Vortex-ring-fractal Structure of Atom and molecule

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Abstract. This chapter is an attempt to attain a new and profound model of the nature's structure using a vortex-ring-fractal theory (VRFT). Scientists have been trying to explain some phenomena in Nature that have not been explained so far. The aim of this paper is the vortex-ring-fractal modeling of elements in the Mendeleev's periodic table, which is not in contradiction to the known laws of nature. We would like to find some acceptable structure model of the hydrogen as a vortex-fractal-coil structure of the proton and a vortex-fractal-ring structure of the electron. It is known that planetary model of the hydrogen atom is not right, the classical quantum model is too abstract. Our imagination is that the hydrogen is a levitation system of the proton and the electron. Structures of helium, oxygen, and carbon atoms and a hydrogen molecule are presented too.

Keywords: model of atoms, covalent bond, vortex-ring-fractal structures
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INTRODUCTION

The electrical force decreases inversely with the square of distance between charges. This relationship is called Coulomb's law. There are two kinds of "matter", which we can call positive and negative. Like kinds repel each other, while unlike kinds attract – unlike gravity, where only attraction occurs [8]. When charges are moving the electrical forces depend also on the motion of charges in a complicated way [1].

Fractals seem to be very powerful in describing natural objects on all scales. Fractal dimension and fractal measure are crucial parameters for such description. Many natural objects have self-similarity or partial-self-similarity of the whole object and its part [3].

Most of our knowledge of the electronic structure of atoms has been obtained by the study of the light given out by atoms when they are exited. The light that is emitted by atoms of given substance can be refracted or diffracted into a distinctive pattern of lines of certain frequencies and create the line spectrum of the atom.

The careful study of line spectra began about 1880. The regularity is evident in the spectrum of the hydrogen atom. The interpretation of the spectrum of hydrogen was not achieved until 1913. In that year the Danish physicist Niels Bohr successfully applied the quantum theory to this problem and created a model of hydrogen. Bohr also discovered a method of calculation of the energy of the stationary states of the

hydrogen atom, with use of Planck's constant *h*. Later in 1923 it was recognized that Bohr's formulation of the theory of the electronic structure of atoms to be improved and extended. The Bohr theory did not give correct values for the energy levels of helium atom or the hydrogen molecule-ion H_2^+, or of any other atom with more than one electron or any molecule.

During the two-year period 1924 to 1926 the Bohr description of electron orbits in atoms was replaced by the greatly improved description of wave mechanics, which is still in use and seems to be satisfactory. The discovery by de Broglie in 1924 that an electron moving with velocity v has a wavelength $\lambda=h/m_e v$ [2]. The theory of quantum mechanics was developed in 1925 with the German physicist Werner Heisenberg. Early in 1926 an equivalent theory, called wave mechanics, was independently developed by Austrian physicist Ervin Schroedinger. Important contributions to the theory were also made by the English physicist Paul Adrien Maurice Dirac. The most probable distance of the electron from the nucleus is thus just the Bohr radius r_B (r_o); the electron is, however, not restricted to this distance. The electron is not to be thought of as going around the nucleus, but rather as going in and out, in varying directions, so as to make the electron distribution spherically symmetrical [2].

Matter is composed of tiny atoms. All the atoms of any elements are identical: they have the same mass and the same chemical properties. They differ from the atoms of all other elements. Twenties-century X-ray work has shown that the diameters of atoms are of the order 0.2 nm ($2x10^{-10}$ m). The mass and the positive charge are concentrated in a tiny fraction of the atom, called nucleus. The nucleus consists of protons *(p)* and neutrons *(n)*. Protons and neutrons are made up of smaller subatomic particles, such as quarks. Both protons and neutrons have a mass approximately 1840 times greater than an electron *(e)*. The more energy an electron has, the further it can escape the pull of the positively charged nucleus. Given sufficient energy, an electron can jump from one shell to higher one. When it falls back to a lower shell, it emits radiation in the form of photons.

