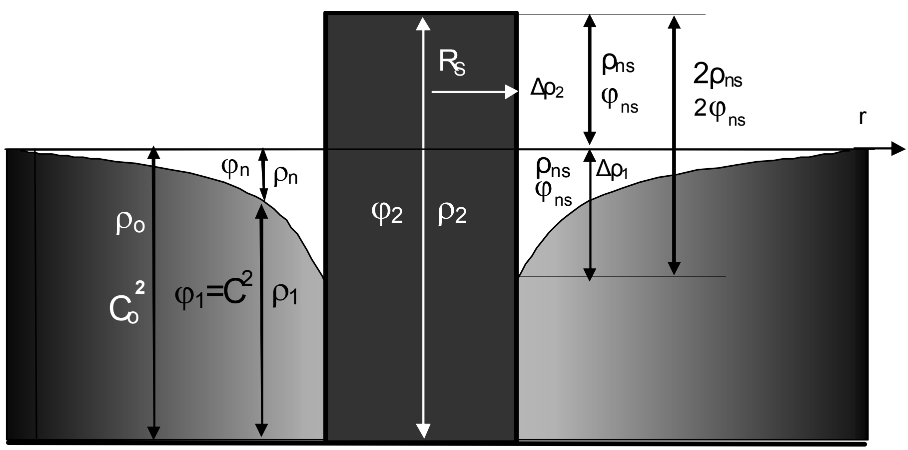

Fig. 5.1. Gravitational diagram of the nucleon in vacuum.

15. Equivalence of mass and energy

$$W_0 = \int_0^{C_0^2} m_0 d\varphi = m_0 C_0^2 \tag{5.22}$$

The presence of the intrinsic gravitational potential C_0^2 of the non-deformed quantised space-time enables us to determine the rest energy W_0 (5.22) of the particle during its nucleation and vacuum as the work of transfer of mass m_0 from infinity to the region of the potential C_0^2. This is the simplest and easiest to understand conclusion of the equivalence of mass and energy.

16. Equivalence of electromagnetic and gravitational energies

The equivalence of mass and energy (5.22) may be used to formulate the principle of equivalence of electromagnetic and gravitational energies; this has been fully confirmed in [4]. In fact, mass is a gravitational charge and is a carrier of the gravitational field in the form of the spherically deformed quantised space-time. The energy of spherical deformation of the quantised space-time is determined by its gravitational potential C_0^2 in accordance with (5.22). In particular, the gravitational energy of the spherical deformation of the quantised space-time was not taken into account by the modern theory of gravitation. In annihilation of mass, its gravitational energy (energy of deformation of quantised space-time) transforms fully to electromagnetic radiation.

17. What is the mass of the particle?

The Poisson equation (5.16) for the deformation vector (5.15) of the quantised space-time has the form

$$\rho_m = k_0 div \ \mathrm{D} \tag{5.23}$$

Applying the Gauss theorem to the Poisson equation (5.23), we determine the mass of the particle in the form of the flow of the deformation vector penetrating the closed surface S around the mass in the spherically deformed vacuum

$$m = k_0 \oint_S \mathbf{D} dS \tag{5.24}$$

Thus, equation (5.23) determines that the particle mass forms as a result of the spherical deformation of quantised space-time and is its integral part. In experiments, this is detected in the manifestation by the particle of the features of corpuscular-wave dualism. The mass is the energy of spherical deformation of quantised space-time. This determines the equivalence of the mass and its energy (5.22). Movement of the particle, having a mass, is the transfer of spherical deformation of the quantised space-time and the gravitational interface of the medium.

This study is concerned with analysis of the gravitational interface of the nucleons in the vacuum field. The structure of the gravitational interface determines the structure of the nucleons and the nature of nuclear forces. A brief introduction to the EQM and Superunification theories will help to deal with the presented material.

5 .2. Problem of the nucleon mass

The structure of nucleons can be examined separately from the quantised space-time. All the attempts to develop physical models of the problem of the neutron as free from the quantised space-time of particles have been unsuccessful. This is due to the fact that the interaction of nucleons should result not only in the generation of nuclear forces in the process of formation of the nucleon structure of the atom nucleus and its mass but it also determines the entire set of the physical properties of the nucleons, the atomic nucleus and the atomic structure, including interaction with orbital electrons.

Which physical properties of the nucleons should be discussed? In particular, this relates to the formation of the nucleon mass as the manifestation of the gravitational properties of the particles in the vacuum field. Without knowing the mechanism of formation of the nucleon mass we cannot explain and describe the reasons for the formation of the mass defect in splitting and synthesis of the atomic nucleus and, consequently, we cannot understand the mechanisms of release of the colossal energy of the quantised space-time in these reactions, referred to as nuclear and thermonuclear energy.

If we want to be more punctual, then in accordance with the Superunification theory the energy is a common basis and represents the entire variety of electromagnetic manifestations expressed in different forms and methods of its release from the quantised space-time. When discussing nuclear and thermonuclear energy, then from the viewpoint of the current level of knowledge this refers to the release of the energy of the atomic nucleus in nucleon–nucleon interactions. However, from the viewpoint of Superunification theory, the occurrence of nucleon–nucleon interactions in the reactions of splitting and synthesis of the atom nucleus is only one of the methods of release of the colossal amount of energy, initially accumulated in the vacuum field (in the quantised space-time).

I have already criticised many times the quantum chromodynamics as the theory which appears to be directed to explaining the strong interactions between the nucleons the nuclear processes. However, chromodynamics has not even touched the main problem of the nucleons – the problem of formation of nucleon mass. Quantum chromodynamics is a fantastic theory which has nothing in common with the actual nuclear processes taking place in the vacuum field in nucleon synthesis, and is in fact a collection of unsolved problems in elementary particle physics.

Naturally, the problem of formation of the nucleon mass is associated with the structure of the nucleons. The structure of the nucleons should already determine the entire set of their physical properties, including the spherical deformation of the quantised space-time which is far greater than in the electron and the positron and results in the large mass of the nucleons [3, 4].

At the same time, the structure of the nucleons must ensure nucleon–nucleon attraction inside the nucleus taking into account the general approaches of the Superunification theory which regards the nuclear forces as manifestation of static electricity (electromagnetism) in contact interaction of sign-changing nucleon shells. The Superunification theory does not regard the nuclear forces as the manifestation of special independent interactions which can not be explained on the basis of classic electromagnetism.

In addition, the structure of the nucleons should be connected inseparably with the vacuum field and have gravitational, electrical and magnetic properties. The gravitational properties are reflected in the deformation of the quantised space-time (its distortion), and the electrical and magnetic properties should be reflected in the capacity of nucleons for polarisation, regardless of the presence of the free nuclear charge.

Finally, the structure of the nucleons must explain the reasons for the stability of the proton and instability of the neutron, and also the mechanism of their mutual transformation. At the same time, the separately considered proton should ensure that the simplest atomic structure of the proton and the electron is stable without allowing the orbital electron to fall on the proton and, in more complicated nuclei, to fall on the nucleus, maintaining the electron in the orbit [3].

I have only mentioned some of the properties of the nucleons investigated in this book. However, these are the main and fundamental properties, and the reasons for the existence and manifestation of these properties are explain for the first time by the Superunification theory only from the viewpoint of classic electromagnetism, taking into account the interaction of the particles inside the electromagnetic structure of the quantised space-time.

5 .3. Shell sign-changing model of the nucleon

In solving the problem of constructing a shell model of the nucleon it is assumed that the nucleon shell should represent a distinctive gravitational interface in the vacuum field. This shell should generate forces of colossal spherical tension of the quantised medium, carrying out the spherical deformation of the quantised space-time and thus forming the mass of the nucleon from the quantised space-time.

The shell model of the nucleon was proposed for the first time in [1]. Since then, I have attempted to develop alternative models of nucleons, bypassing the shell model, for example, in the form of spherical formations filled completely with electrical monopoles. However, this model did not permit spherical deformation of the quantised space-time.

In principle, when constructing models of elementary particles, the range of structural materials is not large, in fact it is small. We have at our disposal the discrete structure of the quantised space-time, consisting of quantons and a surplus of electrical monopoles (massless charges) [1–4].

Two electrical monopoles have already been used in constructing the structure of the electron and the positron: negative and positive polarity, which in interaction with the vacuum field form the complicated structure of the polarised and deformed quantised space-time referred to as the electron and the positron [3, 4].

The deformation of the quantised space-time by the massless electrical monopole determines the specific mass of the electron (positron) which is ~1836 times smaller than the proton mass and to ~1840 times smaller than the neutron mass. The proton carries an elementary electrical charge of positive polarity of the monopole type. However, the monopole electrical charge of positive polarity, being in the free state in the vacuum field, is capable of synthetising only the positron with the mass 1836 times smaller than the proton mass.

How to increase the positron mass in order to transform the positron into the proton? Of course, to increase the mass, it is necessary to intensify the spherical deformation of quantised space-time. If this method is used (the method was applied in the process of formation of positron mass as a result of spherical deformation of the quantised space-time) deformation can be intensified by increasing the magnitude of the central electrical charge with positive polarity. However, in practice this can not be carried out because it is not possible to combine into a single central charge even two electrical monopoles of the same polarity. This is so because Coulomb repulsive forces can not be overcome over such short distances.

Thus, the proton mass forms in vacuum by a mechanism which differs completely from that in the formation of the positron mass. It can be seen that the excess elementary charge of positive polarity has no effect in the formation of proton mass. It should be mentioned that the electron mass forms as a result of pulling of the quantons to the central monopole charge with negative polarity under the effect of ponderomotive forces [3, 4].

It can be assumed that the proton mass is increased by a large number of monopole electrical charges of positive polarity which are compensated by the monopoles with negative polarity, with the surplus of one elementary charge with positive polarity. In this formulation of the problem, the neutron can be regarded as a completely electrically compensated particle. In this case, the interaction of the electrical monopoles with different polarity results in the formation of a large number of electronic neutrinos included in the nucleon structure. However, such a neutrino particle (conglomerate) has no mass because even a large number of neutrinos, filling the volume of the particle, represents a massless formation or has a hardly perceptible mass which has nothing in common with the nucleon mass.

However, with the exception of some surplus of the electrical monopoles, there is no structural material in the quantised space-time. This is determined by the electrical asymmetry of the quantised space-time. This means that there is only one method of formation of the nucleons in which the electrical monopoles should form a shell of electrical and monopoles combined into a neutrino. In the cross-section, this shell is a system of sign-changing charges which determine the colossal tension of the shell capable of carrying out spherical deformation of the quantised space-time (quantised medium) thus forming the large nucleon mass.

The Superunification theory treats the structure of the electronic neutrino ν_e as an electrical dipole consisting of electrical monopoles of negative and positive polarity which forms as a result of annihilation of the electron e^- and the positron e^+ with the formation of two gamma quanta γ_q [1–3]

$$e^- + e^+ \rightarrow 2\gamma_q + \nu_e \tag{5.25}$$

Thus, the only possible method of ensuring sufficiently extensive spherical deformation of the quantised space-time, capable of distorting (deforming) the space and ensuring that the space has gravitational features, is the formation of the sign-changing nucleon shell. This shell forms from electrical monopoles bonded in pairs into an electronic neutrino.

On the whole, the sign-changing shell is electrically neutral and has the neutron structure. The presence of a surplus positive charge in the shell forms the proton structure. Contact interaction of the shells results in the effect of colossal Coulomb attractive forces between the nucleons over short distance. These forces are regarded as nuclear forces.

However, most importantly, the presence of the sign-changing shell in the nucleon enables us not only to calculate the tension of the shell and correlation of this tension with the formation of the quantised space-time but also carry out for the first time analytical calculations of nuclear forces. These are Coulomb attractive forces of a large number of electrical dipoles acting between the nucleon shells in contact, regardless of the presence of a surplus electrical charge in the nucleon.

It can be assumed that the shell model of the nucleon is the most non-contradicting model embracing almost all aspects of the interaction of the nucleons not only inside the atomic nucleus but also between the atomic nucleus and the orbital electrons. At present, description of the well-known interactions of the atomic nucleus of the orbital electrons without knowing the structure of the particles is no longer sufficient in order to understand the complicated processes taking place in the vacuum field during operation of the atomic structures.

With all its manifestations, the shell model does not differ at all from the existing experimental data collected in the physics of elementary particles and the atomic nucleus. Most importantly, the shell model satisfies the assumptions of the Superunification theory regarding the spherical deformation of the quantised space-time, ensuring the gravitational properties of the nucleons.

The main problems which had to be solved in the development the shell model of the nucleon are associated with two aspects:

1. It was necessary to link the stability of the proton with complete filling of the cells of the shell model by electrical monopoles with the presence of a surplus elementary positive charge.
2. It was necessary to explain the instability of the neutron and its mass being $\sim 1.3 m_e$ greater in comparison with the proton.

It should be mentioned that most accurate measurements were taken of the difference between proton mass m_p and neutron mass m_n and not of the neutron mass [6]:

$$m_n - m_p = 1.29344(27)\,\text{MeV} \approx 1.3\,\text{MeV} \approx 2.53 m_e \tag{5.26}$$

Here, doubts are cast ??? on the encyclopedic values of proton mass $m_p \sim 1836\ m_e$ and neutron mass $m_n \sim 1840\ m_e$, which were used as handbook values in the calculations [16, 17], and also that the difference between them is $4m_e$, and not $\sim 2.53\ m_e$ (5.26). I assume that the small differences in the handbook data for the proton and neutron masses must be brought into correspondence.

Important features of the Superunification theory are not only the accurate difference between the proton and neutron masses, equal to

~1.3 m_e, but also the accurate values of the masses themselves since the mass determines tensions in the nucleon shell and the structure of the shell and the nucleon. The fact that the accurate neutron mass has not as as yet been determined indicates only the existence of theoretical and experimental difficulties.

When searching for analogues of shell models in other directions of science, a significant positive role in the development of shell models of the nucleons has been played by investigations in the area of fullerenes [18]. The attractive feature of these analogues is that the fullerenes are capable of self-organisation of spatial shell structures in the region of the small dimensions of the nanoworld. The fullerene is a shell of carbon cluster C_{60} containing 30–40 or more atoms.

The fact that arbitrary formations of shell models can form in nature permits the formation of an identical nucleon model, but the carbon in the nucleon shell is replaced by electrical monopoles merged into an electronic neutrino, not only of the dipole type but also more complicated formations.

The basis of the shell model of the nucleon is a grid whose nodes contain electrical monopoles. This grid is characterised by colossal surface tension capable of spherical deformation of quantised space-time, forming the nucleon mass. The equilibrium condition of this structure is determined, on the one hand, by the tension of the grid (shell) and, on the other hand, by the tension of the deformed quantised space-time which is balanced by the tension of the shell. At the same time, the structure should ensure the transfer of spherical deformation of quantised space-time in the stationary space, resulting in the transfer of the nucleon mass in space.

There are two grid models of the nucleon shell:

1. The surplus charge of positive polarity is situated in the centre of the proton outside its completely neutral shell. This model was investigated in [1]. The neutron forms as a result of the electrical monopole with negative polarity.
2. The surplus charge of positive polarity is harmonically included in the nucleon shell thus forming a proton. The neutron forms as a result of annexation of the electrical monopole with negative polarity to the shell of the proton.

5 .4. Shell models of the proton

In principle, these two models of the nucleons ensure stable construction of the proton and unstable construction of the neutron, fulfilling the condition of correspondence of the properties of stability and instability of the nucleons with the experimental data. The stability of the proton forces us to assume that the proton model must be the initial model of the nucleon.

Figure 5.2 shows the shell model of the nucleon with a built-in central electrical charge of the monopole type with positive polarity (*a*) and the model of the nucleon when the charge is built into the shell (*b*). These two shell models of the proton greatly differ from each other and can determine the stability instability of the proton. However, only one of them is found in nature. It is necessary to define scientific approaches to the analysis of these models which would enable us to select the required model.

So far, we have not examined the construction and structure of the nucleon shell and have only concluded, on the basis of previous investigations, that the nucleon shell structure has the form of a grid model with the sign-changing distribution of the monopole electrical charges in the nodes of the grid [1].

