NUCLEAR FORCES AND NUCLEAR ENERGY

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*Articolul tratează două teme de cercetare fundamentală în teoria fizicii, tradițională şi pragmatică. **Fizica tradițională** nu identifică forțele nucleare dar calculează energia nucleară în funcție de „defectul de masă" din teoria relativității Einstein. **Fizica pragmatică** calculează forțele nucleare ca forțe gravitaționale de ordin superior şi identifică energia nucleară ca energie internă a nucleului atomic.*

The paper deals with two fundamental research topics in the traditional and pragmatic physics theory. Traditional physics does not identify nuclear forces but calculates nuclear energy based on „mass defect" from the Einstein theory of relativity. Pragmatic physics calculates the nuclear forces as high order gravitational forces and identifies the nuclear forces as internal energy of the atomic nucleus.

Keywords: Nuclear Physics, Nuclear forces, Nuclear energy

1. Introduction

The article deals with two fundamental research topics in the theory of physics: 1) calculus of the nuclear forces and 2) identification of the nuclear energy. We present the solutions of the pragmatic physics [1], [2] for these topics and we comment the solutions of the traditional physics [3], [4].

We make distinction between two physical theories: traditional and pragmatic. There are many differences between the two theories but we highlight an essential difference. ***The traditional Physics,*** [1], [2], enunciates ***laws, principles and postulates*** and ***the pragmatic physics,*** [3], [4], enunciates ***laws and principles*** but eliminates the postulates of the traditional physics (classical and modern).

We admit two variants for the meaning of the *postulate*: a) the traditional theory considers that the postulate is a *scientific prevision* which needs only experimental confirmation and b) the pragmatic theory considers that a postulate of the traditional theory is a *hypothesis* which needs to be verified theoretically and experimentally before being declared a physical law, theorem or utopia. We

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draw three conclusions from the above considerations: 1) The traditional physics gives priority to experimental checks of a postulate even if it violates laws and principles which have been previously validated, 2) the pragmatic theory eliminates the traditional postulates because it proves that some postulates are laws or theorems and the other are utopias and 3) the presence of postulates in a physical theory shows that the theory is not finalised.

Experimental results from traditional physics and theoretical results from the pragmatic physics suggest the following hypothesis for each topic: 1) the law of gravitation, introduced by Newton, shall be completed with three terms, from which the last one expresses the nuclear forces, 2) electrons and protons form two classes of elementary particles which are necessary and sufficient for the study of atomic nuclei from the Mendeleyev table, 3) a specific property of the elementary particles is the spin movement which ensures the impenetrability of the elementary particles and the independent conservation of masses and of electrical charges – negatives and positives, 4) the neutron is not an elementary particle but composed by a proton and an electron which slides on the surface of the proton, conserving its mass and the negative electric charge, 5) kinetic energy of the sliding electron is the internal energy of the nucleus which can be extracted by different means and is named nuclear energy, 6) the extracted energy through the fission of a nucleus, with the current technique, is around 200 MeV and represents only the „top of the iceberg" from the maximum possible energy of $1.44 \cdot 10^{17}$ MeV for a sliding electron.

2. Elementary particles

The elementary particle is an indestructible body. The pragmatic theory of microscopic physics studies the elementary particles in two successive iterations: 1) the study of the elementary particles (proton and electron) which have been identified in the atoms of the Mendeleyev atoms and 2) the study of the particles and of the antiparticles, supposed to be elementary, which have been discovered in the cosmic radiations (mesons, pions, hyperons). In what follows, we present the first iteration of the theory of elementary particles, by considering the hypothesis that there are only two classes of elementary particles: the class of protons and the class of electrons.

2.1. Universal physical constants

An elementary particle, electron or *proton*, has the following physical characteristics: spherical form with radius r, mass m, electric charge q and modulus L_s of the mechanical kinetic spin moment $\overline{L}_s$. The following physical characteristics of the elementary particles (marked with subscripted indices e and p for electron) are universal constants of the macroscopic theory:

$$m_e = 9{,}109\cdot10^{-31}\ \text{kg} \qquad r_e \cong 1{,}225\cdot10^{-16}\ \text{m} \qquad (1)$$

$$m_p = 1{,}673\cdot10^{-27}\ \text{kg} \qquad r_p \cong 1{,}5\cdot10^{-15}\ \text{m} \qquad (2)$$

The mass of the electron m_e is the smallest mass known in nature. The proton mass m_p from (2) can be expressed as function of the mass quanta with the relation $m_p = k\, m_e$, where k is the numerical constant k $\cong$ 1836. Electrical charges q_p and q_e can be expressed function of the electrical charge e, named *electrical charge quanta:*

$$q_{p,e} = \pm\ e \qquad \text{where} \qquad e = 1{,}602\cdot10^{-19}\ \text{C} \qquad (3)$$

We do not know direct measurement of electron and proton radius. The traditional theory recommends the „classical radius" of the electron $r_e = 2{,}8\cdot10^{-15}$ m and estimates the atomic nuclear radius with the semi empirical formula:

$$r = r_0\, A^{1/3} \qquad \text{where:} \qquad r_0 = 1{,}5\cdot10^{-15}\ \text{m} \qquad (4)$$

The constant A is the atomic mass number of the nucleus in the table of Mendeleyev. For the hydrogen nucleus (H), we consider A = 1 and we get the radius of hydrogen which is also the radius of the proton: r_H = rp =r0 = $1{,}5\cdot10^{-15}$ m. We find out that the estimated radius of the proton $r_p = 1{,}5\cdot10^{-15}$ m is smaller than the „classical radius" of the electron. We renounce to use the „classical radius" and we estimate the electron radius as function of the proton radius. We admit the hypothesis that the electron and the proton have the same mass density and write the relation $(r_p/r_e)^3 = m_p/m_e \cong 1836$ which we use to calculate r_e from (1).

Before giving the numerical values to the spin moments of the elementary particles, we first study the orbital moments, mechanical and electrical.

2.2. Orbital moments

We consider the simplest atom – the hydrogen atom which contains a proton and a planetary electron. We define two orbital moments of the planetary electron: mechanical moment L (or the moment of the mechanical moment mv) and the magnetic moment μ:

$$L = m\, v\, r \qquad \mu = \pi r^2 i \qquad (5)$$

where

$$i = \frac{e}{T} \qquad T = 2\pi\frac{r}{v} \qquad (6)$$

The first relation (6) is the expression of then convection electric current i, due to electrical charge e of the planetary electron. The second relation (6) represents the rotation period T as function of the speed v on the orbit of radius r. With the relations (5) and (6) we demonstrate the relations:

$$\mu = \frac{1}{2}e v r \qquad \frac{\mu}{L} = \frac{1}{2}\frac{e}{m} \qquad (7)$$

According to the last relation (7), where e and m are universal physical constants, the magnetic moment μ can be calculated as function of mechanical moment L or vice-verse. According to the first relation from (5) and (7), ***the orbital moments L and*** μ ***are status quantities*** because they depend on radius r and speed v on the orbit.