Main ideas and differences between a classical and a new vortex-ring-fractal (VRF) model are presented on Fig.1.

THE SPIN OF THE ELECTRON

It was discovered in 1925 that the electron has properties corresponding to its spin *S*. It can be described as rotating about an axis of a ring structure of the electron (see Fig.1 and Fig.7) [7]. The spin of the electron is defined as angular momentum [8], [28]:

$$\vec{S} = m_e(\vec{r}_e \times \vec{v}_e) \tag{1}$$

For the spin on axis z:

$$S_z = N\frac{m_e}{N} r_e \bar{v}_e \tag{2}$$

where m_e is the mass of the electron, r_e is the radius of the electron and N is number of substructures inside the structure of the electron. In [8] the formulae for radius r_e of the electron are:

$$\bar{r}_e = \frac{e^2}{8\pi^2 \varepsilon_0 m_e} \cdot \frac{1}{\bar{v}_e^2} \tag{3}$$

$$\bar{v}_e = \bar{v} = \pm \frac{2}{\pi} v_{me} = \pm \frac{2}{\pi} v_m \tag{4}$$

$$v_m = \frac{e^2}{4\varepsilon_0 h} \tag{5}$$

where $\bar{r}_e$ is mean radius, $\bar{v}$ is mean velocity of the electron [8], $\bar{v}_e$ is mean velocity of the subelectron, v_m is maximum translation velocity of the electron and v_{me} is maximum velocity of the subelectron ^{-1}e (maximum rotational velocity of the electron) if the electron has distance d_o (see Fig.2 and Fig.8) and minimum energy E_{qo} , see Eq. 33 or [8].