Only this sign-changing structure is capable of developing tension inside the shell. It is now important to understand that the shell of the proton represents the gravitational interface in vacuum ensuring spherical deformation of the quantised space-time.

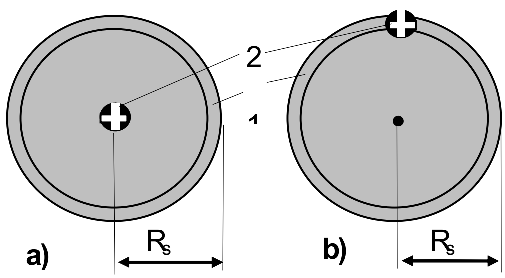

Fig. 5.2. Shell model of the proton with a surplus central charge: positive polarity (a) and with the charge built into the shell (b); 1) the shell, 2) the electrical charge of positive polarity of the monopole type.

The radius R_s of the gravitational interface of the proton is determined by the equation [19]:

$$R_s = (0.814 \pm 0.015)\mathrm{F} \approx 0.81 \cdot 10^{-15}\,\mathrm{m} \tag{5.27}$$

Regardless of the fact that the physics of deformation of quantised space-time of the proton by the sign-changing shell differs from the physics of deformation of quantised space-time by the central electron charge, in the general form the equations linking the vectors of deformation of the quantised space-time in the formation of the proton mass were derived previously in the EQM theory (5.24), (5.16), (5.23), (5.18):

$$m = \frac{1}{4\pi G}\frac{C_0^2}{\rho_0}\oint_S \mathbf{D}\,dS \tag{5.28}$$

$$\rho_m = k_0 \operatorname{div}\mathbf{D} = k_0 \operatorname{div}\operatorname{grad}(\rho) \tag{5.29}$$

Integrating (5.28), we determine proton mass m_p by deformation $\mathbf{D}_s$ of the gravitational interface R_s between the proton and the medium:

$$m_p = R_s^2 D_s \frac{C_0^2}{\rho_0 G} \tag{5.30}$$

Using (5.30), we determine the vector of deformation of the quantised space-time on the surface of the gravitational interface of the proton in vacuum

$$D_s = \frac{\rho_0}{C_0^2}\frac{Gm_p}{R_s^2} = 6.7\cdot 10^{51}\,\frac{\text{quanton}}{\text{m}^4} \tag{5.31}$$

Naturally, the concept of deformation of quantised space-time has not as yet been accepted in physics, and the value (5.31) does not yield much information without comparative analysis.

Thus, for example, deformation of the quantised space-time on the Earth surface reaches $4.9\cdot 10^{60}$ quanton/m^4, and on the Sun surface $1.4\cdot 10^{62}$ quanton/m^4. In relation to these values, the deformation of the quantised space-time by the proton (5.31) is tens of orders of magnitudes smaller, but as regards the quantised space-time, the deformation is defined by a very high value.

5.5. Shell models of the neutron

The neutron differs from the proton by its electrical neutrality, instability and a slightly larger mass. The decay time of the neutron in the free state in the vacuum field is ~15.3 min, and the decay time of the proton is more than 10^{30} years.

In particular, the instability of the neutron excludes its structure in the form of the fully neutral shell with all filled monopole charges in the nodes of the grid of the nucleon shell. It would appear that, losing the electrical charge of positive polarity, the proton transforms into the neutron (Fig. 5.2). In this case, the neutron should have a completely neutral shell which should have the form of a stable and durable particle, with the stability identical with that of the proton. However, this does not correspond to the observed results. At the same time, the loss of the charge by the proton during its hypothetical transition to the neutron should reduce its electromagnetic mass. The neutron mass is greater than the proton mass. Naturally, we are discussing here free particles in the vacuum field.

Thus, all the experimental investigations showed that the neutron is formed by the annexation of the electron or monopole electrical charge of negative polarity to the proton. In this case, the positive charge of the proton is compensated and is transferred to a neutral particle. In addition, this annexation increases the electromagnetic mass of the neutron.

The electromagnetic mass of the neutron is the total energy of the particle, including the energy of deformation of the quantised space-time and the energy of its additional polarisation associated with the annexation of the additional charge. Evidently, the annexation of the additional charge to the proton, resulting in its transformation into the neutron, is not associated with any increase of its gravitational mass. It may be assumed that only the binding energy of the charge annexed to the proton increases.

We can calculate the increase of this energy ΔW_p as the difference of energy in the transition of the monopole charge from the distance of the classic radius r_e of the electron to the radius R_s of the gravitational boundary of the proton $0.81 \cdot 10^{-15}$ m

$$\begin{aligned} \Delta W_p &= \frac{e^2}{4\pi\varepsilon_0}\left(\frac{1}{r_e} - \frac{1}{R_s}\right) = \frac{e^2}{4\pi\varepsilon_0}\frac{(R_s - r_e)}{R_s r_e} = \\ &= 2.02 \cdot 10^{-13}\,\mathrm{J} = 1.26\ \mathrm{MeV} \approx 1.3\,\mathrm{MeV} \end{aligned} \tag{5.32}$$

It can be seen that the energy (5.32) annexed to the neutron is not the gravitational energy and is the energy of interaction of the annexed charge with the neutron. It may be assumed that equation (5.32) is not quite accurate, but all the results of calculations of the interaction of the annexed charge with the neutron are reduced to the determination of the value of

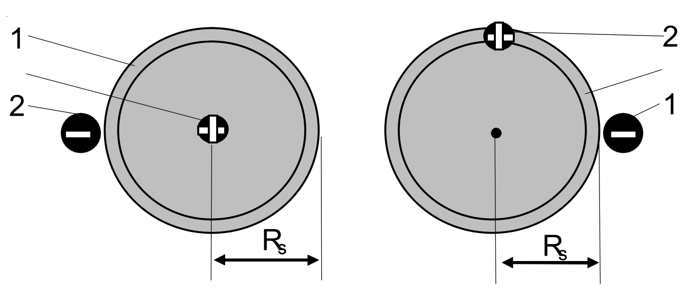

Figure 5.3 The shell model of the neutron by annexation of the external charge of negative polarity. 1) shell, 2) electrical charge of positive polarity of the monopole type, 3) the annexed charge of the monopole type of negative polarity.

the order of 1.3 MeV.

Figure 5.3 shows the shell model of the neutron by annexing the external charge of negative polarity to the proton.

To verify the correspondence of the particle models, it is often necessary to use handbook encyclopaedic materials because they contain the concentration of the required information on the particles. The electron capture effect is well-known in elementary particle physics. The concept of electron capture is characterised literally by a physics encyclopaedia as follows:

'Electron capture is the beta decay of nuclei, consisting of capture by a nucleus of an electron from one of the internal shells of the atom. The proton of the nucleus transforms into the neutron, i.e., the atom (Z, A) transforms to the atom (Z–1, A), where Z is the atomic number, A is the mass number. This transformation takes place by the scheme:

$$(Z, A) + e^- \rightarrow (Z-1, A) + \nu_e \tag{5.33}$$

Here e^- is the electron capture by the atom nucleus (Z, A) from K, L and other shells, ν_e is the electronic neutrino.

The electron capture process is accompanied by the emission of characteristic x-ray radiation of the atom (Z–1, A), formed in filling of vacancies in its shell, and also by low-intensity electromagnetic radiation with a continuous spectrum whose upper boundary is determined by the difference of the masses of the initial and final atoms (less the energy of the quantum of characteristic radiation). This radiation is referred to as internal bremsstrahlung. If the nucleus (Z–1, A) is in the excited condition as a result of electron capture, the process is also accompanied by gamma radiation. If the difference of the masses of the atoms (Z, A) and (Z–1, A) is greater than the double rest mass of the electron, then beta decay with emission of the positron starts to compete with electron capture' [20].

The characteristic of electron capture [20] fully corresponds to the annexation (capture) model of the electrical charge by the proton and its transformation to the neutron (Fig. 5.3). It should be mentioned that prior to the development of the EQM theory, the processes of transformation of elementary particles were described only by Feynman diagrams [21]. However, these diagrams do not describe the mechanisms of internal processes taking place in the structure of the particles.

Electron capture is a spontaneous process and represents the anomaly of the incidence of the orbital electron on the atomic nucleus. However, any spontaneous process must be preceded by appropriate conditions. For the electron to leave the orbit and be captured by the proton of the nucleus, it is necessary to fulfil at least two conditions:

1. The electron orbit should pass in the immediate vicinity of the nucleus.
2. The electron orbit should intersect a specific barrier which reduces the velocity of the orbital electron and changes its trajectory in the direction of capture by the proton.

Previously, when examining the structure of the electronic neutrino and the process of synthesis of the electron and the positron from the quantised space-time [3], it was assumed that there is a certain number of the electronic neutrinos in the excited state in the vicinity of the proton. The electronic neutrino can be captured by the proton and form a specific environment of the proton, without increasing its mass. Evidently, the orbital electron can be captured by the proton with intervention of the electronic neutrino, excited by the proton.

It should be mentioned that the capture of the orbital electron by the proton is accompanied by the ejection of an entire spectrum of electromagnetic radiation, including the radiation of gamma quanta, which can be ejected if the electron loses part of its mass. This is natural because the electron interacts with the proton charge, and the distance between the charges of the electron and the proton may prove to be smaller than the critical radius of annihilation of the particles $r_a = 1.4 \cdot 10^{-15}$ m, smaller than the classic electron radius $2.8 \cdot 10^{-15}$ m.

Therefore, the expression for the reaction of capture of the electron by the proton in accordance with (5.33) does not appear to be quite accurate

$$p + e^{-} \rightarrow n + \nu_e \tag{5.34}$$

since the expression (5.34) does not reflect the energy conservation law. For this reason, equation (5.34) is not used in elementary particle physics.

In fact, the neutron mass is greater than the sum of the proton mass and the mass of the annexed electron, without mentioning the emission of electromagnetic radiation and ejection of the electronic neutrino. It is assumed that the energy-balanced regime is the beta decay of the electron [22]

$$n \rightarrow p + e^{-} + \tilde{\nu} \tag{5.35}$$

Equation (5.35) shows that if the electron has separated from the neutron (Fig. 5.3), the neutron transforms into the proton (Fig. 5.2). Since the electromagnetic mass of the neutron is greater than the sum of the proton and electron masses, it is then assumed that the difference in the energy is carried away by the electronic anti-neutrino $\tilde{\nu}$. Until recently, this explanation was satisfactory to physicists. The energy carried away by the antineutrino can also be calculated:

$$\tilde{\nu} \to n - p - e^- \to 0.782\,\text{MeV} \; = 1.53 m_e \tag{5.36}$$

As indicated by (5.36), the energy carried away by the antineutrino in the reaction of neutron decay (5.35) is equivalent to $\sim 1.5m_e$. However, the antineutrino does not have such a mass. Knowing the structure of the antineutrino and the neutrino in the form of the electrical dipole with the opposite orientation in space [5], we can determine the distance between the charges inside the dipole structure of the electronic neutrino:

$$r = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{1.53 m_e C_0^2} = 1.84 \cdot 10^{-15}\,\text{m} \tag{5.37}$$

As indicated by (5.37), the resultant distance between the charges exceeds the annihilation distance $r_e = 1.4 \cdot 10^{-15}$ m. The antineutrino cannot exist in this extremely excited state and must split into two electrical charges which form an electron and a positron in the vacuum field. However, this phenomenon is not detected in neutron decay. This means that neutron decay (5.35) does not reflect the entire complexity of the processes taking place in the vacuum field during neutron decay. This reaction is written down incorrectly.

It is assumed that neutron decay takes place spontaneously. The spontaneity of the phenomenon can be discussed when reasons for it are not known. The reasons for neutron decay are natural fluctuations of the zero level of the energy of the quantised space-time whose bursts are capable of separating the electrical charge with negative polarity from the neutron.

In a general case, the phenomenon of fluctuation of the zero level of the quantised space-time is not found in the region of the macroworld. however, in the microworld, there are many reasons for fluctuations. All the processes taking place in the vacuum field are associated with the effect of the laws of high numbers, starting with the reality of the quantum density of the medium (quantised space-time), which is expressed by the value of 75 orders (5.14). In addition to this, the quantised space-time is filled with neutrinos of different type whose concentration and velocity distribution have been studied insufficiently. In addition, the vacuum field contains a large number of elementary particles which deform and polarise the vacuum, shaking and stretching quantons from side to side. All this takes place on the background of the spectrum of all kinds of electromagnetic radiation which penetrates through the quantised space-time.

Therefore, when discussing the spontaneity and randomness of the phenomenon, it is the external manifestation of the effect of the laws of high numbers (statistical laws) inside of the quantised space-time. The internal reasons for these phenomena are connected with the behaviour of elementary particles in the presence of the fluctuations of the quantised space-time. Taking into account that in the range of distances of 10^{-15} m the interactions of the elementary particles take place at colossal strengths of the electrical and magnetic fields in the conditions of discrete space, possible fluctuations of the quantised space-time result in the disruption of the equilibrium in the medium. In the final analysis, this causes that the fluctuations of the quantised space-time, as an element of chaos, result in the specific value of the decay time of the free neutron in vacuum which equals ~15.3 min. This phenomenon can occur if there is a reason for it, i.e. fluctuations of vacuum

If we do not examine the random occurrence of the fluctuations of the quantised space-time, the models of the elementary particles, proposed by the Superunification theory, can be used to analyse the purely physical systems of manifestation of fluctuations and perturbations in vacuum. We examine the interaction of the electron with the proton in the case of electron capture up to the moment of formation of a neutron shown in the scheme (Fig. 5.4), taking into account the fact that the dimensions of these particles are approximately the same [3, 4]. When an electron is captured by a proton and they come together to contact with the gravitational boundaries, the structure of this formation, shown in in Fig. 5.4, is highly unstable and exist for a very short period of time. Naturally, the electron, impacting on the shell of the proton, is decelerated as a result of plastic deformation of its shell. As already mentioned, the electron does not have a distinctive gravitational boundary [3, 4], and its shell has lowered elasticity in comparison with the proton shell. At the moment, we should accept the dimensions of the electron with respect to its conventional gravitational

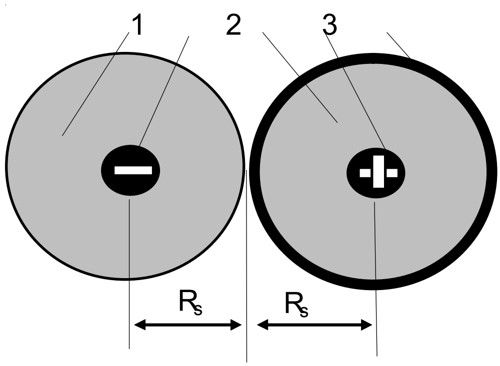

Fig. 5.4. Diagram of interaction of the electron 1 and proton 3 in the case of electronic capture up to the moment of formation of a neutron. 1) the electron, 2) the monopole electron charge, 3) proton, 4) the monopole charge of the proton, 5) sign-changing proton shell.

boundary which is comparable with the radius of the gravitational boundary of the proton R_s.

Naturally, the kinetic energy of the electron, incident on the proton, changes to bremsstrahlung at the moment of capture of the electron. This bremsstrahlung is detected in experiments. It is possible that the deformation of the electron at the moment of collision generates a wide spectrum of electromagnetic radiation. In addition, it is necessary to take into account the additional mass defect as a result of the electron falling into the gravitational well of the proton (Fig. 5.1) [3]. Finally, the scheme in Fig. 5.4 shows the annihilation of the electron on the proton with the emission of gamma radiation. The electron mass changes to the radiation gamma quantum and its monopole charge is annexed to the proton shell transforming the proton into a neutron (Fig. 5.3).

The main advantage of these schemes is that real models can be used to examine the energy transformations in the vacuum field in capture of the electron by the proton and confirm that there are no disruptions of the laws of conservation of energy in the neutron decay reaction (5.34) and formation of the neutron from the proton taking the polarisation of the quantised space-time into account. Here, it is not necessary to use the electronic neutrino (antineutrino) to maintain the energy balance because its energy does not have any specific value in relation to the type of given reactions. The neutrino simply accompanies these reactions because of the specific features of the quantised space-time.