Relations (5), (6), (7) are valid for the planetary electron of the hydrogen atom (H) but also for the planetary electrons of the other atoms from the periodic table of Mendeleyev.

2.3. Spin moments

The elementary particles make permanent rotation movement around their own axis of symmetry (gyroscopic movement or spin). We express two spin moments for an elementary particle, the mechanical moment of spin L_s and the magnetic moment of spin μ_s:

$$L_s = \frac{2}{5} m r_s v_s \qquad \mu_s = \frac{1}{3} e r_s v_s \qquad (8)$$

and

$$\frac{\mu_s}{L_s} = \frac{5}{6}\frac{e}{m} \qquad \text{or} \qquad \frac{\mu_s}{L_s} \cong \frac{e}{m} \qquad (9)$$

The spin moments L_s and μ_s from (8) are expressed in the following hypothesis: the particle has spherical shape, the mass m is uniformly spread in the sphere volume and the electrical charge e is uniformly spread on the surface of the sphere. According to relations (9), which are demonstrated analytically, the spin moments L_s and μ_s are not independent.

It is found experimentally that the ***spin moments*** of the proton (L_{sp}, μ_{sp}) and of the electron (L_{se}, μ_{se}) ***are physical constants*** of the elementary particles and thus shall be considered ***universal constants of the microscopic physics***. With the relations (9), is sufficient to establish experimentally only a pair of spin moments – for instance the pair L_{sp}, L_{se} or the pair μ_{sp}, μ_{se}.

The relations (7), (8), (9) unveil new properties of some status quantities which we studied independently in the macroscopic theory: the mechanical moments L, L_s and the magnetic moments μ, μ_s. These properties justify the status of equilibrium of the hydrogen atom where the mechanical moment of spin $\overline{L_s}$ is parallel or anti-parallel with the orbital mechanical momentum $\overline{L}$. The orientation of the momentum $\overline{L_s}$ compared to momentum $\overline{L}$, is accomplished through the magnetic moments as follows: a) the orbital magnetic moment $\overline{\mu}$ has the same versor with the orbital mechanic moment $\overline{L}$, which makes the rotation movement, b) the magnetic moment $\overline{\mu}$ acts on magnetic moment $\overline{\mu}_s$ which is oriented parallel or anti-parallel with $\overline{\mu}$, according to the laws of electrodynamics, c) the versor of mechanical moment of spin $\overline{L_s}$ is imposed now by the versor of the magnetic moment of spin $\overline{\mu}_s$ which is parallel or anti-parallel with the versor of the versor of the orbital mechanical moment $\overline{L}$.

2.4. Spin energy

From the relations (8) results that the spin speeds v_s of the elementary particles are physical constants. In consequence, the spin energy is also a physical constant of an elementary particle, proton or electron, because it can be expressed with the relations:

$$E_s = \frac{1}{2} J_s \omega_s^2 \qquad \text{where} \quad J_s = \frac{2}{5} m r_s^2 \tag{10}$$

and

$$\omega_s = \frac{v_s}{r_s} \qquad \text{and} \quad E_s = \frac{1}{5} m v_s^2 \tag{11}$$

The relations (10), (11) are demonstrated for the gyroscopic movement of a sphere where: *m* is the mass of the sphere, J_s is the moment of inertia, ω_s is the angular speed. With the last relation from (11) can be calculated the physical constant E_s in function of the physical constant v_s which results from (8). The relations (8), (9) and (10), (11) are true for both classes of elementary particles, electron and proton. When applying the relations (8), (9) and (10), (11) for electron (e) and for the proton (p) we will exchange the unique index *s* with the indexes *se* and *sp*.

The spin energies E_{se} and E_{sp} are physical constants and form a specific class of microscopic energy which is not the same with none of the macroscopic status quantities: kinetic energy and potential energy. This situation of the physical constants E_{se} and E_{sp} is compatible with the situation of the constant c_0 which has the dimension of the speed of movement of a body but is not a kinetic measurement status of a body but is the speed of propagation of electromagnetic waves.

Numerical example 1. The experimental values of spin magnetic moments are:

$$\mu_{sp} = 1{,}411 \cdot 10^{-26}\ \text{J/T} \qquad \mu_{se} = -\ 928{,}471^{-26}\ \text{J/T} \tag{12}$$

Function of the spin magnetic moments from (12), we calculate the spin speeds v_{sp} and v_{se} from the last relation (8), written fro the proton and for the electron:

$$v_{sp} = \frac{3\mu_{sp}}{er_p} = 1{,}764 \cdot 10^8\, m/s \qquad v_{se} = \frac{3\mu_{se}}{er_e} = 1{,}421 \cdot 10^{12}\, m/s \tag{13}$$

We compute the ration $v_{se}/c_0 \cong 4700$ and we see that the speed of electron spin overpasses the speed of light in vacuum. With the last relation (11), we calculate the spin energies for the proton and for the electron:

$$E_{sp} = \frac{1}{5} m_p v_{sp}^2 = 1{,}041 \cdot 10^{-11}\, J \qquad E_{se} = \frac{1}{5} m_e v_{se}^2 = 3{,}679 \cdot 10^{-7}\, J \tag{14}$$

It is remarkable the spin energy of the electron, which overpasses around $4{,}5 \cdot 10^6$ times the relativistic energy from the Einstein theory $E = m_e c^2 = 8{,}198 \cdot 10^{-14}$ J = 0,512 MeV, where eV is the unit of energy electron-volt and 1 MeV = 10^6 eV = $1{,}6 \cdot 10^{-13}$ J.

3 Nuclear particles

Nuclear particles are composed from elementary particles (protons and electrons) and are formed under the action of nuclear forces of attraction which surpasses the electrostatic forces of rejection. We evaluate the attraction and rejection forces which appear at the genesis of a nuclear particle and we describe two nuclear particles: α and y.