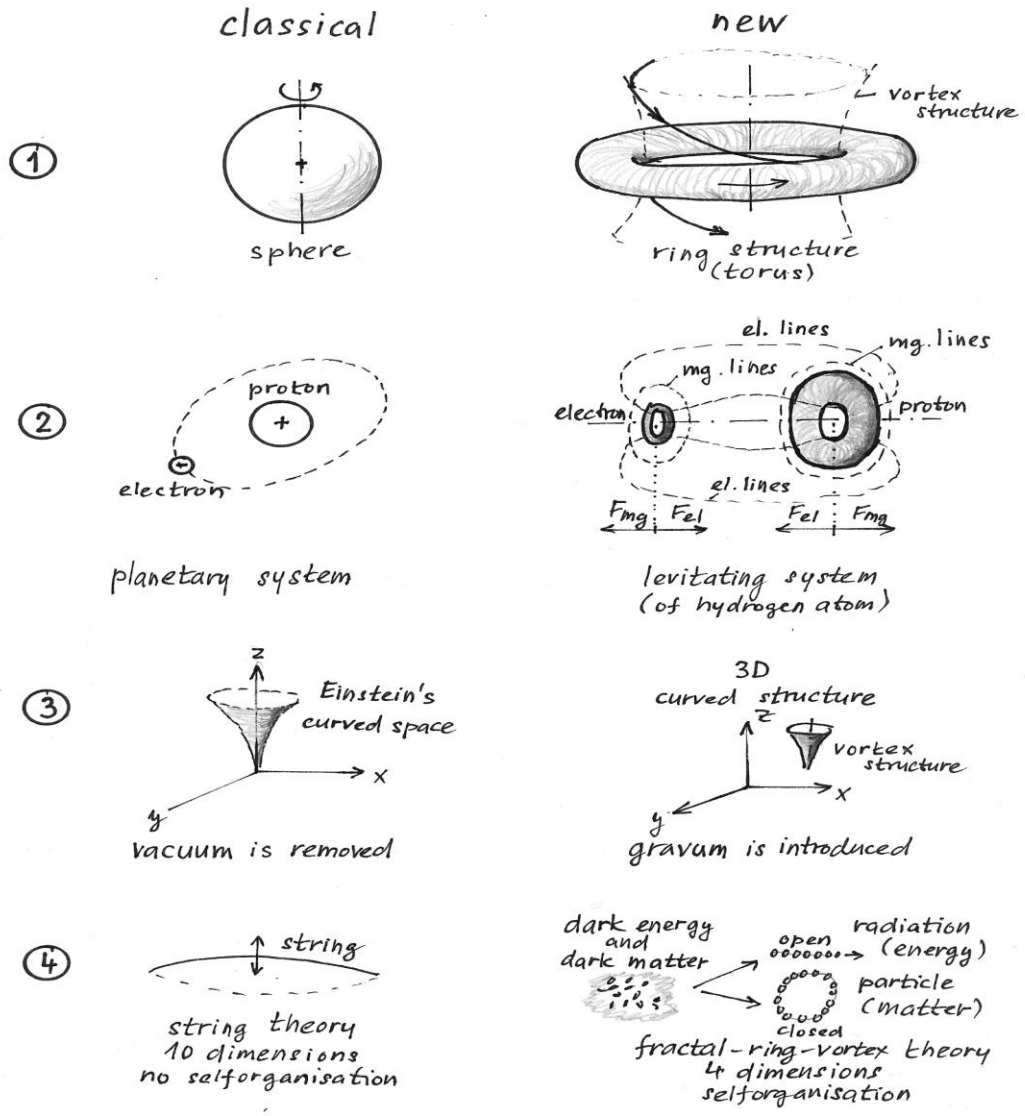


FIGURE 1. Four main ideas and differences between a classical and new VRF model

ean radius $\bar{r}_e$ is:

$$\bar{r}_e = \frac{e^2}{8\pi^2\varepsilon_0 m_e}\cdot\frac{\pi^2}{4v_m^2} = \\ = \frac{e^2}{8\varepsilon_0 m_e}\cdot\frac{1}{4v_m^2} = \\ = \frac{e^2}{32\varepsilon_0 m_e}\cdot\frac{16\varepsilon_0^2 h^2}{e^4} = \frac{\varepsilon_0 h^2}{2m_e e^2} = \frac{d_o}{2} \tag{6}$$

The spin S_z on axis z: $S_z = m_e\bar{v}_e\bar{r}_e = \pm m_e\frac{2}{\pi}v_m\bar{r}_e =$

$$= \pm m_e\frac{2}{\pi}\cdot\frac{e^2}{4\varepsilon_0 h}\cdot\frac{\varepsilon_0 h^2}{2m_e e^2} = \\ = \pm\frac{1}{2}\cdot\frac{h}{2\pi} = \pm\frac{1}{2}\hbar = m_s\hbar \tag{7}$$

where

$$m_s = \pm\frac{1}{2} \tag{8}$$

The result in (8) is in coincidence with the generally equation for the spin, where m_s is spin quantum number [8].

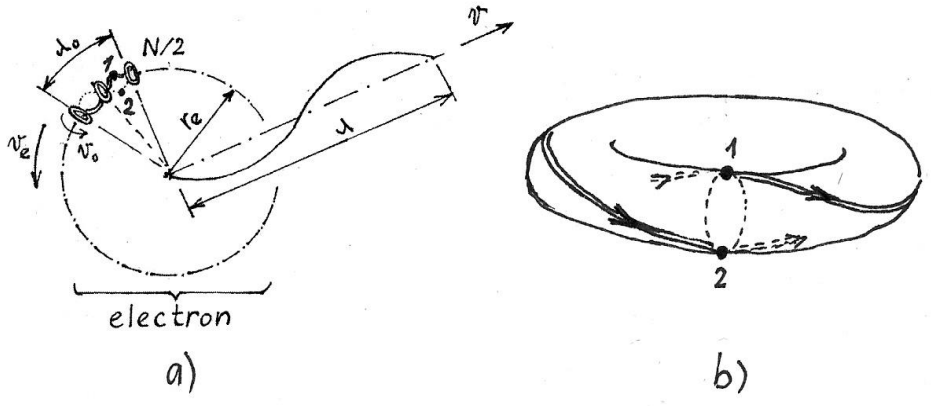


FIGURE 2. The electron that is moving with velocity *v* has a wavelength $\lambda=h/m_e v$
a) Relation between λ and λ_o in the fractal-ring structure of the electron,
b) An inner ring of the electron with spin quantum number: 1/2 (twice around annuloid to match).