The main error of elementary particle physics is that it does not take into account the interaction of monopole charges in the vacuum field. To show the total energy balance of the system, shown in Fig. 5.4, it is necessary to take into account the mass of not only the electron and the proton but also to take into account the energy W_e of interaction of the charges of the particles with each other. This energy W_e determines the polarisation of quantised space-time by charges for the moment shown in Fig. 5.4

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{2R_s} = 1.42\cdot 10^{-13}\,\mathrm{J} = 0.89\,\mathrm{MeV} = 1.73 m_e \tag{5.38}$$

Naturally, the expression for the energy of interaction of the charges is determined by the distance between the charges. At short distances, in the vicinity of particles, equation (5.38) is not completely accurate from the viewpoint of electrostatics because it does not take into account the change of the electrical properties of the structures of the particles as a result of spherical deformation of the quantised space-time during formation of mass of the particles. The exact solution of this problem is associated with the solution of relatively complicated boundary-value electrostatics problems

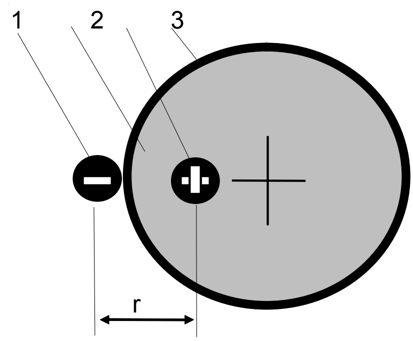

Fig. 5.5. Calculation of additional energy of the neutron, 1) the annexed monopole charge of negative polarity, 2) the neutron, 3) the intrinsic excess charge of the neutron with positive polarity) the neutron shell.

taking into account the deformation of quantised space-time, both inside and outside the gravitational boundary.

The model of the neutron shown in Fig. 5.2 also confirms that the energy of interaction of the charges exists inside the neutron and determines its large electromagnetic mass. At the moment, it is difficult to derive an exact analytical equation which would determine the additional energy of interaction between the annexed and natural charges, but this additional energy is not linked with the gravitational mass of the neutron. Unfortunately, it is this additional energy of interaction of the charges that has not been considered in elementary particle physics.

Nevertheless, some ‘reconnoitering’ calculation parameters of the additional energy of interaction of the charges inside the neutron can be presented. To some extent, these calculations make it possible to predict the selection of the proton model with an internal charge or a charge implanted in the shell.

Figure 5.5 shows the calculation diagram of the additional energy of the neutron as a result of interaction of the annexed and natural excess charges. In this stage, we do not take into account the effect of the sign-changing shell of the neutron which may have both a screening effect or be the factor of interaction causing generation of additional energy.

If the additional energy of the neutron is determined by the interaction of these charges, then irrespective of whether the charge is situated inside the gravitational boundary behind the shell or is implanted in the shell, the approximate value of the energy can be calculated taking into account the distance *r* between the charges under the condition that this energy is equal to 1.3 MeV (5.26)

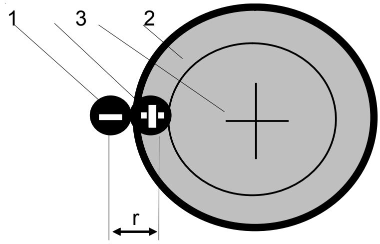

Fig. 5.6. Model of the neutron with the positive electrical charge built into the shell and compensated on the external side by the monopole charge of negative polarity. 1) the annexed monopole charge of negative polarity, 2) neutron, 3) intrinsic excess charge of the neutron of positive polarity, 4) neutron shell.

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r} = 1.3\,\mathrm{MeV} = 2.1\cdot 10^{-13}\,\mathrm{J} \tag{5.39}$$

From (5.39) we determine the required distance between the charges

$$r = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{W_e} = 1.1\cdot 10^{-15}\,\mathrm{m} \tag{5.40}$$

As indicated by (5.40), the required distance between the charges is greater than the radius of the gravitational boundary of the neutron $0.81\cdot 10^{-15}$m. This means that the internal charge with positive polarity should not be displaced in the direction of the external charge with negative polarity and should be repulsed in the opposite direction. However, this contradicts the known laws of electrostatics. The neutron is already produced at capture of the orbital electron by the proton shell.

It can be assumed that these calculations are highly approximate and the model of the proton with the central charge can exist. However, in this case the neutron formed from such a proton should have a dipole electrical momentum equal to the value of the order:

$$p_e = eR_s = e\cdot 0.8\cdot 10^{-15}\,\mathrm{C{\cdot}m} \tag{5.41}$$

However, in reality, the neutron does not have any dipole electrical moment (5.41). This confirms that the excess electrical charges of the proton is built in into its shell, and the neutron forms as a result of annexation of the electrical charge of negative polarity by the proton shell.

$$p_e \le e\cdot 2\cdot 10^{-23}\,\mathrm{C{\cdot}m} \tag{5.42}$$

Figure 5.6 shows the model of a neutron with a positive electrical charge built into the shell and compensated on the external side by the monopole charge with negative polarity. In principle, this model can satisfy all the properties of the neutron. It is completely neutral and has in fact a very small dipole momentum and is capable of electrical and magnetic polarisation. Most importantly, the model is capable of spherical deformation of quantised space-time, forming the gravitational mass of the neutron. This model is characterised by a larger electromagnetic mass in comparison with the proton, and is unstable. The external electrical charge of negative polarity can be separated from the neutron and injected into the quantised space-time, transforming into an electron, and the neutron itself transforms to a proton.

Further difficulties in matching this neutron model are reduced to the determination of the initial energy of the bond of the connected charge with the neutron shell which has a single monopole charge of positive polarity. To solve this problem, it is necessary to analyse the possible structure of nucleon shells.

5.6. Structure of nucleon shells

It can be seen that the the Superunification theory removes quite easily many contradictions in the physics of nucleons, starting with the analysis of possible structures of nucleons in interaction with the vacuum field and by taking into account the known properties of elementary particles. In particular, the need for strong spherical deformation of the quantised space-time in the formation of the nucleon mass determines the presence of a sign-changing shell of the nucleon, capable of strong spherical tension in compression of the quantised medium (Fig. 5.1). In addition, the presence of the sign-changing shell of the nucleon enables two or more nucleons to interact with the electrical charges of the shells thus generating nuclear

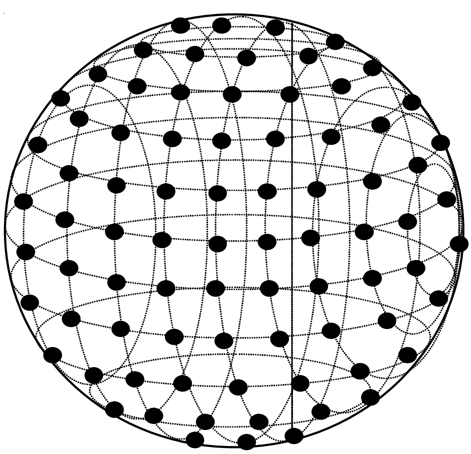

Fig. 5.7. The model of the nucleon shell with square cells of the grid

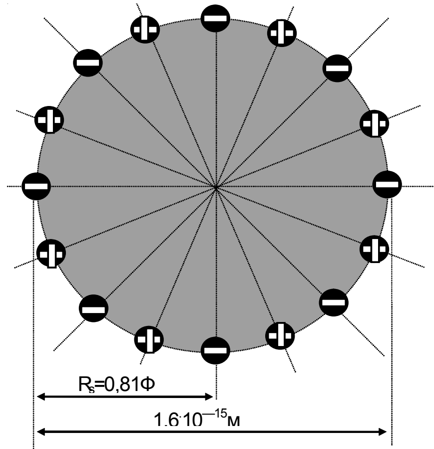

Fig. 5.8. Section of the nucleon shell with the sign-changing distribution of electrical charges in the grid nodes.

forces. These are contact Coulomb attractive forces of the nucleon shells and the forces acting through the monopole sign-changing charges built into the shell. The interaction forces of the sign-changing structures are characterised as short range forces [1, 2].

The calculated shell model of the nucleon can be substantiated by selecting the configuration of the cell of the grid shell. In this stage of investigations, we can investigate only possible variants of formation of the cell of the grid shell and, further, carrying out calculations, we can provide estimates of the extent to which the given grid model corresponds to the physical parameters of the nucleon. Naturally, the basic shell should be represented by the stable shell of the proton. The structure (configuration) of the cells is important for such a stable shell.

Figure 5.7 shows the model of the shell of the nucleon with the square cells of the grid, with the nodes containing the monopole charges with sign-changing polarity, forming a sign-changing shell. This model was proposed for the first time in [1]. The characteristic properties of the sign-changing fields have been examined in [1]. In this stage of investigations, it is important to show the bonds of the charges in the nodes of the grid and determine at least the approximate number of the monopoles in the nucleon shell.

Figure 5.8 shows the equatorial section of the nucleon shell with the sign-changing distribution of the electrical charges in the grid nodes. In particular, the sign-changing shell determines the gravitational boundary between the internal (compressed) region of the nucleon and the external region of the quantised space-time in the formation of nucleon mass. That this shell has the spherical compression effect is determined by the fact that the electrical monopoles, included in the composition of the shell, are distributed with alternation of the polarity of the charges resulting, under the effect of electrical forces, in the constantly acting tension inside the sign-changing shell.

The described section of the shell does not contain any excess positive charge whose existence is determined by the structure of the proton as the initial nucleon. The presence of the excess charge in the shell is a special separate problem. At the moment, we shall try to estimate at least approximately the number of electrical monopoles in the nucleon shell. For this purpose, we shall use the previously developed methods of evaluation of the tension forces in the shell during the formation of electron mass [3, 4].

As established previously, the electron mass forms by the tension of spherical magnetic shells (electron spins) [3, 4]. In contrast to the electron, the nucleon mass forms by the tension of the electrical shell. Since the proton mass is 1836 times greater than the electron mass, it is evident that the tension forces in the nucleon shell should be 1836 greater than the tension forces in the electron shell. This is justifiable because the deformation of the quantised space-time by the elementary particles in the non-relativistic velocity range takes place in the zone of small deformation displacements and is therefore linear.

The tension of the magnetic shell of the electron is determined the strength of the spherical magnetic field induced by the radial electrical field of the central charge. For the electrical shell, the tension is determined by the strength **E** of the electrical field acting on the electrical charge inside the shell. Evidently, the equivalent strength of the electrical field in the nucleon shell can be calculated on the basis of the strength of the magnetic field of the electron at the distance equal to its classic radius, increasing the strength 1836 times

$$E = \frac{1836}{4\pi\varepsilon_0} \frac{e}{r_e^2} = 3.4 \cdot 10^{23} \frac{\text{kV}}{\text{m}} \tag{5.43}$$

As indicated by (5.43), the strength of the electrical field acting on the charge in the sign-changing nucleon shell should reach colossally high values to ensure the required tension of the shell. Further calculations are reduced to determining the function of the strength of the field of a system of sign-changing charges, situated on the spherical shell (Fig. 5.7). A ready solution could not be found and since this is a demanding calculation task, in the first approximation we can use the equation of the strength of the electrical field for half the sign-changing string [1, 2] which in the presence of the large number of charges in the shell should be fully acceptable for estimating the field in Fig. 5.8. For the total string we use the actual strength of the field which is twice as high:

$$E = \frac{1.64}{4\pi\varepsilon_0} \frac{e}{r_n^2} \tag{5.44}$$

where r_n is the distance between the charges in the nucleon shell (neutron and proton), m.

Taking into account that two sign-changing strings intersect in a grid node, the actual strength of the field in the shell is doubled

$$E = \frac{3.28}{4\pi\varepsilon_0} \frac{e}{r_n^2} \tag{5.45}$$

Equating (5.43) and (5.45), we determine the square of the distance and the distance between the charges in the nucleon shell:

$$r_n^2 = \frac{3.28}{1836} r_e^2 = \frac{r_e^2}{560} = 1.41 \cdot 10^{-32}\,\mathrm{m}^2 \tag{5.46}$$

$$r_n = \frac{r_e}{23.7} = 1.2 \cdot 10^{-16}\,\mathrm{m} \tag{5.47}$$

It can be seen that the distance between the electrical charges in the sign-changing shell of the nucleon is smaller than the annihilation distance and almost an order of magnitude smaller than the radius of the gravitational boundary of the nucleon. The annihilation distance of $1.4 \cdot 10^{-15}$ m is determined from the reaction (5.25) and indicates that all the charges, included in the shell, have no mass and are monopoles. The electron and the positron restore their mass in vacuum at distances between them smaller than the annihilation distance between the charge centres.

The calculations described previously are of the reconnoitering type and linked with the state of the electron as if its mass has been increased 1936 times. More accurately, the distance between the charges in the nucleon shell can be calculated on the basis of the equivalence of the energy of the gravitational field and of the energy of the electrical field of the nucleon.

The energy of the electrical field of the sign-changing shell of the nucleon is used for the deformation of the quantised space-time, i.e., for the formation of the nucleon mass and its gravitational field. Consequently, we can write the equation of the balance of the energies of the nucleon in the vacuum field in the statics, equating the electrical energy W_{en} of the shell of the nucleon and its gravitational energy W_0 (rest energy)

$$W_{en} = W_0 \tag{5.48}$$

$$W_{en} = \frac{3.28}{4\pi\varepsilon_0}\frac{e^2}{r_{en}}n_{en} \tag{5.49}$$

where n_{en} is the number of electrical charges in the nucleon shell, number; r_{tn} is the distance between the charges in the nucleon shell, m.

$$W_0 = m_p C_0^2 \tag{5.50}$$

The rest energy of the nucleon is attached to the proton. The number of charges in the nucleon shell is determined on the basis of the surface of the shell and the area of the grid cell

$$n_{en} = \frac{4\pi R_s^2}{r_{en}^2} \tag{5.51}$$

Equating (5.49) and (5.50), and taking (5.51) into account, we obtain the equality

$$\frac{3.28}{4\pi\varepsilon_0}\frac{e^2}{r_{en}}\frac{4\pi R_s^2}{r_{en}^2} = m_p C_0^2 \tag{5.52}$$

Consequently, we obtain

$$r_{en}^3 = \frac{3.28}{\varepsilon_0}\frac{e^2 R_s^2}{m_p C_0^2} = 41.4\cdot 10^{-48}\,\text{m}^3 \tag{5.53}$$

$$r_{en} = \sqrt[3]{\frac{3.28}{\varepsilon_0}\frac{e^2 R_s^2}{m_p C_0^2}} = 3.46\cdot 10^{-16}\,\text{m} \tag{5.54}$$

The resultant distance $3.46\cdot10^{-16}$ m between the charges in the cells of the grid of the nucleon shell is in satisfactory agreement with the reconnoitering distance of $1.2\cdot10^{-16}$ m (5.47). This shows that the method used for calculating the dimensions of the grid cells for the nucleon shell is fully suitable for application in practice, although its accuracy can be improved.

Knowing the distance between the charges (5.54), which determines the area of the cell of the great in the shell, we determine the number (5.51) of electrical monopoles charges, included in the nucleon shell:

$$n_{en} = \frac{4\pi R_s^2}{r_{en}^2} = \frac{4\pi(0.81\cdot 10^{-15})^2}{(3.46\cdot 10^{-16})^2} \approx 69 \tag{5.55}$$

Thus, the number of the electrical monopoles included in the structure of the nucleon shell is determined by a number of the order of 69. I would like to repeat that this number is approximate and its accurate determination requires both experimental and theoretical investigations. Only 69 charges in the proton shell result in the proton mass 1836 times greater than the electron mass.

Up to now we have examined the structure of the nucleon shell and even estimated the possible number of electrical monopoles forming the shell. Naturally, we face the question of the mechanisms of formation of such a shell in the vacuum field. Evidently, the square configuration of the shell cell is not optimum from the viewpoint of minimisation of the number of bonds between the charges inside the shell.

Figure 5.9 shows that the square cell of the grid of the nucleon determines bonding of a single charge with positive polarity with four charges of negative polarity. However, the minimum number of the bonds required to form the grid surface is determined by only three bonds. In particular, these three bonds have been used in the natural formation of the shell structures of fullerenes [18].