3.1. Nuclear forces

There are two classes of forces which act on elementary particles: *electrostatic* which depend on electrical charges of the particles and *gravitational* which depend on the mass of the particles. The electrostatic forces, of attraction or rejection, can be expressed with the Coulomb formula Coulomb and the nuclear forces, of attraction between the particles, protons or electrons, can be expressed with the general law of gravitation:

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{d_{12}^2} \qquad F = \gamma \frac{m_1 m_2}{d_{12}^2} \left(1 + \frac{R_2^2}{d_{12}^2} + \frac{R_4^4}{d_{12}^4} + \frac{R_6^6}{d_{12}^6} \right) \tag{15}$$

The physical constants from the relations (15) are given for the SI measurement system where the constants ε_0 and γ have the physical dimensions ε_u and γ_u and are taken from [4]:

$\varepsilon_0 = 8{,}846 \cdot 10^{-12}\, \varepsilon_u$ $\qquad \gamma = 6{,}672 \cdot 10^{-12}\, \gamma_u$ (16)

$R_2 = 0{,}229$ m $\qquad R_4 = 0{,}480 \cdot 10^{-2}$ m $\qquad R_6 = 1{,}017 \cdot 10^{-4}$ m (17)

We have to calculate only three forces of interaction between the elementary particles: electron-electron, proton-proton and electron-proton. We express and calculate the resulting forces of interaction by admitting the convention that the attraction forces are positive (and the rejection forces are negative):

$$F_{ee} = F_{ee}^{g} - F_{ee}^{e} \cong \gamma \frac{m_e^2}{d_{ee}^2}\frac{R_6^6}{d_{ee}^6} - \frac{1}{4\pi\varepsilon_0}\frac{e^2}{d_{ee}^2} \cong \left(4.718\cdot 10^{29} - 3.84\cdot 10^{3}\right)N \quad (18)$$

$$F_{pp} = F_{pp}^{g} - F_{pp}^{e} \cong \gamma \frac{m_p^2}{d_{pp}^2}\frac{R_6^6}{d_{pp}^6} - \frac{1}{4\pi\varepsilon_0}\frac{e^2}{d_{pp}^2} \cong \left(3.149\cdot 10^{27} - 25.6\right)N \quad (19)$$

$$F_{ep} = F_{ep}^{g} + F_{ep}^{e} \cong \gamma \frac{m_e\, m_p}{d_{ep}^2}\frac{R_6^6}{d_{ep}^2} + \frac{1}{4\pi\varepsilon_0}\frac{e^2}{d_{ep}^2} \cong \left(2.337\cdot 10^{26} + 87.6\right)N \quad (20)$$

The superior indexes g, and e are denoting the gravitational and electrical forces and the inferior indexes ee, pp, ep are denoting the pairs electron-electron, proton-proton and electron-proton. We kept from the gravitational law (15) only the last term which is dominant compared with the others because the distances between the mass centres of the particles are: $d_{ee} = 2{,}45\cdot 10^{-16}$ m for the pair of electrons, $d_{pp} = 3\cdot 10^{-15}$ m for the pair of protons and $d_{ep} = 1{,}623\cdot 10^{-15}$ m for the pair electron-proton. We say that the forces (18), (19), (20), dominated by the last component of the gravitational law, are nuclear forces or strong forces, which vary inversely proportional with the 8th power of the distance between the two mass centres.

The results (18), (19), (20) are estimates because the radius of the elementary particles are not known with sufficient accuracy as we showed in subchapter 2.1. More than that, we do not know if the surfaces of the particles can approach up to touching themselves. Only further experiences will decide eventual corrections for the radius of elementary particles and for the distance between their surfaces.

We calculated gravitational and electrical forces for minimum distances between elementary particles, which conserves the geometric dimensions (radius r_p, r_e), their mass and electric charge, positives and negatives. We remark that the principles of conservation of masses and electrical charge from the macroscopic physics act in new forms in microscopic physics due to the movement of spin of elementary particles. The principle of impenetrability of bodies from the macroscopic physics is confirmed in the microscopic physics by the existence of spins.

3.2. Nuclear particle α

The nuclear particle α is formed of 6 elementary particles: 4 protons (*p)* and 2 electrons (*e*)*.* The electrical charge of the α particle is $q_\alpha = 2e$ as it results from the relation of conservation of electrical charges $q_\alpha = 4q_p + 2q_e$ where $q_p = +$

e and $q_e = -e$. The mass centres of elementary particles *p* and *e* are disposed in a plan (Fig. 1) and the versors of the kinetic and magnetic moments of spin are perpendicular on the plan and anti-parallel two by two. In these conditions, the resultant magnetic moment (of spin) of the α particle is null.

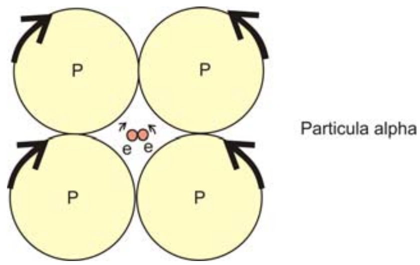

Fig. 1. Nuclear particle α

We study the α particle in an isolated physical system which is immobile in vacuum but we mention that the immobility of the system is relative according to Newtonian mechanics. We define the internal energy of the α particle as sum of potential energy of the elementary particles. A simple estimation of the potential energy of the α particle is $U_\alpha \cong 6U_{pp} + U_{ee}$ where:

$$U_{ee} \cong -2\frac{d_{ee}}{7}F_{ee}^{g} \qquad U_{pp} \cong -2\frac{d_{pp}}{7}F_{pp}^{g} \qquad (21)$$

By performing the calculus with the relations (21), we obtain U_{ee} = - $3{,}3\cdot10^{13}$ J and U_{pp} = - $2{,}7\cdot10^{12}$ J then $U_\alpha \cong -3{,}57\cdot10^{13}$ J. The estimate result U_α shows that the α particle needs huge energy consumption in order to dismantle it in the elementary components. Experiences confirm that the α particle is extremely stable and thus it is used as a bullet for dismantling atomic nuclei.

We observe that the α particle from the pragmatic theory differs from the α particle of the traditional theory because: 1) α particle from traditional theory is composed from two protons and two traditional neutrons and 2) the traditional neutron *n* is elementary particle and the pragmatic neutron is a composed particle.

3.3. Nuclear particle y

The nuclear particle y is composed from a proton *p* and an electron *e* which „*slides”* on the surface of the proton as in Fig. 2. We say that the composed particle y is a pragmatic *neutron*. The magnetic moment of spin $\overline{\mu}_{sn}$ of the neutron, is the vector sum of two magnetic moments: magnetic moment of spin $\overline{\mu}_{sp}$ of the proton and the orbital magnetic moment $\overline{\mu}_{oe}$ of the electron which slides on the surface of the proton. With the notations from Fig. 2, we write the relation between the vectors of the magnetic moments and we express the modulus μ_{oe} of the orbital magnetic moment $\bar{\mu}_{oe}$:

$$\bar{\mu}_{sn} = \bar{\mu}_{sp} + \bar{\mu}_{oe} \qquad \text{and} \qquad \mu_{oe} = \mu_{sn} - \mu_{sp} \qquad (22)$$