The electron on Fig.2 is the 21-multiple "double-helix-line" structure (here only one "double helix" with markers 1, 2.

We can suppose that a fractal structure of the electron has wavelength $\lambda = N\lambda_o$ (see Fig.2a):

$$2\pi r_e = \lambda_o\frac{N}{2} = \frac{\lambda}{N}\cdot\frac{N}{2} = \frac{\lambda}{2} \tag{9}$$

or from Fig.2b

$$2 \cdot 2\pi r_e = \lambda \qquad r_e = \frac{\lambda}{4\pi} \tag{10}$$

where N is number of subparts (for example: number of subelectrons). Eq.7 with Eq.10 lead to:

$$|S_z| = m_e|\bar{v}_e|r_e = \frac{1}{2}\cdot\frac{h}{2\pi} = N\cdot\frac{m_e}{N}\cdot|\bar{v}_e|\cdot r_e =$$
$$= N\cdot\frac{m_e}{N}\cdot|\bar{v}_e|\cdot\frac{\lambda}{4\pi} \tag{11}$$

$$\lambda = \frac{h}{m_e|\bar{v}_e|} = N\cdot\lambda_o = \frac{h}{m_e|\bar{v}|} = \pm\frac{h}{m_e\bar{v}} \tag{12}$$

$$\bar{v}_e = \bar{v} \tag{13}$$

It can be an explanation of de Broglie's equation for a wavelength $\lambda=h/mv$ because we suppose that the electron energy E_t of translation movement is the same as the rotational energy E_r of the rotating electron [8].

MODEL OF HYDROGEN ATOM

In a new model of the hydrogen atom with a levitating electron [7], [8] there is attractive (electric) force F_+ and (magnetic) repellent force F_- :

$$F = F_+ - F_- = \frac{e^2}{4\pi\varepsilon_o}\left(\frac{1}{d^2} - \frac{d_o^2}{d^4}\right) \tag{14}$$

The hydrogen atom can have the electron on left side or on right side (see Fig.5a, 5b). The attractive force F_+ is Coulomb's force. The repellent force F_- is caused with magnetic fields of the proton and the electron (see Fig.3). A distance between the electron and the proton is d in Eq.14. The electron moves as "Yo-Yo" (see Fig. 4)

The Bohr radius r_B (or r_o) has the same size as the distance $d_o \approx 5.29\cdot10^{-11} m$ [2] in our vortex-fractal-ring model [8].

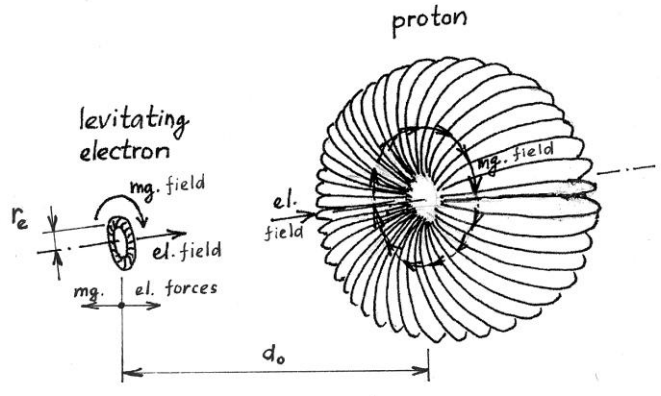


FIGURE 3. The levitating electron in the field of the proton (the fractal structure model of hydrogen **H** is simplified [8]).