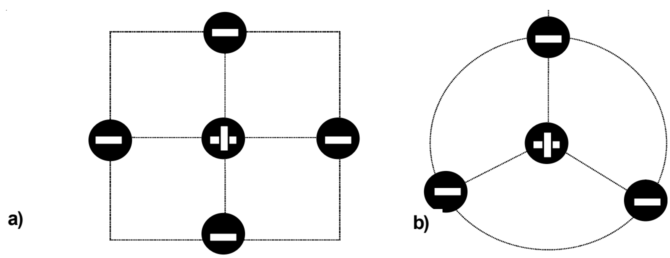

Fig. 5.9. The number of bonds between the charges inside the grid shell of the nucleon for the square cell (a) and the rational cell (b).

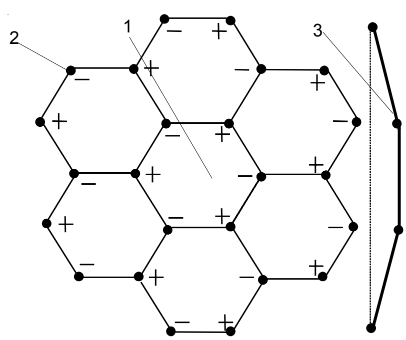

Fig. 5.10. Fragment of the grid shell of a nucleon according to the type of fullerene cluster C_{60}; 1) the cell, 2) the monopole charge.

Figure 5.10 shows a fragment of the grid shell of the nucleon according to the type of fullerene cluster C_{60}. This shell is based on the cell of the grid with the rectangular hexagon configuration. The grid nodes contain electrical monopole charges 2. In particular, the hexagonal grid cell determines the minimum number of bonds (three) of charges in the shell (Fig. 5.9*b*). A characteristic feature of the hexagonal cell is its total electrical neutrality in the case of sign-changing distribution of the charges inside the cell.

Naturally, this electrically neutral shell would be an ideal shell for the neutron. However, this shell is too stable and resistant. This means that in order to transfer the neutron into the proton from the shell, it is necessary to separate one electrical charge of negative polarity using external force for this. However, the neutron is unstable and decays spontaneously into a proton under the effect of fluctuations of quantised space-time emitting an electron.

On the whole, the ideal neutral shell, shown in Fig. 5.10, is not suitable for the neutron shell because of its physical properties. On the other hand, as shown by analysis, the alternatives of the shell model of the nucleons capable of spherical deformation of the quantised space-time, are not foreseen. The shell with the square cell can be used only in preliminary simplifed calculations and is not optimum. Optimum is the shell based on a hexagonal cell of the grid, but even this shell does not fully satisfy all the physical properties of the nucleon.

The situation can be solved by further analysis of the shell with the hexagonal grid cells. The attempts to roll up the surface consisting of hexagons into a sphere are associated with the deformation of the hexagons themselves on the sphere, i.e., with the variation of the topology in space. In fact, producing a surface from regular hexagons we can produce only the flat surface 1 (Fig. 5.10). To produce a sphere or a section of the spherical surface 3, it is necessary to the form the grid cells. However, this is not a simple task, taking into account that we must deal with the colossal tensions in vacuum.

The grid shell can be rolled up into a sphere only in the presence of defects in some cells of the grid when the hexagonal cells are deformed into pentagonal. Many readers will remember leather footballs produced from hexagonal and pentagonal fragments. The sphere can be produced only in this case. In the fullerenes, the formation of the spherical surface is also associated with the presence of defective pentagonal cells [18].

Figure 5.11 shows a fragment of the formation of a spherical surface by rolling into a cup the grid cells defective cells present in the grid. In particular, the defective internal cell makes it possible to produce an excess charge of positive or negative polarity in the cell.

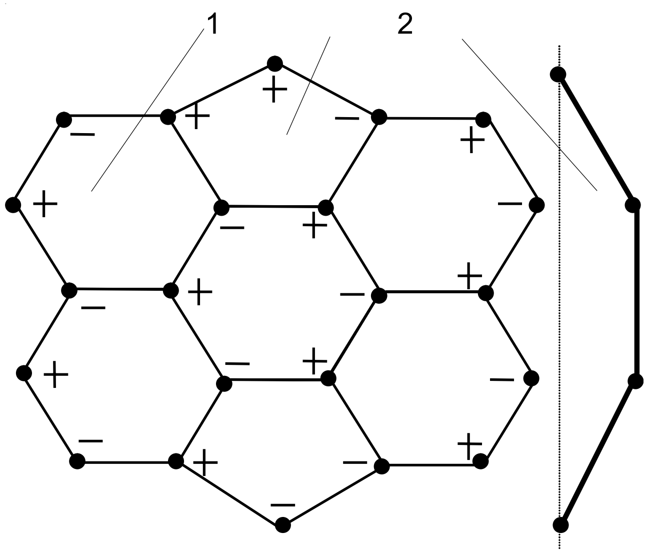

Fig. 5.11. Fragment of rolling into the spherical surface (cup) 3 the grid of hexagons 1 in the presence of defective pentagonal cells 2.

Consequently, we can substantiate the proton shell with an excess positive charge. However, the main point is that the presence of defects in the nucleon shell makes this shell active.

It is important to mention the comparison of the quantised space-time with a superhard solid, because of the colossal tensions acting in it. If we make some analogy between the vacuum field and traditional solid-state physics, the work of semiconductor crystals is related with the presence of impurities and defects in the crystal which activate the work of the crystal. All the processes taking place in the vacuum field with the nucleons are

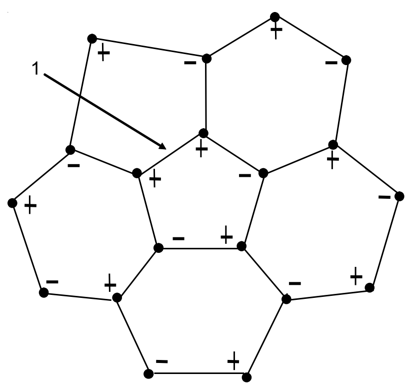

Fig. 5.12. Defects in the nucleon shell (fragment).

also related with the presence of defects in their shell. This also applied to other elementary particles having a mass whose appearance is the result of formation of a new formation in the form of spherical deformation of quantised space-time. This process can be regarded as the formation of local defects in the vacuum field.

To ensure that the nucleon shell is active and capable of spontaneously transferring the electrical charge of negative polarity at the neutron and of transforming the neutron into the proton under the effect of fluctuations of the quantised space-time, there must be defects in the nucleon shell. However, the proton, because of the activity of the nucleon shell, is capable of traping the orbital electron and transforming to a neutron.

Figure 5.12 shows a fragment of the formation of defects in the grid structure of the nucleon shell. It may be assumed that even in the presence of the defects, the shell remains electrically neutral with the exception of the final fragment when the presence of the defect 1 (indicated by the arrow) results in the formation of a surplus of a single positive charge in the shell. This corresponds to the state of the proton. Defect 1 is represented by a bond of two electrical charges with positive polarity. This is an anomalous zone on the surface of the shell. This anomalous zone can capture the orbital electron and hold it in the shell.

It is possible that the described models of the nucleon shells are not perfect. However, these are initial models which require further development. It is important to mention that the transition from purely phenomenological investigations to investigations of the structure of elementary particles has been made in the physics of elementary particles for the first time.

Ending this section, attention should be given to the fact that the contradictions in the properties of the models in relation to the properties of the particle, formed as a result of investigations, are gradually removed by improving the model itself. I believe that the publication of this book will activate investigations in this direction.

It is necessary to solve the problem of the transfer of energy of the electrical charge, annexed to the proton, in capture of the orbital electron. For the calculated dimensions of the gris, the capture of an additional electrical charge by the neutron increases the binding energy of the captured charge to a considerably greater degree than the difference between the electromagnetic masses of the neutron and the proton. Evidently, the decrease of the binding energy may be reduced by the energy of elastic tensioning of the shell itself because the captured charge is forcefully introduced into the shell. By analogy, if we press on the surface of an elastic ball made of table tennis plastic, the resultant depression generates stresses in the shell of the sphere directed against the compression forces and, after some time, the sphere rapidly restores its initial form.

Evidently, this also takes place with the electrical charge of negative polarity which as a result of the fluctuations of the quantised space-time is ejected from the shell of the neutron by the forces of its elastic tension. The neutron decays into a proton and an electron which captures the electronic antineutrino, fluctuating in the strong fields of the shell.

Thus, the Superunification theory has been used to construct the model of nucleons and indicate directions of investigations aimed at optimising the topology of their shell structure. Whilst there were no significant problems in the development of the physical model of the electron, and the model harmonically followed from the conditions of spherical deformation of the quantised space-time by the central charge, in the optimisation of the models of the structure of nucleons there is a large number of problems whose solution is described in the Superunification theory.

5.7. Prospects for splitting the nucleon into elementary components

The equivalence of the energy of electrical and gravitational fields of the nucleon determines the binding energy of the electrical charges in the proton shell (5.49) even is the number of monopole charges is only 69:

$$W_{en} = \frac{3.28}{4\pi\varepsilon_0}\frac{e^2}{r_{en}}69 = 1.5\cdot 10^{-10}\ \text{J} = 938.3\ \text{MeV} \tag{5.56}$$

It would appear that to fracture a nucleon consisting of a single electrical shell requires an energy greater than 938.3 MeV, which is the energy of the order of 1 GeV. These energies have already been generated in currently available elementary particle accelerators but no decay of the nucleon to individual electrical monopoles has been detected.

Quantum chromodynamics (QCD) predictied proton decay at energies of the order of 200 GeV/nucleon [23]. However, even at these energies the nucleon does not decay to elementary components. The elementary components of the nucleons in QCD are quark-gluon plasma and in the Superunification theory is the electrical monopoles in the form of a sign-changing shell ensuring the spherical deformation of quantised space-time.

It would appear that the resultant energy is 200 times greater than the energy of decay of the nucleon shell. However, the nucleon resists. So what is the matter?

I think that the point is that an increase of the velocity of the proton in accelerator increases the proton mass, i.e., the energy of the gravitational field of the particle increases. In accordance with the principle of equivalence between the gravitational energy of the proton and its electrical energy of the shell, an increase of velocity results in an automatic increase of the energy of electrical bonds of the charges in the shell. This is caused by the change of the electrical and magnetic properties of the quantised space-time as a result of its deformation. The shell becomes automatically stronger ensuring the balance of tensions of the quantised space-time.

Let us assume that a proton is accelerated to high energies of the order of 200 GeV/nucleon and it hits another stationary proton with the energy of only 1 GeV. Seemingly, the proton with the binding energy between the charges in the shell of 1 GeV should disintegrate into fragments under the effect of a proton with 200 GeV.

It can be assumed that in this case the proton does not fracture as a result of the elastic transfer of energy to the second proton which accelerated as a result of the effect of the received momentum which automatically increased its strength. To break up the proton, the proton must run into an absolutely stationary barrier which would prevent acceleration of the proton as a result of elastic impact. Even if the experiment is carried out with proton beams propagating in the opposite directions, it is not possible to prevent elastic collision and dispersion of the protons and, consequently, the proton cannot be split into elementary components. However, these are only additional hypotheses which require experimental confirmation.

Physicists throughout the world are waiting impatiently for the results of experiments with the detection of quark-gluon plasma in more powerful accelerators. There were reports on positive results. However, what is the reliability of conclusions that fractional charges of the quarks have been discovered? Nobody has measured the magnitude of these charges. I have previously presented several hypotheses which could also be useful in obtaining new effects on powerful accelerators. I would like to express my doubts regarding advanced theoretical physics in the area of investigation of elementary particles and the atomic nucleus because it can not describe, even in the first stage, the structures of not even a single elementary particle and explain the presence of mass in these particles.

Naturally, these experiments attract the attention of mass information media expressing fears that these experiments could create conditions similar to the initial moment of creation of the universe as a result of the Big Bang. These experiments appear to place the Earth at the edge of annihilation. From the viewpoint of the Superunification theory this is the result of unfounded fantasies. In order to release all the colossal energy of quantised space-time in the nucleon volume, it is necessary to apply external energies many orders of magnitude greater than those achieved in the currently available accelerators.

In order to split the quanton, it is necessary to supply an energy greater than 10^7 GeV/quanton. The energy of the quantons in the nucleon volume is already of the order of 10^{39} GeV/nucleon. This colossal energy of the quantised space-time cannot be compared with the value of 200 GeV/nucleon, obtained in the accelerators. Therefore, the fears regarding the experiments causing possible splitting of the structure of space and inducing a Big Bang do not have any scientific basis and are the result of pure fantasy.

It may be assumed that the Superunification theory is some sort of modernisation of the QCD, only the three initial quarks with fractional electrical charges are replaced by four quarks with integer charges, two of which are electrical and the other two magnetic. This is not completely accurate. The QCD is based on the interactions between quarks, and the theories of EQM and TUEF are based on the interaction with the vacuum field.

The Superunification theory enables us to determine the limiting energy (5.1) of the nucleon when the latter reaches the velocity of light as the finite energy ($R_s = 0.81 \cdot 10^{-15}$ m)

$$W_{MAX} = \frac{C_0^4}{G} R_s = 9.8 \cdot 10^{28}\,\mathrm{J} = 6.1 \cdot 10^{47}\,\mathrm{eV} \tag{5.57}$$

5 .8. Electrical nature of nuclear forces

The Superunification theory regards the quantised space-time as the only source of energy in the universe. This energy is accumulated in the vacuum by means of the space quantum (quanton) whose structure has the form of a static electromagnetic quadrupole. The size of the quantons is of the order of 10^{-25} m. The electromagnetic energy in vacuum is accumulated both inside the quanton and in the form of energy of interaction of adjacent quantons [3, 4].

The Superunification theory reduces all the types of known interactions to the interaction inside the quantised space-time. It has been possible to combine gravitation with electromagnetism. Gravitation is based on the processes of spherical compression of quantons, without disrupting their electrical equilibrium. The processes in the electromagnetic wave are determined by the electromagnetic polarisation of the quantons manifested in the form of laws of electromagnetic induction. They are not associated with the gravitational deformation of the quantised space-time. Therefore, the laws of electromagnetic induction do not permit the production of excess energy.

Up to now, the excess energy has been produced as a result of the mass defect mass of elementary particles and the atomic nucleus, more accurately, nucleons, included in the composition of the atom nucleus. The Superunification theory shows that the release of chemical energy is due to the mass defect of valence electrons during their rotation inside the gravitational well (Fig. 5.1) formed by the atom nucleus. The presence of the well has not been taken into account by anybody [3]. The release of nuclear energy is caused by the mass defect of the nucleons during the merger of the nucleons or splitting in the nucleus. This energy release takes place through the variation of the spherical deformation of the quantised space-time.

The spherical deformation of the quantised space-time by the nucleon is possible in one case only – if the gravitational boundary in the deformed medium is capable of sustaining deformation of the quantised space-time. This property is observed only in the case of the sign-changing shell of the nucleon consisting of electrical monopoles (massless electrical charges).

This approach makes it possible to reduce the interaction between the nucleons inside the nucleus to the electrostatic attraction of the monopole charges of the sign-changing shells of the nucleons. The properties of the sign-changing fields of the shells of the nucleons are clearly evident in this case and they have the form of short-range fields, determined by the radius of the effect of nuclear forces comparable with the step of the cell of the grid of the nucleon shell (54):

$$r_{en} = 3.46 \cdot 10^{-16} \text{ m} \tag{5.58}$$

The proton shell contains approximately 69 (5.55) monopole electrical charges with a single excess charge of positive polarity. The remaining charges of the shell are divided equally between the charges with negative and positive polarity. The neutron forms by capture of an electron with the annexation of the shell of the proton of the monopole charge with negative polarity, making the shell completely neutral. The Coulomb interaction of the shells of the nucleons is due to the interaction of the charges included in the composition of the shells, irrespective of the presence of the excess charge.

Undoubtedly, the strong interactions become evident not only in nuclear forces as a result of the electrostatic attraction of nucleon shells but also represent a wide range of gravitational and electromagnetic interactions. The sign-changing shell of the nucleon provides for the spherical deformation of the quantised space-time which results in the formation of the gravitational field of the nucleon and its mass as a gravitational charge. In interaction of the nucleons, as a result of distortion of the spherical shape, the total deformation of the quantised space-time decreases. This deformation is detected in experiments in the form of electromagnetic radiation as a result of the mass defect of the nucleon.