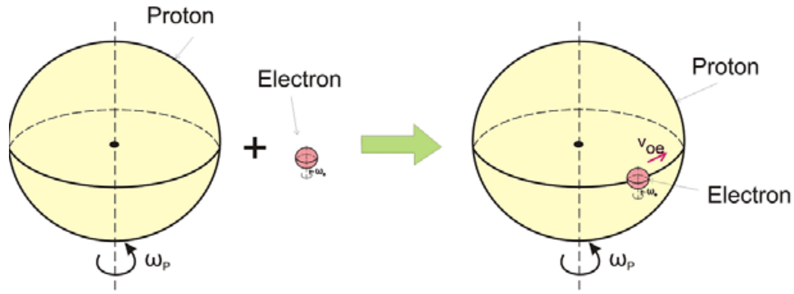

Fig. 2. Nuclear particle y

We use a measurement of the traditional spin μ_{sn} and calculate then μ_{oe} with the last relation from (22):

$$\mu_{sn} = -\,0{,}965\cdot10^{-26}\ \text{A}\cdot\text{m}^2 \qquad \mu_{oe} = -\,2{,}374\cdot10^{-26}\ \text{A}\cdot\text{m}^2 \qquad (23)$$

We write the first relation (7) for the orbital magnetic moment μ_{oe} and we express the speed v_{oe} of the sliding electron on the orbit of radius $r_{pe} = r_p + r_e$:

$$v_{oe} = \frac{2\mu_{oe}}{e\,r_{pe}} \qquad \text{and} \qquad E_{oe} = \frac{1}{2} m_e\, v_{oe}^2 \qquad (24)$$

The speed v_{oe} and the energy E_{oe} from (24) are not physical constants because the magnetic moment of the neutron μ_{sn} from (23) is not a physical constant but a status variable of the nuclear particle *y*. The speed v_{oe} can vary between two limits, which are not physical constants: $v_{oe\,min} = -\,v_{oe\,max}$, with

$$v_{oe\max} \cong \sqrt[2]{\gamma \frac{m_p}{r_{pe}} \left(\frac{R_6}{r_{pe}}\right)^3} \qquad \text{where} \qquad \frac{m_e v_{oe\max}^2}{r_{pe}} \cong \gamma \frac{m_e m_p}{r_{pe}^2} \left(\frac{R_6}{r_{pe}}\right)^6 \qquad (25)$$

The first relation (25) results from the last relation (25) which is the equation of stationary equilibrium of the electron on the orbit of radius $r_{pe} = r_p + r_e$. The speed $v_{oe\ max}$ is the maximal speed which can have the sliding electron, before being a satellite of the proton. After the detachment from the proton surface, the electron tend to reach the first Bohr orbit such that the neutron *y* can become a hydrogen atom or can be disintegrated in two elementary particles (one proton and one electron).

The hypothesis on the structure of the pragmatic neutron are sustained by the following arguments: 1) after the detachment from the nucleus, the neutron disintegrates in two particles identical to the elementary particles proton and electron and 2) neutron produces magnetic moment which cannot be justified by the traditional hypothesis (neutron is elementary particle without electrical charge).

Numerical exemple 2. With relations (24), we compute the speed v_{oe} of the sliding electron and kinetic energy E_{oe} of the sliding electron:

$v_{oe} = 1{,}978 \cdot 10^7$ m/s and $E_{oe} = 1{,}782 \cdot 10^{-16}$ J. (26)

With the relations (25) and (24), we compute the speeds $v_{oe\ min}$, $v_{oe\ max}$ and the corresponding kinetic energies, which are physical constants of the macroscopic theory:

$v_{oe\ min} = 1{,}768 \cdot 10^7$ m/s and $E_{oe\ min} = 1{,}424 \cdot 10^{-16}$ J (27)

$v_{oe\ max} = 2{,}248 \cdot 10^{17}$ m/s and $E_{oe\ max} = 2{,}302 \cdot 10^4$ J (28)

The numerical values of the physical constants $v_{oe\ max}$ and $E_{oe\ max}$ are impressive. The maximal speed of the sliding electron overpasses $7{,}5 \cdot 10^9$ times the speed of light in vacuum and the maximal kinetic energy overpasses $2{,}7 \cdot 10^{17}$ times the relativistic energy which we calculated in subchapter 2.4 at the Numerical example 1.

4. Atomic nucleus

The nucleus is the immobile central component of the atom which contains also one or more planetary electrons. The immobility of the nucleus in vacuum is relative according the Newtonian mechanics which demonstrates that the mass centre of the nucleus can have a linear and uniform movement in an inertial reference system.

4.1. Structure of the nucleus

According to the periodic table of Mendeleyev, the atom is composed from a central nucleus with *N nucleons* and with *Z electrons* (planetary) rotating around the nucleus and having the electrical charge *-Ze*. A nucleon can be a proton, with electrical charge +e, or a traditional neutron with zero electrical charge. The total electrical charge of the atom is zero because the nucleus contains Z protons with electrical charge +Ze and *N-Z neutrons* with zero electrical charge.

In the pragmatic theory of physics, we accept to systematize the knowledge from the periodic table of elements of Mendeleyev with some modifications. We replace the traditional notation ${}^{A}_{Z}X$ with the pragmatic notation ${}^{N}_{Z}X^{Y}$, where X is the symbol of atomic nucleus and indexes Z, N, Y have the following significations: Z is the atomic number or the number of planetary electrons in both theories, N = integer A is the mass number in both theories and Y is the number of neutrons *y* in the pragmatic theory.

We remind that the traditional nucleus has Z protons and N-Z neutrons such that the electrical charge of the nucleus is +Ze. We specify that the pragmatic nucleus contains N protons and N-Z electrons such that the electrical charge of the nucleus is +Ne – (N-Z)e = +Ze. In the hypothesis that $m_n = m_p + m_e$, the masses of the two nucleus, traditional and pragmatic, are equal, because $Zm_p + (N-Z)(m_p + m_e) = Nm_p + (N-Z)\, m_e$.

The pragmatic nucleus ${}_{Z}^{N}X^{Y}$ contains three classes of nucleons or nuclear particles: a number of N_p particles *p*, a number of N_α particles α and a number of Y particles *y*. We remark the following particularities: 1) proton has the role of an elementary particle or of nuclear particle in both traditional and pragmatic theories, 2) nuclear particles p and α can be the nucleus of some atoms (hydrogen and helium) and 3) nuclear particle y cannot be atomic nucleus.

The number of nucleons N_α, Y and N_p can be calculated with a simple algorithm. If N_α is an even number, the following relations can be written: $4 N_\alpha + Y = N$ and $2 N_\alpha + Y = N - Z$, resulting: $N_\alpha = Z/2$ and $Y = N - 2Z$. For the general case, when N_α is even or odd, it results the following algorithm:

1. $N_\alpha = Z/2$ and $N_p = 0$
2. If Z is even go to point 4
3. N_α = integer of Z/2 and $N_p = 1$
4. $Y = N - Z - 2N_\alpha$

Based on the values Z, N, Y from the notation ${}_{Z}^{N}X^{Y}$ one can easily get the numbers N_α and N_p as follows: if Z is even, then $N_\alpha = Z/2$ and $N_p = 0$, so N_α = integer of Z/2 and $N_p = 1$.