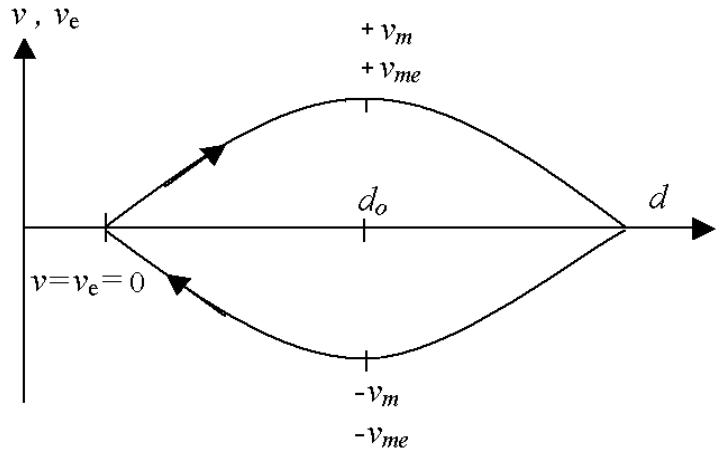


FIGURE 4. Displacement velocity v and rotation velocity v_e of the electron on Fig.3

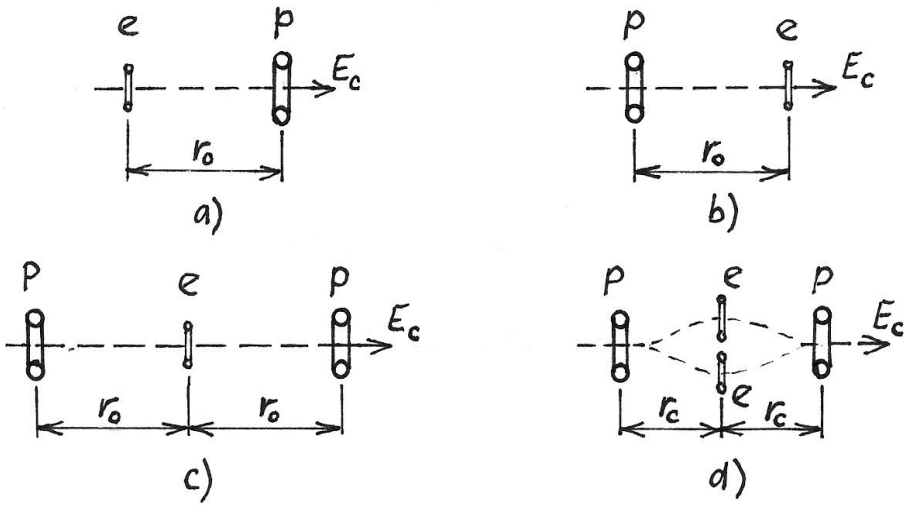


FIGURE 5. Distances $d_o = r_o$ between proton and electron [8]
a) left side orientation of hydrogen
b) right side orientation of hydrogen
c) the hydrogen molecule-ion H_2^+
d) the hydrogen molecule H_2 with covalent bond

To calculate quantum model of hydrogen we use radius r_e of the electron, which was derived in [8]:

$$r_e = \frac{\mu_o e^2}{4\pi^2 m_e} \frac{v_o^2}{v_e^2} \tag{15}$$

for $$v_o = \frac{c}{\sqrt{2}}$$

$$v_o^2 = \frac{c^2}{2} = \frac{1}{2\varepsilon_o \mu_o} \tag{16}$$

$$r_e = \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{v_o^2}{v_e^2} = \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{c^2}{2v_e^2} = = \frac{e^2}{8\pi^2 \varepsilon_0 m_e} \cdot \frac{1}{v_e^2} \qquad (17)$$