The Superunification theory combines for the first time the nuclear forces, gravitation and electromagnetism through the superstrong electromagnetic interaction (SEI), whose carrier is the quantised space-time. When scientists discuss the theory of Grand Unification, away from the actual world and with complete ignorance of the structure and properties of the quantised space-time, it appears necessary to return the problem formulated by Faraday and subsequently developed by Einstein. This is the problem of unification of gravitation with electromagnetism. Without solving this problem it is not possible to solve the problems of strong interactions.

If we examine in detail the EQM theory used as the basis for the Superunification theory, it appears that this theory is constructed practically on the known assumptions of physical science. Only one particle has been introduced, i.e., quanton - the static quantum of the stationary space-time (or the quantum of the static electromagnetic field which can not be further divided). This means that an integrating particle has been found instead of the unified equation of nature. This immediately remedies the situation. It is possible to integrate informally in the nucleon gravitation with electromagnetism through the spherical deformation of the quantised space-time by the sign-changing shell of the nucleon and, subsequently, the strong, gravitational and electromagnetic interactions are unified through the contact interaction of the sign-changing nucleon shells.

The energy parameters of the nucleon indicate that the electrical energy of bonding of the charges in the shell is fully balanced by the gravitational energy of deformation of the quantised space-time. To calculate the nuclear forces, it is necessary to analyse the contact interaction of the sign-changing shells of the nucleons. It is the electrostatic attraction of the shells that ensures the effect of nuclear forces.

5 .9. Analytical calculation of nuclear forces

At present, nuclear physics does not have any procedure for analytical calculation of the nuclear forces because it does not have any real physical model of the nucleons. This is due to the fact that the nucleus is a relatively complicated object and understanding of the structure of this object is based on a purely phenomenological description [24–26]. In the last 50 years, regardless of QCD attempts, the nature of the nuclear forces has not been discovered.

The assumption that the nuclear interactions cannot be based on Coulomb interactions was the largest mistake of nuclear physics. Evidently, the physicists were confused by the fact that the nuclear forces are capable of overcoming the Coulomb repulsion of the protons in the nucleus and also of bonding together the completely electrically neutral neutrons and neutrons with the protons, regardless of the presence of the electrical charge. It therefore appeared as if the nuclear forces represented a completely independent category not associated with the Coulomb interaction.

Rejecting the electrical nature of nuclear forces, the theoretical physicists could not therefore construct a satisfactory physical model of interaction of the nucleons inside the nucleus [27]. The nature of nuclear forces was ignored due to the fact that the theoretical physicists, working in the physics of elementary particles and the atomic nucleus, did not know any unique properties of the sign-changing fields, regardless of the fact that these properties were well known in electrical engineering. The sign-changing fields with the sign-changing charges are electrical fields generating short-range forces perceived as nuclear forces in the interaction of nucleons [1].

We examine the contact interaction of the shells of the nucleons using a real physical model in which the charges with the changing sign are placed in the shell and form a system of sign-changing fields. It is necessary to estimate the interaction energy of the shells of the nucleons and the attractive forces of the nucleons and also show that these forces are of the short-range time. For this purpose, it is necessary to find the functional dependence of weakening of the force when the nucleons travel away from each other.

Figure 5.13 shows the scheme of Coulomb interaction of the sign-changing shells of the nucleons. A specific feature of Coulomb interaction is that two (or more) sign-changing shells of the nucleons are attracted to each other under the effect of the forces of electrostatic attraction of the charges with the opposite signs. The scheme shows that in the area of contact of the shells the positive polarity charge of one shell is connected by Coulomb interaction with the negative polarity charge of another shell, and vice versa. Consequently, the area of contact of the shells is characterised by the Coulomb attractive forces from the group of interacting

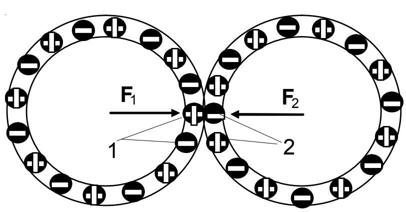

Fig. 5.13. Contact Coulomb interaction of nucleon shells. 1 and 2 are the monopole charges.

charges whose overall effect is perceived as the nuclear attraction force of the nucleons.

The model in Fig. 5.13 reduces the nuclear forces to the Coulomb interaction forces $\mathbf{F}_1$ and $\mathbf{F}_2$ of the charges in the nucleon shells. This model fits completely the concept of the Superunification theory in which all the existing interactions in nature are reduced to the electromagnetic interactions (electrical and magnetic) through the superstrong electromagnetic interaction (SEI).

The solution of this electrostatic problem of interaction of the nucleon is associated with the determination of the function of the strength of the electrical field in the space for the system of sign-changing charges situated on the surface of the sphere. Knowing this distribution function, we can accurately analyse the forces acting on the electrical charge in such a field and also the variation of forces when the shells travel away from each other. Unfortunately, I couldn't find a ready exact solution of the given electrostatic problem for the function of the strength of the electrical field. I believe that the experts concerned with the calculation of complicated fields have now a stimulus to find the exact solution of this problem.

At present, we can use the approximate solution. Naturally, the nucleon shells have the form of elastic spheres whose contact interaction is restricted by a specific distance within which the nucleons cannot approach each other. Without discussing the physics of this phenomenon, it is assumed that this distance is the same as the distance between the charges in the nucleon shell r_{en}=3.46·10^{-16} m (5.54).

At these distances, the energy of interaction between two electrical charges is:

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}} = 0.665 \text{ J} = 4.15 \text{ MeV} \tag{5.59}$$

For the scheme of the two-nucleon interaction shown in Fig. 5.13 which connects together a proton and a neutron in a stable system, i.e., deutron, the binding energy is only 2.25 MeV [28]. As indicated by (5.59), the interaction energy of two electrical charges at the distances between them equal to ~3.5·10^{-16} m (5.54) is 4.15 MeV, i.e., higher than 2.25 MeV. Thus, we have solved, at least approximately, the first task which confirms that the nuclear forces can be electrical. The results showing that the interaction of two charges in the shell is stronger than the actual value of the binding energy of the nucleons in the deutron is associated with the approximations made in the calculations.

To determine more accurately the energy of interaction of the charges in the nucleon shell, instead of analysing the interaction of two charges it is

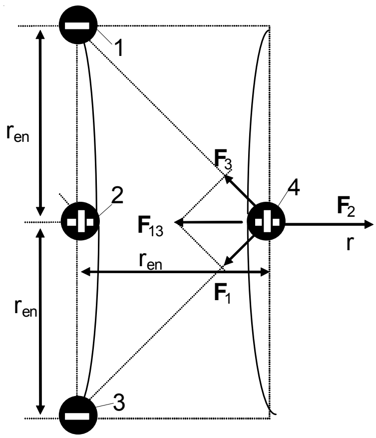

Fig. 5.14. Diagram of formation of the repulsive force $\mathbf{F}_2$ and attractive force $\mathbf{F}_3$ by a system of sign-changing charges (1, 2, 3) in the shells of the nucleons acting on the excess charge 4 of positive polarity.

necessary to analyse the interaction with a bunch of three or more sign-changing charges (Fig. 5.9). This is essential in order to confirm the presence of forces, both Coulomb attraction and repulsive forces, acting between the sign-changing nucleon shells (neutron and proton).

Figure 5.14 shows a system of a bunch of only three charges (1, 2, 3), in which the charges 1 and 3 have negative polarity and the central charge 2 positive polarity. The charges 1, 2, 3 belong to the first nucleon (neutron). The distance between the charges is r_{en} (5.54). The system of three charges acts on the fourth charge 4 with negative polarity which situated on the axis r and belongs to the second nucleon (proton).

The situation, shown in Fig. 5.14, is very close to the actual situation since the proton shell contains a single excess electrical charge 4 with positive polarity and the remaining charges in the shell compensate each other in pairs.

To estimate the effect of Coulomb forces between the nucleon shells and the energy parameters of these forces, it is necessary to take into account if only the effect of the nearest charges situated on the sphere. For this purpose we determine the number of the charges n_s situated in the diametral section of the sign-changing nucleon shell:

$$n_s = \frac{2\pi R_s}{r_{en}} = 14.7 \approx 15 \tag{5.60}$$

The angular sector α_s of a single charge in the nucleon shell is 24°:

$$\alpha_s = \frac{360°}{15} = 24° \tag{5.61}$$

Therefore, at present we confine ourselves to examining the forces acting only on the excess charge 4 with positive polarity of the proton on the side of the group consisting of three charges (Fig. 5.14) and also real four charges bonded in the node of the neutron shell (Fig. 5.9*b*). The remaining proton charges are not considered at the moment and we assume that they are bonded in pairs and fully compensate each other. Undoubtedly, we must take into account the effect of other proton and neutron charges.

Analysis of the scheme shown in Fig. 5.14 shows that the interaction of the charges 2 and 4 forms the repulsive force $\mathbf{F}_2$. The combined interaction of the charges 1 and 3 with the charge 4 generates the attraction force $\mathbf{F}_{13}$ which consists of two forces $\mathbf{F}_1$ and $\mathbf{F}_3$. We estimate force $\mathbf{F}_1$ on the basis of the modulus as the function in the removal of the charge 4 in the direction $\mathbf{r}$ connected with the distance r_{en} between the charges in the sign-changing nucleon grid:

$$\mathbf{F}_1 = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{(r_{en}^2 + r^2)} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2}\frac{1}{(1+k_r^2)} \tag{5.62}$$

where k_r is the coefficient of departure of the charge 4 in the direction $\mathbf{r}$

$$k_r = \frac{r}{r_{en}} \tag{5.63}$$

The modulus of the attractive force $\mathbf{F}_{13}$ is determined as the composition of the vectors of forces $\mathbf{F}_1$ and $\mathbf{F}_3$ in the direction $\mathbf{r}$

$$\mathbf{F}_{13} = 2\mathbf{F}_1\frac{r}{\sqrt{r_{en}^2 + r^2}} = 2\mathbf{F}_1\frac{k_r}{\sqrt{1+k_r^2}} \tag{5.64}$$

Taking (5.62) into account, we obtain

$$\mathbf{F}_{13} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2}\frac{1}{(1+k_r^2)}\frac{2k_r}{\sqrt{1+k_r^2}} \tag{5.65}$$

Taking into account that another additional charge is bonded in the node of the shell grid (Fig. 5.9b), we determine the magnitude of the attractive force for the node of the grid of four charges for the case shown in Fig. 5.14

$$\mathbf{F}_{13} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2}\frac{3k_r}{(1+k_r^2)^{\frac{3}{2}}} \tag{5.66}$$

The modulus of repulsion force $\mathbf{F}_2$ is determined by the interaction of the charges 2 and 4 in the direction $\mathbf{r}$ with (5.63) taken into account

$$\mathbf{F}_2 = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2\frac{r_{en}^2}{r_{en}^2}} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2}\frac{1}{k_r^2} \qquad (5.67)$$

Regarding the repulsive forces the positive side force, and the attractive force as the negative sign force, we can write the balance of forces in the direction $\mathbf{r}$ as the sum $\Sigma\mathbf{F}_r$

$$\sum \mathbf{F}_r = \mathbf{F}_2 - \mathbf{F}_{13} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2}\left(\frac{1}{k_r^2} - \frac{3k_r}{(1+k_r^2)^{\frac{3}{2}}}\right) \qquad (5.68)$$

Equation (5.60) includes the force F_e of interaction of two charges at the distance r_{en} (5.54)

$$F_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}^2} = 1.9\cdot 10^3 n \approx 2\ \text{kN} \qquad (5.69)$$

It may be seen that the forces of interaction of the charges in the nucleon shell are very large and estimated by the value of the order of 2 kN. This value of the force is regarded as the adjusting force and we shall use it in the analysis of the forces of interaction between the proton and the neutron using the functional dependence f_r included in (5.68)

$$\sum F_r = F_e \cdot f_r \qquad (5.70)$$

$$f_r = \left(\frac{1}{k_r^2} - \frac{3k_r}{(1+k_r^2)^{\frac{3}{2}}}\right) \qquad (5.71)$$

In particular, the functional dependence (5.71) enables us to analyse the variation of the interaction force of the nucleons with the nucleons moving away from each other. It is evident that at a large distance, slightly greater than r_{en} (5.54), the positive excess charge of the proton in its shell is subjected to the attractive force of the neutron shell. When the nucleons come close to each other, the attractive force weakens and reaches zero at a certain distance. The electrical repulsive force will start to operate then. We determine the distance r_{e0} at which the attractive and repulsive forces are balanced, using the condition:

Table 5.1. Calculated values of the variation of electrical interaction forces of nucleon shells on the distance between them

	Parameter	1	2	3	4	5	6	7	8	9
1	k_r	0.5	0.75	1.0	1.25	1.5	2.0	3.0	4.0	5.0
2	$r \cdot 10^{-15}$ m	0.17	0.26	0.35	0.44	0.53	0.7	1.05	1.4	1.75
3	f_r	+2.9	0.62	0	−0.27	−0.33	−0.29	−0.17	−0.11	−0.07
4	ΣF, kN	+5.5	+1.2	0	−0.5	−0.63	−0.55	−0.32	−0.21	−0.13

$$\frac{3k_r}{(1+k_r^2)^{\frac{3}{2}}} = \frac{1}{k_r^2} \tag{5.72}$$

from which

$$k_r = 0.96 \approx 1 \tag{5.73}$$

Taking into account (5.63), we determine the distance r_{e0} between the nucleons at which the forces of interaction of the shells are balanced

$$r_{e0} = k_r r_{en} \approx 3.5 \cdot 10^{-16}\,\mathrm{m} \tag{5.74}$$

It may be seen that the distance travelled by the nucleons when coming closer to each other can be estimated by the value (5.74) which comparable with the dimensions of the grid cell of the nucleon shell. This is natural because it reflects the radius of action of the nuclear forces acting between the nucleons. To determine the range of the radius of the effect of nuclear forces, we analyse function (5.71) in the graphical form, after compiling the calculated data in Table 5.1.

Analysis of the graphic dependence of the electrical interaction forces of the nucleon shells in Fig. 5.15, shows convincingly that as regards their characteristics, these forces fully correspond to the nuclear forces:

1) The forces are characterised by the regions of attraction and repulsion of the shells. A region at a larger distance attracts nucleons, whereas a

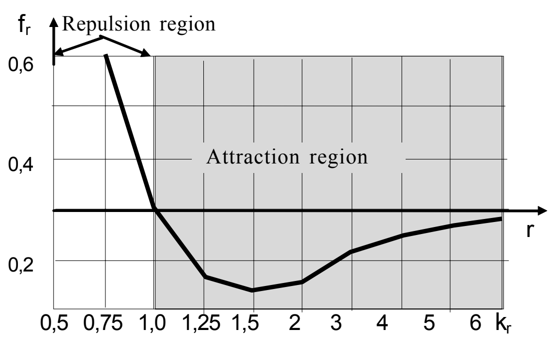

Fig. 5.15. Variation of the electrical repulsive and attractive forces in interaction of nucleon shells as a function of f_r (k_r) (71).

region situated at a shorter distance prevents the nucleons from coming closer to a distance smaller than

$$r_{e0} = 3.5 \cdot 10^{-16}\,\mathrm{m}\,. \tag{5.75}$$

2) The radius of the effect of the attractive forces of the nucleons is in the range from k_r to $5k_r$, i.e. from $3.5 \cdot 10^{-16}$ m to $\sim 2 \cdot 10^{-15}$ m. According to all the currently available experimental data, this range corresponds to the radius of action of nuclear forces. At the distances greater than $2 \cdot 10^{-5}$ m the attractive forces between the nucleon shells start to decrease very rapidly.
3) The experiments show that only the proton and the neutron form a stable pair of nucleons in the two-nucleon interaction. This corresponds to the scheme shown in Fig. 5.14 when the neutron may capture the proton by the excess charge of positive polarity in the proton shell, and vice versa. No stable two nucleon formations formed from the neutrons were found in experiments.