Nucleuses with the same atomic number Z but with different mass numbers are named isotopes and can be found in nature in different ratios. The mass number of the most found isotope in nature is considered the basic mass number, associated with the atomic number Z. The computing algorithm of the number of nucleons N_α, N_p, Y is applied also for isotopes in the hypothesis N > 2Z.

There are four isotopes, ${}_{4}^{7}Be$, ${}_{6}^{11}C$, ${}_{8}^{15}O$, ${}_{12}^{23}Mg$ for which this algorithm does not work, because we obtain Y = - 1 because N < 2Z. In these cases, we compute the number of nucleons N_α, N_p, Y in the hypothesis that the above isotopes are obtained by extracting a neutron ${}_{0}^{1}y^{1}$ from the nuclei ${}_{4}^{8}Be^{0}$, ${}_{6}^{12}C^{0}$, ${}_{8}^{16}O^{0}$, ${}_{12}^{24}Mg^{0}$.

4.2. Nucleus stability

Generalities. We study the atomic nucleus as a system of bodies in vacuum under the action of gravitational, electrical and magnetic forces. According to the laws of physics there is an infinity of equilibrium states of the system of bodies and according to the principle of minimum energy there is an optimal status of equilibrium of the system of bodies where the energy of the physic system is at minimum. We say that statuses of equilibrium are normal states of stability and the optimal state of equilibrium is a state of maximal stability.

Generally speaking, a physical macroscopic system can be in a stable status of equilibrium or in a status of transition from a stable equilibrium to another stable equilibrium. The status of equilibrium can be static (bodies are immobile) or stationary (bodies are in a uniform movement, of translation or of rotation). In this subchapter, we refer only at statuses of equilibrium (stable) and in the next chapter we study the statuses of transition.

We define two notions for the study of equilibrium statuses of the elementary particles with spin movement. We say that the status of equilibrium of a system of elementary particles is quasi-static or quasi-stationary if the axes of the spin movement are at rest or in uniform motion comparing to an inertial reference system. The mass of the atomic nucleus is much bigger than the mass of the planetary electrons so the mass centre of the nucleus can be considered at rest in vacuum comparing to the planetary electrons. In these conditions, the status of equilibrium of the elementary particles p, e from the nuclear particle α is a status of quasi-static equilibrium (the spin axes are bounded with nucleus at rest) and the status of equilibrium of the elementary particles p, e from the nuclear particle y is a status of quasi-stationary equilibrium because the spin axe of the sliding electron is in uniform movement of rotation.

The analytic study of the stable equilibrium statuses of a nucleus, need to develop the mathematical model for the mentioned statuses and the application of specific methods of calculus. This deterministic way of study is possible for simple physical systems but becomes inapplicable for the study of atomic nuclei. We propose two methods for estimation of nucleus stability: 1) a theoretical method where we use the indicators N_α and Y and 2) an empirical method where we verify experimentally the stability of a class of nuclei.

The first method starts with the calculus of the indicators N_α and Y based on the algorithm from previous subchapter. The method continues with the comparative evaluation of the stability of the nuclei as follows: I) nuclei formed only by α particles are the most stable (they have atomic numbers 2, 6, 8, 10, 12, 14, 16, 20), II) follows the nuclei relatively light, from the middle of the Mendeleyev table, where N_α is bigger than Y and III) heavy nuclei where Y is bigger than N_α. The last series contains 40 nuclei and start with nucleus 81 for which N_α = 40 and Y = 43. The experience shows that the atomic nuclei, except the heavy ones (radioactive), have an exceptional stability which explains the unsuccessful history of the alchemy in the Middle Age.

The second method consists of experimental check of the stability of a class of nuclei. We use nuclear particles (*α, y, p*) to bombard nuclei up to destruction (a nucleus of a class of nuclei). In this way can be experimentally the binding energy per nucleon (Fig. 3) which represents an indicator for the comparative evaluation of the nuclei stability: nuclei of high binding energy per nucleon are more stable than those with smaller binding energy per nucleon.

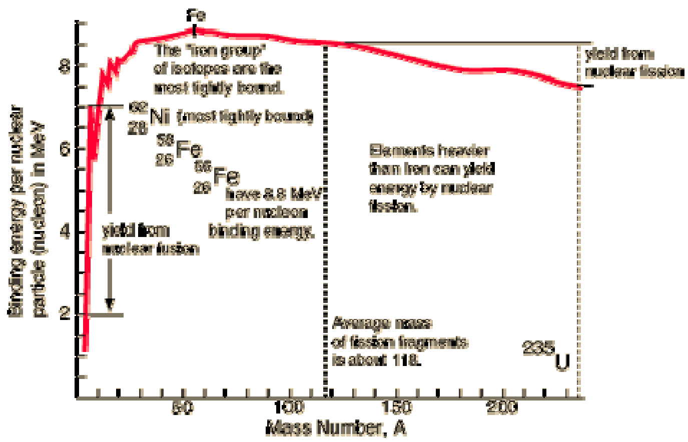

Fig. 3. Binding energy per nucleon

Fig. 3 represents the diagram of binding energy per nucleon, which can be found in most of the modern physics works. We accept the traditional diagram (fig. 3) as a first (heuristic) estimation of the binding energies of the protons and neutrons in the nuclei, except the nuclei formed only by α particles. In the chapter 6, we will comment the calculus for the binding energy based on mass defect of the relativistic theory of Einstein.

4.3. Unstable nuclei

The heavy nuclei from the last part of table of Mendeleyev are nuclei in transition towards stable statuses. According to the principle of minimum energy, heavy nuclei need to diminish the internal energy by expelling y nucleons which contain internal kinetic energy. With the expel of nucleons y, there are also expelled α nucleons such that the heavy nucleus losses mass and diminish its geometric dimension. We say that the heavy nuclei are spontaneously disintegration (without intervention of external factors) or we say that the heavy nuclei are radioactive because they expel spontaneously particles (y, α) and electromagnetic radiations (photons and neutrinos).

Let consider N_0 the number of heavy nuclei at the moment t=0 and N the number of nuclei which are disintegrating in the time t>0. We study the disintegration of the nuclei as a random phenomenon and we write the relations:

$$-\frac{dN}{dt} = \lambda N \qquad \text{or} \qquad N = N_0 e^{-\lambda t} \qquad (29)$$

According to the first relation (29), the variation of number N in time is proportional with the number N. The proportionality factor λ is a specific characteristic of the disintegrating material. The last relation (29) is the integral form of the first relation (29) and is named law of material for the radioactive disintegration. A measure of the disintegration speed is the half-life time $T_{1/2}$ which can be obtained from (29) for t = $T_{1/2}$ and N = $N_0/2$:

$$\frac{N_0}{2} = N_0 e^{-\lambda T_{1/2}} \qquad \text{or} \qquad T_{1/2} = \frac{\ln 2}{\lambda} \qquad (30)$$

The nuclear radiation has three components: two corpuscular components (α particles or helium nuclei and β or electrons) and a component of electromagnetic radiation γ. The corpuscular components α, β can be recognized from their deviations in magnetic field, due to Lorentz forces (Fig. 4).