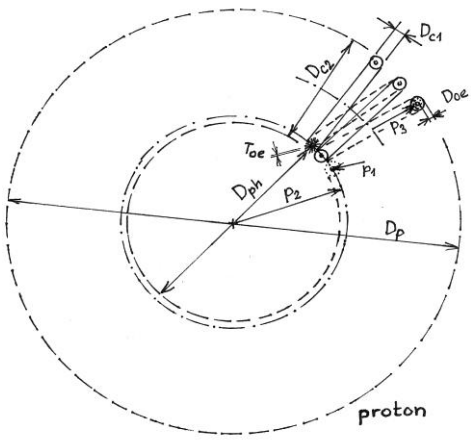


FIGURE 6. Vortex-fractal structure of the proton [8]

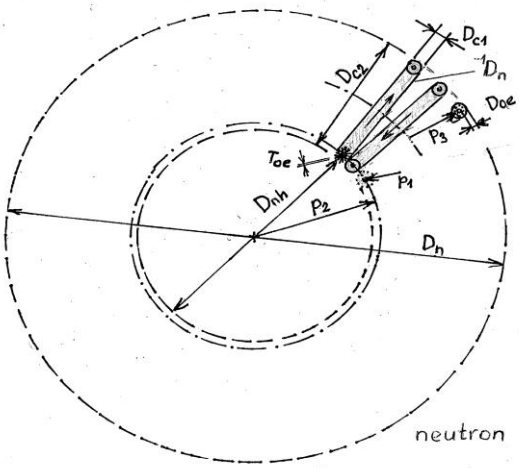


FIGURE 7. Vortex-fractal structure of the neutron [8]

STRUCTURE OF ELECTROMAGNETIC FIELD

Electric lines or rays with different substructures (positron and electron substructures) repel each other (see Fig.9). The same types of substructures (lines) attract each other and create braids. The same behavior has magnetic field - magnetic lines or rays with electron and positron substructures repel each other (see Fig.10). Electric lines are formed from electron subparts (^{-4}e) or/and positron subparts $(^{-4}\upsilon)$. Magnetic lines are formed from electron subparts (^{-3}e) or/and positron subparts $(^{-3}\upsilon)$. Electric lines or rays are perpendicular to magnetic lines or rays. The ray is a "braid" of lines (see Fig.9).

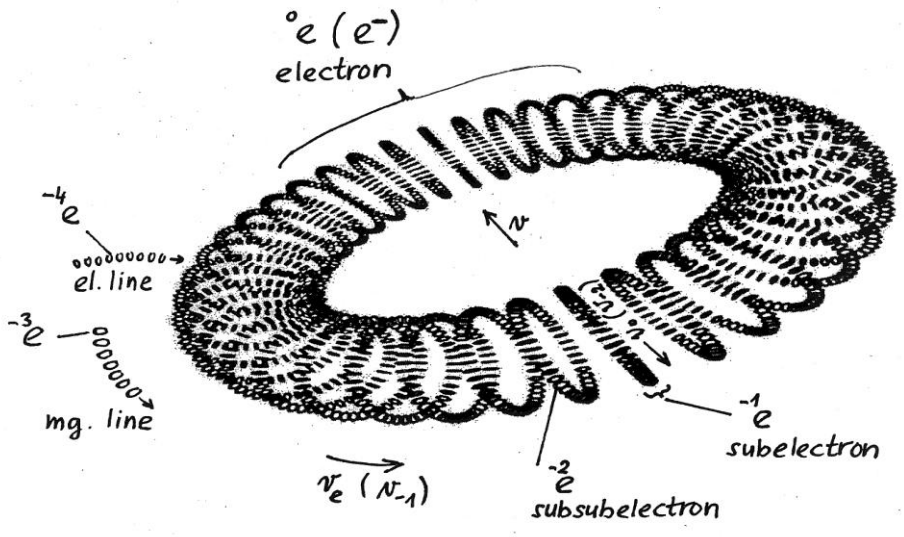


FIGURE 8. Vortex-fractal ring structure of the electron [8]