Naturally, this scheme of interactions of the nucleons is not final because it does not take into account the effect of other charges in the nucleon shells. At present, it was important to show that the nuclear interaction forces may be based on electrical processes of attraction and repulsion of the charges in the nucleon shells. This corresponds to the assumption on the unification of all interactions from the viewpoint of electromagnetism in the Superunification theory.

At the present time, the problem of the stability of the given interaction scheme has not as yet been solved. At distances of the radius of the effect of nuclear forces the excess charge of the proton is captured by the neutron. This process is stable and consistent. However, in the range of shorter distances of $3.5 \cdot 10^{-16}$ m which can be characterised as the contact region of interaction of the nucleon shells, the excess charge 4 (Fig. 5.14) of the positive polarity may roll onto the side under the effect of the repulsive forces penetrating into the region of further attraction. This phenomenon has not been observed in the experiments.

Now we could offer a simple answer assuming that the region of contact interaction of the proton and the neutron is characterised by the constant exchange of positive charges between the nucleons. The proton constantly transfers into the neutron and vice versa. This process also ensures the stability of the two-nucleon system consisting of the proton and the neutron.

However, this process is dynamic and before we discuss it, it is necessary to attempt to utilise all the possibilities of electrostatics. It may happen that the stability of the given system is determined by the unique manner of distribution of the charges on the spherical surface of the nucleon. However, for this purpose it is necessary to calculate efficiently the nucleon shell matching it with the experimental results.

At present, it is clear that if all the charges in the shell are taken into account, the function $f_r(k_r)$ (5.71) will show a more rapid decrease of the attractive force with the increase of the distance between the nucleons. However, additional investigations are essential for constructing the overall structure of the nucleon shell.

5.10. Electrical energy of nuclear forces

Naturally, in addition to the force function $f_r(k_r)$ (5.71) of the two-nucleon electrical interaction, it is interesting to analyse the energy function of energy W_r of nuclear interaction in the electrical parameters. For this purpose, we integrate of the force function $f_r(k_r)$ (5.71) in the direction **r** with (5.68) taken into account

$$W_r = -\int \sum F_r dr = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}}\left(\frac{1}{k_r} - \frac{3}{\sqrt{1+k_r^2}}\right) \tag{5.76}$$

or

$$W_r = W_e \cdot f_{rw} \tag{5.77}$$

The expressions (5.76) and (5.77) include the energy W_e of interaction (5.59) of two elementary charges at the distance r_{en}=3.46·10^{-16} m (5.54)

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}} = 0.665 \text{ J} = 4.15 \text{ MeV} \tag{5.78}$$

The equations (5.76) and (5.77) also include the function of distance f_{rw} for the energy of the system of two nucleons when they are displaced to the distance r/r_{en} (5.63)

$$f_{rw} = \left(\frac{1}{k_r} - \frac{3}{\sqrt{1+k_r^2}}\right) \tag{5.79}$$

Function f_{rw} characterises the dependence of the variation of the energy of the system for the nucleons moving away from each other. We examine this function for the presence of an extremum, equating the derivative with respect to $2k_r$ to zero

Table 5.2. Calculated values of the variation of the electrical energy of interaction of the nucleon shells on the distance between them

Parameter	1	2	3	4	5	6	7	8	9	10	11
k_r	0.2	0.3	0.4	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0
$r \cdot 10^{-15}$ m	0.07	0.1	0.14	0.17	0.26	0.35	0.53	0.7	1.05	1.4	1.75
f_{rw}	2.1	0.46	−0.29	−0.68	−1.07	−1.12	−1.0	−0.84	−0.62	−0.48	−0.39
W_r, MeV	8.7	1.9	−1.2	−2.8	−4.4	−4.6	-4.15	−3.5	−2.6	−2.0	−1.6

$$f'_{rw} = \frac{3k_r}{(1+k_r^2)^{\frac{3}{2}}} - \frac{1}{k_r^2} = 0 \tag{5.80}$$

From (5.80) we determine the coefficient of distance k_r (5.63)

$$k_r = 0.96 \approx 1 \tag{5.81}$$

Taking (5.63) into account, we determine the distance r_{e0} of the extremum value of the energy of the system

$$r_{e0} = k_r r_{en} \approx 3.5 \cdot 10^{-16} \text{m} \tag{5.82}$$

The distance (5.82) corresponds to the zero force on the graphs in Fig. 5.15 and, therefore, to the minimum level of the energy of the system.

Table 5.2 shows the calculated data for the functional dependence of the energy of interaction of the shells of two nucleons (neutron and proton) when they move away from each other.Figure 5.17 shows the functional dependence of energy (5.76) on the distance between the nucleons as the function of moving away (5.79) on the basis of the calculated data in Table 5.2. It can be clearly seen that the minimum level of the interaction energy

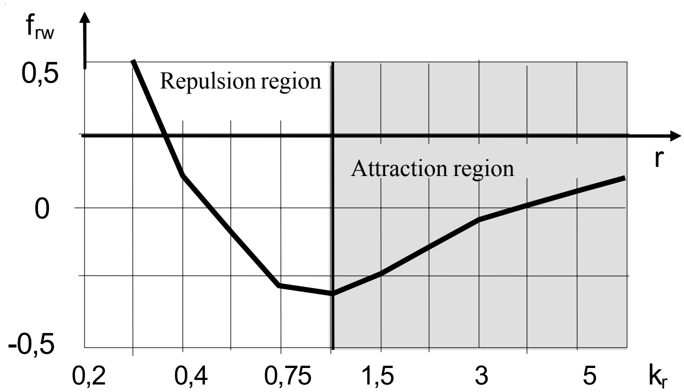

Fig. 5.17. Variation of the electrical energy of interaction of shells with the nucleons moving away from each other.

corresponds to the zero value of the interaction force (Fig. 5.15) at $k_r \approx 1$. Attention should be given to the fact that the negative range of energy does not necessarily indicate that the given region belongs to the attractive forces. The direction of the forces determined by the sign of the derivative with respect to the interaction energy.

In a general case, the introduction of the sign of the energy, as already mentioned several times, is a conventional concept. For example, at the zero energy of the system ($k_r \approx 0.36$, the graph in Fig. 5.16), the attractive force of the nucleons is 14 kN. All this depends on which level is regarded as the zero level in the given case in the vacuum field. In the analysed case, the zero energy level is represented by two points on the axis **r**. The first point is situated at infinity and corresponds to the zero force of interaction of the nucleons. The second point is situated inside the system of the nucleons and corresponds to the colossal force of 40 kN, acting between the nucleon shells (Table 5.1 and 5.2).

The contradicting nature of nuclear forces, as attractive and repulsive forces at short distances, is not explained in the physics of elementary particles and the atomic nucleus in analysis of these forces in similar situated in [27, Fig. 2]. However, all is well when these processes are investigated taking into account the colossal energy of the quantised space-time and of the interaction of sign-changing nucleon shells.

The calculations determine the value of the energy which must be used for the complete separation of the proton from the neutron, or vice versa. For this purpose, we calculate the integral (5.76) in the unification range from to $k_r = 1$ to $k_r = \infty$

$$W_r = -\int_1^\infty \sum F_r dr = -\frac{1}{4\pi\varepsilon_0}\frac{e^2}{r_{en}}\left(\frac{1}{k_r} - \frac{3}{\sqrt{1+k_r^2}}\right) = -4.6 \text{ MeV} \qquad (5.83)$$

They energy of fracture of the nucleons is twice the actual energy of 2.25 MeV. This is explained by the fact that the interactions did not take into account other charges of the nucleon shells whose effect reduces the magnitude of the force and results in a more rapid decrease of this force when the nucleons move away. I assume that more accurate calculations would yield the absolute value of the energy corresponding to the experimental data. However, in this case we no longer need to solve simple problems of electrostatics with the volume distribution of the sign-changing charges on the sphere. It is now important to take into account that a method of calculating nuclear forces as forces of electrical nature has been developed. Improvement of the calculation procedure would increase the accuracy of the results.

The binding energy of the nucleons in a complicated multi-nucleon nucleus is approximately 8 MeV [24]. For example, a tritium nucleus (triton) consists of one proton and two neutrons. The binding energy of the three nucleons in the trition its 8.5 MeV. Naturally, the colossal forces of interaction of the nucleons in the nucleus result in deformation of their sign-changing shells and cause that the mass of the nucleus is not equal to the sum of the masses of the nucleons.

Regarding the nucleons as spheres, it can be assumed that in interaction of three nucleons the interaction forces are determined by three contact areas of the shells. Consequently, the binding energy can be increased by more than three times in comparison with the binding energy of the nucleons in the deutron. Taking into account the fact that nuclear physics is a very large area of knowledge, we must find approaches to this area which would enable us to carry out analysis of the forces and energies by the classic methods, without any need for phenomenological description. This classic approach in the calculation of nuclear forces yields the model of nucleons with the sign-changing shell, regarding the nuclear forces as the forces of electrical attraction and repulsion of the charges between the nucleon shells.

5 .11. Electrical potential of nuclear forces

The Superunification theory operates with the concepts of gravitational, electrical and magnetic potentials. In nuclear physics, the strong interactions are described using special nuclear potentials (Yukawa potential, etc.) [24]. The nuclear forces can now be characterised by electrical potential φ_e taking into account energy W_r (5.76) of interaction of the neutron shell with the excess proton charge

$$\varphi_e = \frac{W_r}{e} = \frac{1}{4\pi\varepsilon_0}\frac{e}{r_{en}}\left(\frac{1}{k_r} - \frac{3}{\sqrt{1+k_r^2}}\right) \tag{5.84}$$

Expression (5.34) includes the potential φ_{en} of the elementary electrical charge at the distance $r_{en} = 3.46\cdot10^{-16}$ m (5.54) and the distance function f_{rw} (5.79)

$$\varphi_{en} = \frac{1}{4\pi\varepsilon_0}\frac{e}{r_{en}} = 4.2\cdot10^6\,\frac{\text{V}}{\text{m}} \tag{5.85}$$

In a general case, the electrical potential (5.84) ensures that the nuclear forces operate as forces of electrical interaction of the nucleons. It is evident that the potential of the nuclear forces can be expressed by the electrical potential (5.84)

$$\varphi_e = \varphi_{en} f_{rw} \tag{5.86}$$

Thus, the determination of the potential of the nuclear forces as the electrical potential (5.86) enables us to regard the nuclear forces in the calculations of these forces as forces of electrical origin and not as independent forces. Undoubtedly, it is important to increase the accuracy of the calculation procedures in the determination of nuclear forces in order to determine more accurately the number of charges in the nucleon shell and the configuration of the cells of the shell grid. However, in any case, the sign-changing shell of the nucleons, spherically compressing the quantised space-time, produces the nucleon mass by unifying the gravitation and electricity.

5.12. Calculation of neutron interaction

In contrast to the proton, the neutron does not have any excess positive charge in its shell and is a completely neutral particle. Regardless of this, the interaction of the neutrons in the atom nucleus is ensured by the contact interaction of the nucleon shells through the attraction of the charges of positive polarity in the shells.

Whilst the proton–neutron unification into the deutron is characterised by high stability, there is no unification of the neutron with the neutron. Neutron unification is possible only through interaction with a proton as is the case in the triton. The unification of the proton with the neutron is explained by the capture of an excess charge with positive polarity of the proton by the neutron shell. In this case, the radius of the effect of the nuclear forces as electrical forces is approximately 10^{-15} m, i.e., it is comparable with the dimensions of the nucleons.

Evidently, in interaction of the two neutrons, the absence of the excess charge in their shells prevents nucleon capture. However, the neutrons inside the nucleus interact with each other leading to the formation of nuclear forces at contact of the shells.

Figure 5.13 shows that the neutrons can interact in the area of contact of the shells through the attraction of electrical charges with opposite polarity. It is necessary to calculate such an interaction and determine the attractive force and the nature of variation of this force when the neutrons are removed. For this purpose, it is important to find the function of the strength of the electrical field of the sign-changing neutron shell. This is a relatively complicated task of electrostatics and has no exact solution so far.

In [1] the calculation model of interaction of the neutrons was represented by a flat grid of sign-changing charges. Since we have an exact solution of the field for the lattice of sign-changing axes, this solution was interpreted for the field of point charges. For this purpose, the continuous linear density of charges τ_e is replaced by the density of discrete charges with a step equal to the length r_{en} (5.54) of the grid cell:

$$\tau_e = \frac{e}{r_{en}} = \frac{1.6\cdot 10^{-19}}{3.46\cdot 10^{-16}} \approx 0.5\cdot 10^{-3}\,\frac{\text{C}}{\text{m}} \tag{5.87}$$

We substitute equation (5.87) into the function of the strength of the field of sign-changing charges for $b = r_{en}$ and obtain the dependence of the strength of the electrical field in movement away from the grid of sign-changing charges [1]

$$E_r = \frac{1}{2\varepsilon_0}\frac{e}{r_{en}^2}\frac{1}{sh(\pi\frac{r}{r_{en}})} \tag{5.88}$$

The strength of the field (5.88) of the flat grid of the sign-changing charges can be approximated with respect to a sphere at a sufficiently large number of sign-changing charges on the sphere surface. For a proton, the calculated number was approximately 69 charges distributed on the sphere. For a neutron, the number of charges was increased by 1 and equals 70 charges. In this case, the function (5.88) can be used with a certain degree of approximation for calculating the electrical field of the sign-changing nucleon shell.

Knowing the strength of the field of the sign-changing neutron shell, we can calculate the electrical force acting on the charge in the shell of the second neutron at their contact interaction for $r = r_{en}$

$$F_r = \frac{1}{2\varepsilon_0}\frac{e^2}{r_{en}^2}\frac{1}{sh(\pi\frac{r}{r_{en}})} = 1\text{ kN} \tag{5.89}$$

The equation derived previously for the force of interaction of the proton and the neutron (5.68) gives the maximum attractive force of 0.63 kN (Table 5.1). As indicated by (5.89), the attractive force of the neutrons during their contact interaction is 1 kN, i.e., it is determined by the same order as (5.68). However, the equations (5.68) and (5.89) are completely different functional dependences. Expression (5.89) is characterised by a more rapid decrease of the force in the case of the nucleons moving away and can be represented by an exponent under the condition $r > r_{en}$

$$F_r = \frac{1}{2\varepsilon_0}\frac{e^2}{r_{en}^2}\exp\left(-\pi\frac{r}{r_{en}}\right) \tag{5.90}$$

Analyses of the exponential function (5.90) shows that the attractive force of two neutrons appears only as a contact force and equals only 1.4 N at a distance of 10^{-15} m, i.e., this force decreases by more than 70 times when the nucleons move away from each other. For the proton–neutron interaction, the attractive force of the nucleons at the same distance of 10^{-15} m is 0.32 kN, i.e., it is 230 times greater than the attractive force of the neutrons.

Regardless of the approximate nature of the calculations, it may be assumed that the nature of the attractive forces both on the proton and the neutron and between the neutrons greatly differ from each other by the radius of the effect of nuclear forces. If the radius of the nuclear forces for the proton–neutron interaction is slightly greater than the distance 10^{-15} m, the radius of the effect of nuclear forces for the neutron–neutron interaction is smaller than $0.5 \cdot 10^{-16}$ m. This shows that the interaction between neutrons can take place only when their shell come into contact.

In order to determine the energy required for fracturing the bond in the interaction of two neutrons, we determine the difference of the electrical potentials $\Delta\varphi_r$ which must be overcome by a single charge bonded in the neutron shell during its movement away from the second neutron. For this purpose, we integrate (5.18) with respect to distance r

$$\Delta\varphi_r = \frac{1}{2\varepsilon_0}\frac{e}{r_{en}^2}\int_{r_{en}}^{\infty}\frac{dr}{sh(\pi\frac{r}{r_{en}})} = \frac{1}{2\pi\varepsilon_0}\frac{e}{r_{en}}\ln\left|\frac{\hat{e}^{\pi\frac{r}{r_{en}}}-1}{\hat{e}^{\pi\frac{r}{r_{en}}}+1}\right|_{r_{en}}^{\infty} = 0.72 \text{ MV} \tag{5.91}$$

Under the logarithm in (5.91) there is the number $\hat{e}$ (this number should not be confused with the elementary charge e).