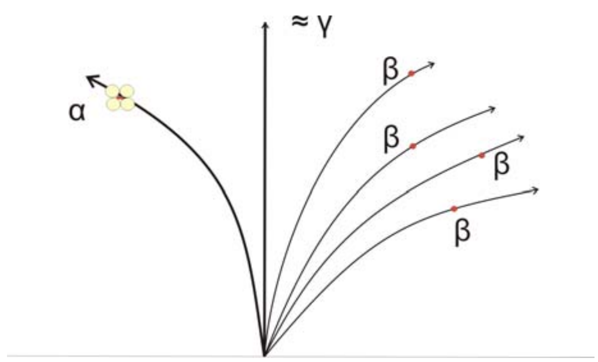

Fig. 4. Deviation of the nuclear radiations in magnetic field

We observe two particularities of the corpuscular components. The α component has well established trajectory, which proves that the α particles are expelled from nucleus with the same speed. The β component has deviations which vary continuously between two limits, zero and maximum. The behaviour of β radiation is a proof of the existence of the pragmatic neutron y and of its sliding electron. The speed of the sliding electron is a status variable, conditioned by the random events when the neutron y was formed.

5. Nuclear reactions

The nuclear reaction is a physical process where the nucleus A and a nuclear particle *a* interacts and give birth to a nucleus *B* and of a nuclear particle *b*, according to the scheme:

$$A + a \rightarrow B + b \quad \text{or} \quad A\,(a, b)\,B \qquad (31)$$

It is said that A is the target nucleus, *a* is the incident particle, B is the resulting nucleus and b is the emergent particle. In some nuclear reactions the emergent particle can miss and in other can be more that one resulting nuclei and more than one emergent particles.

Nuclear reactions which emit energy are named *exo-energetic* and nuclear reactions which consume energy are named *endo-energetic*. Between exo-energetic reactions there is practical interest for the fission of heavy nuclei and for the fusion of heavy nuclei.

5.1. Examples of nuclear reactions

We comment some nuclear reactions for which we have sufficient experimental data from the traditional theory. We use the pragmatic notation ${}_{Z}^{N}X^{Y}$ for the nucleus but also for the nuclear particles *α, p, y*.

1⁰. We consider the endo-energetic nuclear reaction which brought to the discovery of the neutron by Chandwick:

$${}_{4}^{9}Be^{1} + {}_{2}^{4}\alpha^{0} \rightarrow {}_{6}^{12}C^{0} + {}_{0}^{1}y^{1} \quad \text{and} \quad W = -\,5\text{ MeV} \qquad (32)$$

Chandwick bombarded the nucleus of Beryllium with α particles having a kinetic energy of 5 MeV (emitted by a natural isotope of polonium). The energy W = - 5 Mev represent the consumed energy for smashing the neutron *y* from the nucleus of beryllium (binding energy of the nucleon). We verify the conservation of the numerical indicators Z, N, Y in the two terms of the nuclear reaction from (32): Z = 4 - 2 = 6 + 0 and N = 9 + 4 = 12 + 1 and Y = 1 = 1.

The neutron *y* extracted from the nucleus disintegrates in approximate 15 minutes, releasing the sliding electron, together with the kinetic energy, which remains unknown (unmeasured) in this experience. After measuring the kinetic energy of the electron we will see probably that the reaction (32) is exo-energetic.

2⁰. We consider an exo-energetic nuclear reaction which does not produce an emergent particle:

$${}_{3}^{7}Li^{2} + {}_{1}^{1}p^{0} \rightarrow 2\;{}_{2}^{4}He^{0} \quad \text{and} \quad W = 17{,}2\text{ MeV} \qquad (33)$$

The incident particle *p,* with kinetic energy of approximate (100 – 500) keV, is captured by the target nucleus *lithium* which transforms in *helium* and the emergent particle is missing. The internal energy of the two neutrons (kinetic energy of the sliding electrons) from the lithium nucleus is transferred to the two helium nuclei and is measured W = 17,2 MeV. By neglecting the kinetic energy of the incident particle, it results that the internal kinetic energy of a neutron from lithium is approximate 8,6 MeV.

3^{0}. We consider a last exo-energetic nuclear reaction, tacking into account the comparison of the internal energies of the neutrons:

$${}^{19}_{9}F^{2}+{}^{1}_{1}p^{0}\rightarrow{}^{16}_{8}O^{0}+{}^{4}_{2}\alpha^{0} \qquad \text{and} \qquad W = 6{,}52 \text{ MeV} \qquad (34)$$

The two neutrons from the nucleus of fluorine free the internal energy W and transfer it under the form of kinetic energy to the nucleus of oxygen and to the α particle. It is measured W = 6,52 MeV and it is computed the kinetic energy of the sliding electron from the atom of fluorine W/2 = 3,26 MeV.

4^{0}. *Observations*. The reactions (32), (33), (34) describe relations between nuclei and nuclear particles but do not contain information about energy. The energy W is not a term of the nuclear reaction but a distinct physical measurement and is separately expressed in energy units.

We compare the internal energies of the neutrons of lithium and fluorine from the nuclear reactions (32) and (33) and we see that they are in the ratio 8,6/3,26 $\cong$ 2,63. The result confirms the hypothesis that the neutrons are composed particles and not elementary ones such that the kinetic energies of the sliding electrons are status variables and not physical constants.

The reactions (33), (34) verify the conservation of the indicators Z and N but do not verify the conservation of indicator Y. The two *y* neutrons from the nucleus of lithium and the two neutrons *y* from the nucleus of fluorine are disintegrating and can be found as protons and electrons in the resulting nuclei. The indicator Y from the target nucleus shows that the two reactions (33), (34) are exo-energetic. The internal energy of nuclei (kinetic energy of the sliding electrons) is transferred, through collisions, to the resulting nuclei (and eventually to the emergent particles) under the form of kinetic energy which we name external kinetic energy.

5.2. Nuclear fission

We make distinction between two categories of neutrons which are involved in a reaction of nuclear fission: quick neutrons *and* slow neutrons. Both categories of neutrons have internal kinetic energy ($m_e v_e^2/2$) but the quick neutrons have also external kinetic energy ($m_n v_n^2/2$) of approximate 6 MeV comparing with slow neutrons which have a negligible external energy.

The reaction of nuclear fission develops in three main steps, after one of the schemes [5]:

$${}^{235}_{92}U^{51} + {}^{1}_{0}y^{1} \rightarrow \left({}^{236}_{92}U^{52}\right)_{nc} \rightarrow {}^{140}_{54}Xe^{32} + {}^{93}_{38}Sr^{17} + 3\,{}^{1}_{0}y^{1} \quad \text{and} \quad W = 200 \text{ MeV} \quad (35)$$

or $${}^{235}_{92}U^{51} + {}^{1}_{0}y^{1} \rightarrow \left({}^{236}_{92}U^{52}\right)_{nc} \rightarrow {}^{141}_{56}Ba^{29} + {}^{92}_{36}Kr^{20} + 3\,{}^{1}_{0}y^{1} \quad \text{and} \quad W = 200 \text{ MeV} \quad (36)$$

In the **first step**, the nucleus U 235 captures a slow neutron and becomes an excited nucleus or a composed nucleus $(U\ 236)_{nc}$. The slow neutron, entered in the nucleus, free a part of the internal energy by the collisions of the sliding electron, such that it destabilizes the initial nucleus of uranium.

In the **second step**, according to the principle of minimum energy, the destabilized nucleus randomly fissions in more stable fragments and frees a surplus of kinetic energy of about 200 MeV. The liberated energy is spread as kinetic energy on the fission fragments, which include also three speed neutrons, according to the relations (35), (36). The theory and the experience demonstrates that the quick neutrons appeared after the fission, rapidly pass near the other nuclei and do not fission them because the transfer of energy needs time. The fission process can continue and stabilize only with some technical interventions.

In the **third step**, it is introduced in the path of the neutrons a *moderator* medium formed by light nuclei which, through collisions, take a part of the external kinetic energy of the neutrons. If there is a sufficient quantity of fissionable material (nuclear fuel) a stationary fission process may appear, where the number of produced by the fission are equal with the sum of neutrons needed for a new fission plus the lost neutrons through secondary effects, for instance the ones captured by nuclei which do not produce fission.

Observation. The nuclear reactions (35), (36) confirm the conclusions from the previous subchapter 5.1. The target nucleus U^{52} contain 52 neutrons y, having internal energy, and the resulting nuclei Xe + Sr or Ba + Kr contain only 49 neutrons y, having internal energy. The internal energy of the neutrons from the target nucleus U^{52} is transferred to the resulting nuclei but also to the emergent particles which are neutrons y.

5.3. Nuclear fusion

Modern physics sustains two hypotheses for fusion in order to obtain energy: 1) synthesis of a heavy nucleus from two nuclear particles or from two light nuclei and 2) synthesis of a nucleus from elementary and nuclear particles. The modern physics sustains that nuclear fusion can be achieved through annihilation of elementary particles. We describe below the pragmatic fusion by synthesis but in chapter 6 we demonstrate that fusion by annihilation is an utopia.

Below two possible fusion reactions by **nuclear synthesis**:

$$2\,{}^{1}_{0}y^{0} + 2\,{}^{1}_{1}p^{0} \rightarrow {}^{4}_{2}\alpha^{0} \qquad \text{and} \qquad 2\,{}^{2}_{1}H^{1} \rightarrow {}^{4}_{2}He^{0} \qquad (37)$$

The first relation (37) describes the synthesis of the α particle through fusion of two neutrons and two protons. The second relation (37) describes the synthesis of the helium nucleus (α particle) through the fusion of two isotopes of hydrogen (deuterons). In both reactions, two neutrons are disintegrating in protons and electrons, in order to form the composed α particle. The process of synthesis is based on two principles: the principle of minimum energy and the principle of energy conservation. Based on the principle of minimum energy is formed the α particle with minimal internal energy (internal kinetic energy is null). Based on the principle of energy conservation, the α particle becomes mobile (external kinetic energy is different than zero) because it absorbed the kinetic energy of the sliding electrons.

6. Comments to the traditional physics

In chapter 3 we encountered anomalies in the quantum theory of elementary particles and in chapter 5 we reminded about the relativistic mass defect. We comment the anomalies from the quantum theory and the utopia interpretation of the „mass defect" and we present finally some conclusions for the entire article.

6.1. „Anomalies" in the quantum physics

1⁰. Determination of the quantum number of spin of electron starts with errors of classical mechanics and electrodynamics. The quantum physics considers that the last relation (9) must be analogue with the last relation (7) and proposes:

$$\frac{\mu_s}{L_s} = \frac{1}{2}\frac{e}{m} \quad \text{and} \quad \frac{\mu_s}{L_s} = g\frac{1}{2}\frac{e}{m} \qquad (38)$$

The experimental results infirm the first relation (38), proposed by quantum physics and confirms the last relation (9), demonstrated by us with the laws of classical mechanics and electrodynamics. In order to overpass this bottleneck, the quantum mechanics invents a new notion: the last relation (9) is „*anomalous"* because it is in contradiction with the quantum theory. The un-normal relation from (9) shall be replaced with the last relation (38) which is analogous with the last relation from (7). The coefficient g from the relation (38) is a coefficient of correction (Landé), which is established experimentally with great accuracy $g \cong$ 2,oo2 319 304 373. With this semi-empirical solution, the quantum theory arrives at the last relation (7) which is correct but the comments which follow are confusing.

After this experimental correction, the theorists of quantum physics find out that the quantum number of spin of the electron is ½ instead of being an integer number (a number of order). This small anomaly is over passed easily because the number ½ can be considered a semi-integer number. After noticing that the speed of electron spin overpasses the speed of light in vacuum, it is concluded that: electron spin is of pure quantum origin and it should be not tried to find a classic analogy.

Our explanation regarding the electron of quantum origin and regarding semi-integer order numbering is simple. The last relation (9) cannot be demonstrated by analogy with the last relation (7) because the physical models are not similar. The last relation (7) is demonstrated for an idealized electron, without geometrical dimensions, and the last relation (7) is demonstrated for a clear object, an electron with a finite radius.

2^0. The spin moments of the elementary particles, proton and electron, have two values in the traditional theory: *theoretical values*, according with the quantum physics and experimental values which are named *anomalies* because they sensible differ from the theoretical ones.

3^0. The traditional neutron is considered elementary particle with zero electrical charge and this is why it is not justified the existence of the magnetic moment of spin. The experimental result from the first relation (23) is anomaly because does not correspond with the quantum theory of spin moments.