To determine the total energy W_{n2} of interaction of the neutrons in the contact area of their shells, it is necessary to take into account the number of pairs n_{e2} of the interacting charges between the shells which is 4–5 pairs in the node of the neutron shell

$$W_{n2} = e\Delta\varphi_r n_{e2} \approx 2.9 - 3.6 \text{ MeV} \tag{5.92}$$

Evidently, the energy (5.92) of the contact bond of two neutrons is slightly higher because the edge effect of interaction of the adjacent charges on the sphere has not been taken into account.

5.13. Proton–proton interaction

In interaction of protons up to contact it is necessary to overcome repulsion of their excess positive charges in the shells. In order to obtain the exact functional dependence of the electrical force on the distance between the protons which takes into account the repulsion of protons at long distances, their attraction in the region of the effect of nuclear forces, and repulsion in the region smaller than the radius of the nuclear forces, it is necessary to solve the previously formulated problems:

1. Determine the exact structure of the proton and neutron shells with the distribution of the charges on the sphere and tension of the electrical forces in the nucleon shell.
2. Determine the exact function of the strength of the electrical field of the sign-changing spherical nucleon shell.
3. Determine the effect of deformation of the quantised space-time by the nucleon shells on the electrical magnetic parameters of the quantised space-time inside and outside the gravitational interface of the medium taking into account the additional forces of mirror reflection in the local zone at the interface between the nucleons and the medium.
4. Take into account possible configurations of the cells of the grid with the distribution of the charges in the nodes and the presence of defects in the nucleon shell affecting the function of the strength of the electrical field and, correspondingly, the nature of nuclear forces.

Possible defects in the nucleon shell are associated with the structure of the grid cell of the shell, with the deformation of the cell when nucleons approach each other and with the orientation of the nucleon shells in relation to each other during their approach. Possibly, it will be necessary to take into account the effect of the induced magnetic quantum space-time between the charges of the nucleon shell, as was the case when taking into account the magnetic field of the electron as a result of spherical deformation of the quantised space-time by its spin [4].

Only after these investigations have been carried out, when the possibilities of electromagnetostatics have been exhausted, we shall be able to discuss some other new effects accompanying the interaction of the nucleons. However, in any case, the nuclear interactions are based on the laws of Coulomb attraction and repulsion of the system of sign-changing charges of the nucleon shells.

5.14. Nuclear forces in quantum mechanics

The Superunification theory is directed at developing quantum considerations in physics for the case in which the electromagnetic static space-time quantum (quanton) acts in addition to the radiation quantum. On the other hand, the current level of quantum theory is only capable of describing the nature of particles by wave functions on the basis of their group behaviour.

This also relates to the calculation facilities of nuclear interactions of the nucleons.

The advances made in quantum theory are obvious. The authority of the scientists who developed the fundamentals of quantum theory cannot be doubted. In particular, because of this it has not been possible to develop the electrical nature of nuclear forces. This is how Heisenberg, one of the founders of quantum theory, formulated the attitude to the nature of nuclear forces: 'this force cannot be of the electrical nature, if only because the neutron is not charged. In addition, the electrical forces are too weak to lead high binding energies in the nucleus, determined on the basis of the mass defect' [29].

Thus, cutting off in this fashion the directions of investigation in the development of real physical models of the nucleons based on the electrical nature of nuclear forces, theoretical physicists were forced to fantasize and develop formal mathematical models. Results are important in any study. In the last 50 years, theoretical physics, moving in the erroneous direction, could not therefore describe the nature of nuclear interactions.

However, most importantly, it has not possible to link together gravitation and electromagnetism, placing this relationship as the basis of the formation of nucleons and their mass, and also determine the reasons for the mass defect. For this it would have been necessary to investigate the unique properties of the sign-changing fields as the field category of the quantised space-time whose importance for describing the microworld could have lead to the discovery of the EQM theory.

On the basis of erroneous considerations, Heisenberg proposed to treat the nuclear forces as exchange forces between the nucleons which form as a result of exchange by other particles (photons, electrons, positrons, etc). Naturally, priority in the exchange of nucleons by the particles was given to wave considerations which enabled Heisenberg to develop a large area of quantum theory [30].

In the exchange theory, the small radius of the effect of nuclear forces is obtained if it is assumed that the particles, corresponding to photons, have the rest mass. This approach, developed by Pauli, resulted in the development of the meson theory of nuclear forces [31]. According to Pauli's proposal, radius $r_n = 2\cdot 10^{-15}$ m, which determines the action of nuclear forces, is determined by the particles whose rest mass m_0 determines the given radius

$$r_n = \frac{\hbar}{m_0 C}, \tag{5.93}$$

from which we determine the rest mass of the particle

$$m_0 = \frac{\hbar}{r_n C} \approx 200 m_e \tag{5.94}$$

Particles with the rest mass of approximately 200 electronic masses were initially found in cosmic rays and referred to as mesons. A large number of the attempts to construct the functional dependence of the nuclear potential on the basis of the theory of meson–nucleon interactions and other theories using particles with a large mass prove to be unsuccessful. This problem also could not be solved by the quantum chromodynamics (QCD) [23].

At the same time, the quantum mechanics approaches based on the application of wave functions are fully suitable for the determination of a number of parameters in nucleon interactions. I would like to mention the reasons for wave processes taking place in a vacuum field during a perturbation of nucleon–nucleon interactions.

According to these reasons, the interaction between the nucleons is determined mainly by the electrical field of the nucleon shells which acts through the elastic quantised medium which has the form of an ocean filled with a huge number of quantons taking part in nuclear interactions.

The interacting nucleons can be treated as an elastic stressed system, where the oscillation perturbation of any element results in the wave perturbation of the entire system linked inseparably with the vacuum field.

The description of the perturbation of the elastic system by wave functions is already classic and has been included in textbooks. The Schrödinger equation describes the interaction of the proton and the neutron in the deutron through the wave function ψ:

$$\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{d\Psi}{dr}\right) = -\frac{2m_n}{\hbar^2}(W-U)\Psi \tag{5.95}$$

Equation (5.95) includes: the distance between the nucleons r, the nucleon mass m_0, the binding energy W of the nucleons and the depth of the potential well U. Naturally, by solving this equation we can determine one unknown parameter included in the equation, and all other parameters must be given. In particular, for the given first three parameters in equation (5.95) we can determine only the depth of the potential well [32].

Thus, the possibilities of quantum mechanics description of the interaction of the nucleons by the wave function are not so extensive. The physics of nucleon interactions is determined by the structure of nucleons which is examined by the Superunification theory.

On the other hand, equation (5.95) does not take into account the presence of a gravitational well around the nucleon (Fig. 5.1). Therefore, if this important parameter is not taken into account, the calculation apparatus becomes more and more complicated. The Superunification theory, possessing actual physical models, makes it possible to simplify greatly the calculations and physical understanding of the phenomenon. A suitable example of this is the explanation of the electrical nature of nuclear interactions.

5.15. The zones of anti-gravitational repulsion in the nucleon shells

Additions in the form of section 5.15 I wrote in November 2005. At that time, it had been five years since the moment of preparation of the text 'Electrical nature of nuclear forces' for printing, and almost 10 years since I introduced the sign-changing model of the nucleon shell [1]. Now, when I decided to post this study on the Internet, I had to re-examine it. Regardless of the fact that new and interesting material appeared on the examination of the zones of anti-gravitational repulsion between the charges of the nucleon shells, I made only a small number of corrections and left the old version almost without any change. In addition to the theory of the elastic quantised medium restricted by the investigations of the quantised structure of space-time, the Superunification theory investigates the nature of matter and fundamental interactions. Therefore, the text contains corrections in terminology.

I left the old version of the text unchanged because it shows clearly all the difficulties in the path of further development of the calculation facilities of the electrical nature of nuclear forces within the framework of the concept of Superunification which combines the fundamental interactions. The weakest area in the study is in my opinion the incorrect substantiation of the forces of electrical repulsion between the sign-changing shells of the nucleons at the distances smaller than the classic electron radius (Fig. 5.15). The presence of the repulsion region (zone) observed when the nucleon shells approach each other is essential. This is determined by restrictions of the further approach of the nucleons in the atomic nucleus in order to avoid their collapse. The functional dependence of the nuclear force of attraction of the nucleons has an extreme value in the graph (Fig. 5.15) which cannot be formed in the absence of repulsive forces.

Therefore, in order to compensate in some manner the obvious shortage of the repulsive forces, a calculation scheme was proposed for describing the interaction of the excess charge of the positive polarity of the proton with the sign-changing charges in the neutron shell (Fig. 5.14). I knew that this calculation scheme is highly vulnerable because it does not ensure the stability of the charges of the shells in the given approach coordinates. The excess proton charge should be displaced in the direction of the negative charge of the neutron shell, erasing the results of the calculations. To prevent this from taking place, several assumptions which were not very convincing were investigated.

However, the calculation scheme in Fig. 5.14 played its positive role, showing that in the presence of repulsive forces the nature of attraction of the shells of the proton and the neutron fully corresponds to the nuclear forces whose nature is electrical. This is in agreement with the concept of the Superunification theory. It was therefore necessary to find the missing repulsion force between the shells of the nucleons at distances smaller than the classic electron radius resulting in stability of the calculation scheme. Since the compulsory presence of such a repulsion force was predicted, in the final analysis this force was discovered as the force of anti-gravitational repulsion taking into account that gravitation and antigravitation are secondary formations of the superstrong electromagnetic interaction (SEI).

At the moment, I can say with a high degree of reliability that the antigravitation, like gravitation, is widely encountered in nature. It is sufficient to mention a fundamental cosmological effect of the anti-gravitational recession of galactics with acceleration (see chapter 3). In the microworld of the elementary particles and the atomic nucleus, the antigravitation occupies the area as large as the areas occupies by electricity and magnetism. In theoretical physics, it is assumed that in the microworld of elementary particles the effect of gravitational forces is negligible in comparison with electrical forces and can be ignored. This holds with respect to the Newton force of gravitational attraction but not with respect to the energy of the gravitational field because, as confirmed in the Superunification theory, the energy of the gravitational field is determined by the potential of action potential $C^2 = C_0^2 - \varphi_n$, not by the Newton potential φ_n. However, the force is a derivative of energy and does not depend on constant C_0^2.

The forces of anti-gravitational repulsion operate in the microworld of elementary particles at distances shorter than the classic electron radius $r_e = 2.8 \cdot 10^{-15}$ m. Taking into account that this force is greater than the forces of electrostatic attraction of the nucleon shells, then the total effect of the forces determines the characteristic manifestation of the nuclear forces, as shown in Fig. 5.15. In order to avoid rewriting the entire text, I added to the description of the nature of nuclear forces anti-gravitational repulsion forces.

I should mention that antigravitation differs from the gravitation by the presence of a hillock (not a well) on the gravitational diagram. Figure 5.1 (Fig. 3.11) shows the gravitational diagram of the nucleon, characterising the composition of the quantised medium inside the sign-changing shell of the nucleon and tensioning of the medium outside the shell. Consequently, a gravitational well forms in the quantised medium and represents 'a jump' in the quantum density of the medium.

The region of the gravitational well characterises gravitation as gravity. The region of the jump of the quantum density contains a very steep hillock (wall), a unique potential barrier responsible for the effect of antigravitation. It is noteworthy that the forces of anti-gravitational repulsion for the gravitation wall on the ideal diagram in Fig. 5.1 are infinite because the force is characterised by the derivative of energy over distance. In the case of the jump of the quantum density, the gravitational energy also changes in a jump. Naturally, when the nucleons come together in the ideal case, the gravitational wall (potential barrier) can be overcome by the forces of electrostatic attraction. In reality, the potential barrier of repulsion is not a wall and has the form of a hillock but, in any case, here we have the concept of nuclear forces as the electrical attraction forces restricted by anti-gravitational repulsion.

As already mentioned, the gravitational boundary of the nucleon, formed by the sign-changing shell (Fig. 5.7 and 5.8) is not ideal and has the form of a complicated relief of the fields on the sphere. This relief of the fields also contains zones of anti-gravitational repulsion and tunnelling. The exact calculations of the very complicated relief of the fields of the sign-changing

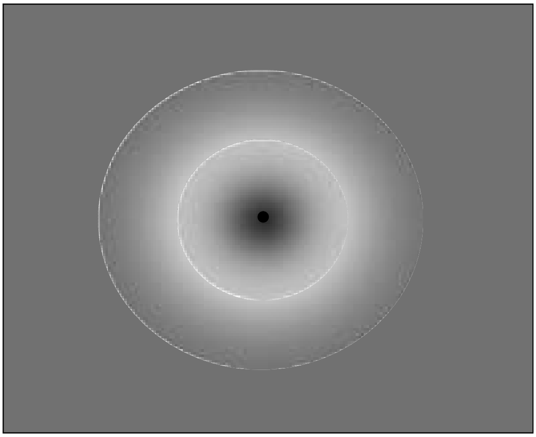

Fig. 5.18. Computer simulation of the structure of the electron (neutron) in the quantised space-time as a result of its spherical deformation by the field of the central electrical point charge.

shell of the nucleons are time-consuming. The process of understanding moves from simple to complicated. Examining a simple jump of quantum density of the medium on the gravitational diagram in Fig. 5.1 we have in principle explain the nature of anti-gravitation for the nucleon. Now, after determining this position more accurately, it is essential to examine the zones of anti-gravitation separately for every charge of the sign-changing shell of the nucleon in order to explain the complicated relief of the nucleon fields on the sphere.

To understand the structure of the gravitational field around the charge of the sign-changing shell of the nucleon, we examine the formation of characteristic zones of the electron (positron), described in chapter 4.

Figure 5.18 shows the graphical computer simulation of the electron (positron) in the quantised space-time without the scale to simplify understanding. The dark spots in the centre of the electron shows a point electrical charge to which the quantons of the medium are pulled, spherically deforming the space-time. The dark region around the point charge shows the zone of compression of the quantised medium which is then smoothly replaced by the tension zone (lighter region). In movement away from the electron, the quantum density of the medium is restored to that in the equilibrium condition. The electron does not have any distinctive gravitational interface and appears to be 'smeared' in the space-time, being the compound part of the quantised medium. The movement of the electron should be regarded as the wave transfer of its structure (Fig. 5.18), retaining the spherical symmetry of the spectra of the speed of movement. This corresponds to the principle of the corpuscular–wave dualism in which the particle has both wave and corpuscular properties.

Since the quantum density of the medium is an equivalent of the gravitational potential, then in a general case the gravitational field of the non-relativistic electron can be represented by the known function (5.20) of the distribution of the gravitational potentials φ_1 and φ_2 as a result of solving the Poisson equation (5.16) and (5.17)

$$\begin{cases} \varphi_1 = C^2 = C_0^2\left(1 - \dfrac{R_g}{r}\right), & r > r_e \\ \varphi_2 = C_0^2\left(1 + \dfrac{R_g}{r}\right), & r < r_e \end{cases} \tag{5.96}$$

Figure 5.19 shows the gravitational diagram of the electron (positron) corresponding to the solution (5.96) regardless of the polarity of the point charge. The centre of the electron contains the point charge e which is represented by a narrow band with radius R_e (4.19) on the gravitational two-dimensional diagram. The gravitational potential reaches the value $2C_0^2$ on the surface of the charge at the point (e). In reality, the point charge of the electron in three-dimensional measurements has the form of a sphere with radius R_e, and in two-dimensional measurements the form of a strip (R_e is the electrical radius of the electron equal to its gravitational radius).

In imaging on a plane by the curve of distribution of the gravitational potentials, the point charge of the electron can be conveniently represented by a narrow strip with the characteristic radii of the electron: r_{e1}, r_e, r_{e2}, R_e, plotted in the direction from the centre of the strip along the horizontal axis r. The vertical axis gives the values of the gravitational potential in the range 0... $2C_0^2$. The level of the potential C_0^2 determines the potential depth of the quantised medium for the non-perturbed quantised space-time. Potential C_0^2 can be termed the equilibrium vacuum potential.