6.2. Mass defect utopia

We start from two relativistic relations which express the relativistic kinetic energy and relativistic mass

$$E = m c^2 \qquad \text{and} \qquad m = \frac{m_0}{\sqrt{1 - v^2/c^2}} \qquad (39)$$

One of the relations (39) is admitted as postulate and the other is demonstrated as theorem with the help of general definitions of kinetic energy E and of the moment p:

$$dE = v\, dp \qquad \text{and} \qquad p = mv \qquad (40)$$

Einstein sustains that the relativistic mechanics is more general than the classical mechanics and considers that the relations of relativistic mechanics shall be reduced to the relations of classical mechanics in the particular case which v/c approaches zero. By considering v = 0 in the relations (39), Einstein obtains $E_0 = m_0 c^2$ instead of $E_0 = 0$ according to classical theory. In order to get out of the impasse, Einstein enounces the *principle of correspondence* (or of the conjectural adjustment) for which the relativistic kinetic energy is not expressed with the relation $E = mc^2$ but with the relations:

$$\Delta E = \Delta m\, c^2 \qquad \text{and} \qquad \Delta m = m - m_0 \qquad (41)$$

For v/c <<1, it is developed in series the square from (39) and is admitted the approximation m $\cong m_0\left(1+\left(v^2/c^2\right)/2\right)$. With the last relation can be expressed Δm = m – m_0 and from the first relation (41) it results ΔE $\cong$ m_0 $v^2/2$. The relations (41) are generalized for the calculus of binding energy for the nucleons:

$$\Delta W = \Delta m\, c^2 \qquad \text{and} \qquad \Delta m = m_1 - m_2 \qquad (42)$$

With the last relation (42) is computed the difference Δm between the masses m_1 and m_2 of the two terms A + a and B + b from the nuclear reaction of form (31). With the first relation (42) is calculated the energy ΔW, expelled or absorbed by the studied nucleus. If the emergent particle *b* is composed of N nucleons (protons or neutrons), it is calculated the binding energy per nucleon ΔW/N.

Numerical example 3. We apply relations (42) for the nuclear reaction (33) and we calculate:

Δm = m_{Li} + m_H – m_{He} =7,016005 + 1,007825 - 2·4,oo2604 = 0,0018622 u.a.m.

Δw = 0,018622·931,481 MeV = 17,346 MeV

The calculated energy 17,346 MeV by using the relativistic mass defect corresponds well with the measured energy 17,2 MeV in the nuclear reaction (33). We found that the result W = 17,346 MeV is acceptable also for the pragmatic theory because it is well between the large limits of the kinetic energy of the sliding electron from the numerical example number 2.

The numerical results are acceptable although the relations (42) written by generalisation is not a convincing demonstration. The relations (43) differ from the relations (41) from two reasons: 1) ΔE is the increase of kinetic energy and ΔW is the increase of total energy, kinetic and potential and 2) Δm from (41) is the difference between the relativistic mass *m* and the rest mass m_0 and Δm from (42) is the difference between the two masses on rest m_1 and m_2.

We are in curios situation: the analytical demonstration is questionable but the numeric results are acceptable. The explanation has to be searched in the way how the nuclear masses are measured in order to calculate the relativistic mass defect. The measurement instrument the mass spectrometer which measures the ratio $k_0 = m_0/q_0$ of the studied nucleus and then calculates the mass $m_0 = k_0\, q_0$ in the hypothesis that the electrical charge q_0 is given.

Let's see for instance, the configuration of the nucleus of helium (α particle from Fig. 1). Without an exact calculus of the electrostatic field, we found that the two electrons, with electrical charge q_e = - 2e, are shielded by the four protons with electrical charge q_p = +4e. The measurement equipment does not „see" the exact electrical charge of the particle q_α = +2e but see an apparent charge which is more than +2e. As a consequence, the ratio k is smaller than the exact ratio k_0 and the calculated mass m = k q_0 is smaller than the mass $m_0 = 4m_p + 2m_e$. As a consequence, the mass defect does not exist in reality but is an apparent result, caused by the configuration of the elementary particles from the studied nucleus.

3^0.Completare la pagina 21. Despre măsurarea masei neutronului

We comment a relativistic interpretation of the physical measurements from the relations (40). Einstein considers successively v = 0 and then $c = 1$ and obtain: $E_0 = m_0 c^2$ and then $E_0 = m_0$. The last result is commented as follows: „ *… the energy of a body on rest is equal with its mass. Mass and energy are therefore of the **same essence**, meaning that they are only different forms of manifestation of **the same thing**.* after [7], page 58. Our conclusion is obvious: ***Einstein mixes up the physical means with their numerical values.***

In the pragmatic theory of the physical means, each relation between physical means is expressed in two forms, one implicit and one explicit, for instance:

$$E = m c^2 \quad \text{and} \quad E =\approx m c^2 \qquad (43)$$

The sign $=\approx$ from the explicit relation is read as equal- equivalent and refers at the two aspects of a physical mean: quantitative aspect (the numeric value or measure) and the qualitative aspect (physical dimension or measurement unit). For our example, we consider $E =\approx E_v E_u$ and $m =\approx m_v m_u$ and $c =\approx c_v c_u$, where E_v, m_v, c_v are numerical values, and E_u, m_u, c_u are measurement units. From the explicit relation (45) results two associate relations: the relation of equality for numerical values and the relation of equivalence for the measurement units:

$$E_v = m_v c_v^2 \qquad E_u \approx m_u c_u^2 \qquad (44)$$

The numerical value c_v can be equal with the unit, $c_v = 1$, if we choose the measurement units for this reason, for example: 1 second for the unit of time and $3\cdot10^8$ meters for the unit of length. The relation of equality between the quantities (numeric values) from (46) becomes $E_v = m_v$, but the relation of equivalence between the qualities (measurement units) remains unchanged $E_u \approx m_u c_u^2$.

7. Conclusions

The paper deals with two topics of fundamental research in the theory of physics and proposes pragmatic solutions for the calculus of nuclear forces and for the identification of the nuclear energy

The paper continues the works of pragmatic physics [1], [2] which proposed solutions to eliminate the relativistic and quantitative utopias with one exception> It remained one question without an answer: "What is the nuclear energy after eliminating the mass defect from the Einstein relativistic theory ?". This article gave the answer at the question and unveils the theoretical and experimental errors which allowed the mass defect utopia. Generally, the pragmatic theory is confirmed by experimental results of the traditional physics and unveils the fundamental errors of the relativistic and quantum theories.

The solutions to the proposed topics, the calculus of the nuclear forces as gravitational forces of high order and the identification of nuclear energy as kinetic energy of the sliding electron, opened the path towards deterministic studies in the nuclear physics. There still much to do in the study of the stability of atomic nuclei because the problem cannot be generally treated. Each class of nuclei has special situations and start with the arrangement of elementary and nuclear particles in atoms and molecules.

Recent scientific research [6] and the obtained results suggest the study of nuclear fusion in two variants: 1) hot nuclear fusion and 2) cold nuclear fusion.

Hot nuclear fusion or *thermonuclear synthesis* is an old research subject of traditional physics which brought results in the .. hydrogen bomb but did not gave results in the production of energy for peaceful targets. Some physicists sustain that the thermonuclear synthesis will bring results when the terrestrial laboratories will reproduce the relativistic and quantum phenomenon which are produced in the Sun.

Cold nuclear fusion or the modern alchemy is a recent research theme, empirical and non-conventional, which gave some promising results in laboratories. The cold fusion is rejected by modern physics because it is not theoretically justified. We consider that the cold nuclear fusion can be theoretically justified inside the pragmatic physics as we will demonstrate in a future article.

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