When moving away from the point charge, the gravitational potential $\varphi_2 = f(1/r)$ decreases along the path (e-d) and, consequently, the quantum density of the medium decreases. The conventional interface (b-c-d) is characterised by a small jump of the gravitational potential and the quantum density of the medium. For better understanding, the gravitational diagram of the electron is presented without the scale otherwise the jump $\Delta\varphi$ of the gravitational potential would not be visible because of the small value.

We examine briefly the characteristic zones of the electron (positron) as a result of spherical deformation of the quantised space-time by a central electrical charge:

1. The compression zone (c-d-e) of the quantised medium. The gravitational potential φ_2 inside the compression zone is higher than the equilibrium potential C_0^2 of the quantised medium.

2. The tensions zone (a-b-c) of the quantised medium. The gravitational potential φ_1 inside the tension zone is lower than the equilibrium potential C_0^2 of the quantised medium. In particular, this section in the gravitational theory determines the curvature of the space which is regarded as the manifestation of mass.

3. The gravitation zone (b-a) characterises the gravitational well by the section $\varphi_1 = f(1-/r)$ (5.96). The gradient of the gravitational potential in the given section has a positive sign, establishing the direction of the gravity force to the centre of the point charge.

4. The antigravitation zone (b-c-d-e) characterises the gravitational hillock by the section $\varphi_2 = f\ (1/r)$. In this section, the gradient of the gravitational potential is negative and determines the direction of the repulsive forces in the centre of the point charge.

As regards the structure of the nucleon and its sign-changing shell, the

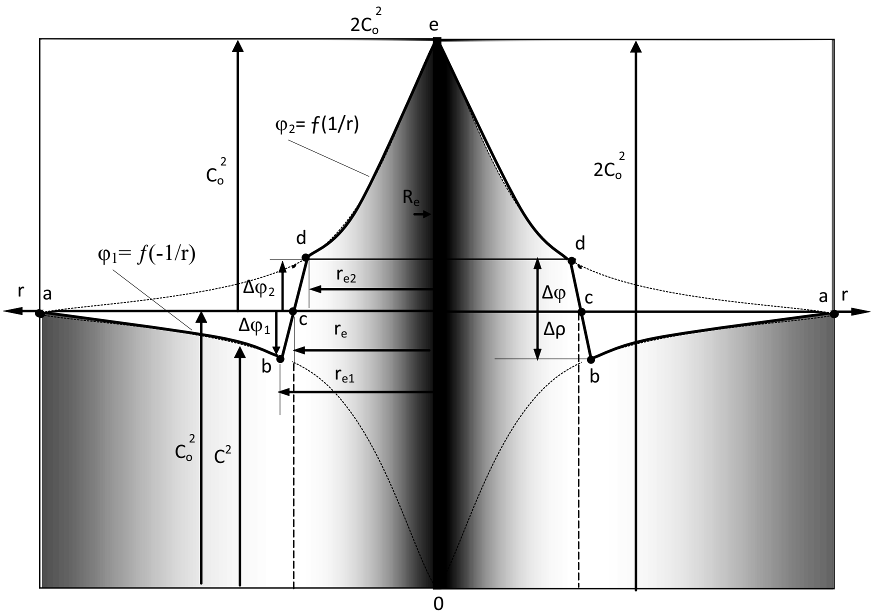

Fig. 5.19. Gravitational diagram of the electron (positron) in the form of distribution of the gravitational potential of the spherically deformed quantised space-time.

gravitational diagram (Fig. 5.19) of the electron (positron) shows a number of changes:

1. As already mentioned, the formation of the nucleon mass is determined by its gravitational interface in the form of a shell of sign-changing point charges with no mass. This means that the structure of the nucleon shell includes charges whose gravitational diagram does not contain the gravitational well (sections a-b-c). The gravitational well changes to the structure of the nucleon itself and is formed by its shell as a whole, forming a complicated relief of the fields.

2. The zones of anti-gravitational repulsion (d-e) are retained at a distances smaller than the classic electron radius around the point charges of the nucleon shell. In particular, the presence of the zones in the complicated relief of the fields of the nucleon shell results in the stable effect of the nuclear forces between the nucleons, as short-range forces.

3. The sign-changing shell of the nucleon is characterised by a highly complicated relief of the electrical, magnetic in gravitational fields, with the zones of compression and tension of the quantised medium, the zones of attraction and repulsion, potential wells and hillocks (potential barriers). In particular, the repulsion zones are important in the formation of the dimensions of the nucleons, to prevent the collapse of the shells and

characterise their stability. Tunnelling of the electron into the atomic nucleus in the effect of electronic capture is possible only in the presence of the complicated relief of the fields of the shells of the nucleons and the atomic nucleus, assembled from the nucleons, where potential barrier is not continuous and contains actual tunnels.

The sign-changing shells of the nucleons have the property of mutual electrostatic attraction at short distances, comparable with the steps of distribution of the charges in the shell.

In particular, the sign-changing structure of the nucleon shells, including the zones of electrostatic attraction and anti-gravitational repulsion, has made it possible to formulate a concept of the electrical nature of nuclear forces within the framework of the Superunification theory.

To conclude, I must pay attention to the fact that the knowledge of the nature of nuclear forces provides a basis for the critical evaluation of the prospects for controlled thermonuclear synthesis in the ITER project. The concept of controlled thermonuclear synthesis was initially based on false assumptions, erroneously assuming that the reason for synthesis is high temperature. Initially, it was assumed that it is sufficient to reach a temperature of 15 million degrees and synthesis of nuclei with generation of energy would start. The temperature in the plasma reaches 70 000 000° and there is no synthesis. The temperature concept of nuclear synthesis does not work.

Now when the nature of the nuclear forces is known, it would be difficult to include in also the temperature factor as a factor of overcoming electrostatic repulsion of the protons. The temperature concept of controlled nuclear synthesis is based on positive experience with the explosion of hydrogen bombs detonated by a preliminary atomic explosion accompanied by the generation of colossal energy. However, in this case, the temperature is one of the energy generation factors. Other factors include high-pressure and acceleration which ‘push’ protons into each other to the distances of the effect of electrical forces of sign-changing nucleon shells, overcoming electrostatic repulsion of the nuclei.

Evidently, the colossal pressures and acceleration cannot be produced in the conditions of thermonuclear reactors in the laboratory because of purely technical reasons. Heating of the plasma in a magnetic trap has no real basis. Knowing the magnitude of the nuclear forces and the cross-section of their effect, it is quite easy to calculate the pressures which must be overcome for the nucleons to come together despite their electrostatic repulsion. For this purpose, the proton nuclei of the light elements must be ‘squeezed’ by accelerated fragments of the atomic nuclei of heavy elements, as is the case in a thermonuclear bomb. It is necessary to develop an atomic press in which the light nuclei are compressed between the accelerated shells of the heavy nuclei and the elastic quantised medium which acts as a wall (anvil) and its strength increases with increase of the effect of acceleration. This factor of the quantised medium, having the property of superhardness under the effect of colossal acceleration, has never been examined in synthesis theory.

On the other hand, I wanted to verify by calculations the extent to which the temperature concept of thermonuclear synthesis is related to nuclear synthesis. In the literature I could not find any calculations linking nuclear forces with temperature. Of course, they can not be there. In order to calculate these forces, it is necessary to have clear information on the temperature not as the parameter on the scale of a thermometer but as an energy factor. However, the current quantum theory also has its shortcomings here. It appears that as the photon energy increases, the recoil of the photon to the atom becomes smaller. The largest recoil is recorded for the low-energy infrared photon.

I paid special attention to this energy paradox because temperature is linked with the temperature oscillations of the atoms and molecules as a result of recoil in emission (re-emission) of the photon. At the beginning, the development of quantum theory also started with the energy paradox expressed by the discrete nature of radiation of the atom and the dependence of the photon energy on its frequency and the fact that it was independent of radiation intensity. This contradicted classic electrodynamics. At the present time, there are such contradictions in the quantum theory between temperature and atom recoil. The current state of the quantum theory does not make it possible to calculate the recil of the simplest atom in emission of a photon. In the case of a gun everything is okay. As the weight of a bullet increases, the recoil becomes stronger. For the atoms this analogy is not suitable and the situation is even reversed. As the photon energy decreases, the atom recoil becomes weaker. It appears that the temperature, being the parameter of oscillations of the atoms, is not connected with the photon energy and, vice versa, temperature increase takes place with a decrease of the photon energy when the photon concentration increases. Evidently, the term 'thermal photons' is suitable for this type of photon.

I have managed to solve the problem for thermal photons discovering the two-rotor structure of the photon which is also investigated in this book. Knowing the configuration and strength of the electrical and magnetic fields of the photon, we can calculate the force momentum acting on the charge of the proton nucleus in photon emission. This force is not sufficient for overcoming electrostatic repulsion of two protons in synthesis of new nuclei. If this were possible, the processes of thermonuclear synthesis under the effect of high-energy photon radiation would have been discovered in experiments a long time ago. However, I know of no positive results of such experiments.

Analysis of the two-rotor structure of the photon made it possible to derive a mathematical equation for the atom recoil whose intensity is inversely proportional to the energy of the emitted photon. This paradox of quantum theory is explained by realising that the elastic quantised medium (EQM), whose properties were previously not taken into account, takes part in atom recoil during photon emission. The discovery of the quantum of space-time (quanton) has greatly widened the analytical possibilities of quantum theory where together with the radiation quantum (photon) we can also operate with the quanton. I should also mention that the photon is a secondary formation in the quantised space-time and fully belongs to this quantised space-time, being its integral part, and the quantum is a primary formation, forming the quantised medium, i.e. primary matter.

It should also be mentioned that the thermonuclear synthesis of luminosity of the stars has not been proven. The temperature in the Sun does not exceed 6000°C and nobody has taken measurements of the temperature inside the Sun. The electronic neutrino fluxes do not correspond to the norms of the thermonuclear reaction. However, the electronic neutrino is also generated in the reactions of annihilation of electrons and positrons when the mass of the particles, as the energy of elastic deformation of the elastic quantised medium, is released and transforms to electromagnetic radiation, and a pair of massless charges generates an electronic neutrino i.e., some field bit of information on the existence of the pair of particles: electron and positron. It is most likely that the source of energy of the stars is the electron–positron plasma which is generated in their interior as a result of the deformation of quantised space-time. The thermonuclear concept of the luminosity of the stars cannot explain the formation of new stars from the quantised space-time which is a source of colossal energy. There is no explanation for the reasons for stabilisation of the luminosity of the Sun as hydrogen burns out over a period of billions of years from the moment of creation of biological life on the Earth. It may be that the ratio of hydrogen and helium on the Sun does not change? Traditional science also cannot explain the source of energy of heating of the Earth interior.

At present, there is no scientific concept of formation of heavy elements in the universe, assuming that the heavy nuclei form in the interior of the stars from the nuclei of light elements and are subsequently ejected with protuberances during explosions of stars into the cosmic space forming cosmic dust. It is quite possible that these processes take place but I believe that they are not fundamental. For the stars to generate something, it is necessary to produce stars themselves: more accurately light elements (hydrogen and helium). Where have these elements come from? From the Big Bang? This has not been proven.

The Superunification theory gives answers to these questions. However, I do not intend to answer the main question: 'who quantised our electrically asymmetric universe?' The answer to this problem is outside the framework of our knowledge. At the moment. The Big Bang hypothesis of the quantisation of the universe is problematic. However, the Superunification theory gives a clear answer to the question: 'who lights up the stars' assuming that the only source of energy in the universe is the quantised space-time as a carrier of the fifth force (superstrong electromagnetic interaction). However, this is a completely different subject.

Thus, the temperature concept of nuclear synthesis is highly vulnerable by criticism and the negative result of the ITER project can be reliably predicted. This is based on the analysis of the nature of nuclear forces as short-range forces between the sign-changing shells of the nucleons taking into account the interaction with the elastic quantised medium. I would like to make some errors in calculations and predictions so that my colleagues in science would not be angry with me. However, the truth is more important, since even a negative result in the ITER project is also important for science like a positive one.

16. Conclusions

The nature of the nuclear forces is one of the most important problems of theoretical physics. It has been assumed that the nuclear forces are the maximum possible forces in nature, characterising the strong fundamental interaction, as one of the four forces known in nature. Attempts to unify the strong interaction with other: electromagnetism and gravitation, have not been successful. It has been shown that this is caused by the fact that on the whole the strong interaction is not a carrier of the maximum possible force and cannot be therefore used as a unifying factor. In order to unify the nuclear forces with gravitation and electromagnetism, and also electroweak interactions, we must have an even greater force, previously not known in science. This is the golden rule of physics that the force can be conquered only by a greater force.

The presence of such a Superforce, as the fifth force, became known after discovery of the quantum of space-time (quanton) and superstrong electromagnetic interaction. In particular, SEI (and not the strong interaction) is the carrier of the Superforce. For comparison: the attraction force of the nucleons, characterising the nuclear forces, is estimated at approximately 0.63 kN (Table 5.1), and the force of interaction between the quantons is of the order of 10^{23} N. The diameter of the nucleon is $\sim 10^{-15}$ m, the diameter of the quanton $\sim 10^{-25}$ m. Even if we not relate the forces to their cross-section, these forces are simply incommensurable. As we penetrate deeper into matter, we face higher and higher concentrations of forces and energy. It becomes clear that the only source of energy in the universe is the superstrong electromagnetic interaction. This is electromagnetic energy. All the known types of energy (chemical, nuclear, electromagnetic, gravitation, etc) are regarded in the final analysis as the manifestation of the superstrong interaction and are represent only method of extracting the energy of this interaction. We live in the electromagnetic universe.

The nuclear forces, acting between the nucleons and the atomic nucleus, must be examined from the unified positions of unification of the fundamental interactions through the superstrong electromagnetic interaction. Here, it must be understood that the mass of the nucleons forms as a result of the spherical deformation of the quantised space-time which is a carrier of the superstrong electromagnetic interaction. It has been established that the only possible method of spherically deforming the elastic quantised medium, ensuring that all the possible properties of the nucleons are utilised, is the presence in the nucleon of the shell assembled from electrical massless charges with sign-changing signs.

This shell is sign-changing and has the property of contracting on the sphere with the effect of forces of electrical attraction between the charges of the nucleon shell. The spherical compression of the sign-changing shell takes place together with the medium inside the shell. However, on the external side of the shell, the elastic quantised medium is subjected to tension. In this case, the quantum density of the medium (quanton concentration) inside the shell increases and outside the shell it decreases. Consequently, the nucleon assumes a mass as the parameter of 'distortion' of the quantised space-time under the effect of spherical deformation. The resistance of the shell to collapse is limited by the pressure of the medium inside the shell which is balanced by the tension of the elastic quantised medium from the external side. In addition, the factor of stability of the nucleons in relation to the collapse of the shell includes the zones of anti-gravitational repulsion between the nuclei of the sign-changing shell whose effect starts to be evident at distances shorter than the classic electron radius of the electron.

Another fundamental property of the sign-changing shells of the nucleons is their capacity to be attracted by the charges with opposite polarity, regardless of the presence or absence of a non-compensated electrical charge. In the proton, the shell contains a non-compensated electrical charge with positive polarity and an odd number of charges – 69 charges. In the neutron, the number of charges in the sign-changing shell is even (70 charges) and these charges are compensated in pairs, so that the neutron is regarded as an electrically neutral particle.

The electrical neutrality of the neutron is evident at distances greater than 10^{-15} m. At shorter distances, not only in the neutron but also in the proton, the electrical field of the sign-changing shell of the nucleons is characterised by specific features of action at short distances of 10^{-16}... 10^{-15} m, comparable with the spacing of the distribution of the charges in the shell. These are short-range fields and forces which enable the forces of electrostatic attraction of the shells to overcome the forces of electrostatic repulsion of the non-compensated charge of the protons in the atomic nucleus. The open zones of anti-gravitational repulsion in the complicated relief of the fields of the nucleon shells prevent the nucleons from coming together closer than 10^{-16} m, thus avoiding the collapse of the nucleons and ensuring stability of the nuclei.

In particular, the sign-changing structure of the nucleon shells, including the zones of electrostatic attraction and anti-gravitational repulsion, has made it possible to formulate a concept of the electrical nature of nuclear forces within the framework of the Superunification theory.

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