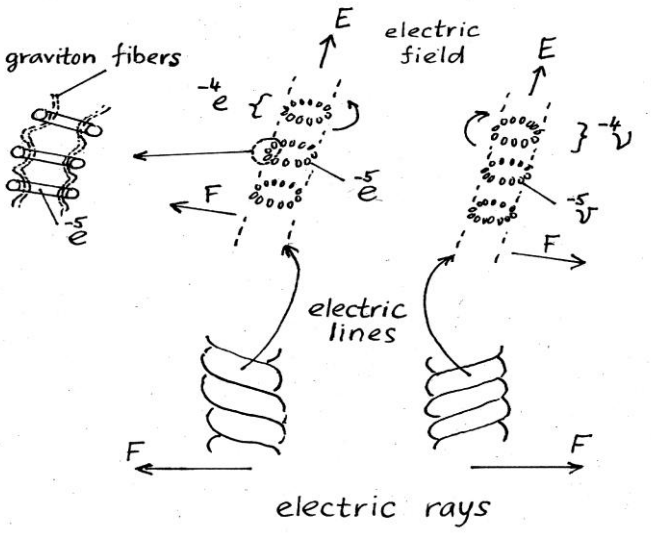


FIGURE 9. Structure of the electric field

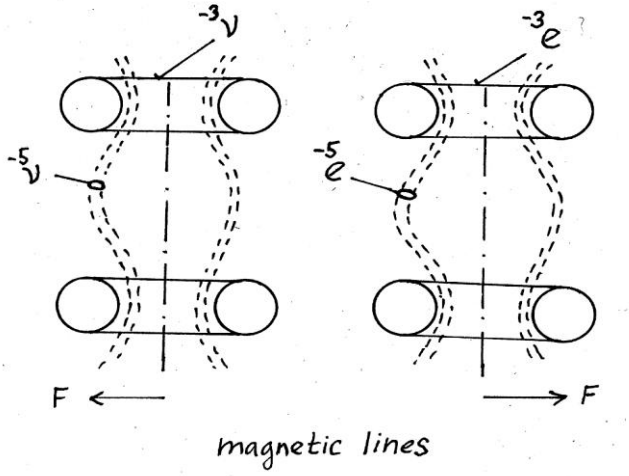


FIGURE 10. Structure of the magnetic field

Energy E_o of the quite and free electron ${}^{0}e$ [8], which has velocity $v=0$ and quite mass m_{eo}, can be calculated from kinetic energy of their subparts: subelectrons ${}^{-1}e$ with velocity v_{-1} (v_e), subsubelectrons ${}^{-2}e$ with velocity v_{-2} (v_o), subsubsubelectrons ${}^{-3}e$ with velocity v_{-3}, subsubsubsubelectrons ${}^{-4}e$ with velocity v_{-4} , and subsubsubsubsubelectrons ${}^{-5}e$ with velocity v_{-5} (see Fig.13):

If velocities of substructures are [7], [8]:

$$v = v_e = 0 \qquad v_o = v_{-3} = v_{-4} = v_{-5} \approx \frac{c}{\sqrt{2}} \tag{18}$$

then their inner kinetic energy is:

$$E_o \approx \frac{1}{2}\frac{m_{eo}}{N^2} v_o^2 N^2 + \frac{1}{2}\frac{m_{eo}}{N^3} v_{-3}^2 N^3 + \\ + \frac{1}{2}\frac{m_{eo}}{N^4} v_{-4}^2 N^4 + \frac{1}{2}\frac{m_{eo}}{N^5} v_{-5}^2 N^5 = m_{eo} c \tag{19}$$

$$E_o \approx m_{eo}c^2 \tag{20}$$

This result is in coincidence with the well-known Einstein's law. Mass is a measure of the amount of matter in an object. The object's inertia is proportional to its mass, and Einstein showed that mass is actually a very compact form of energy.

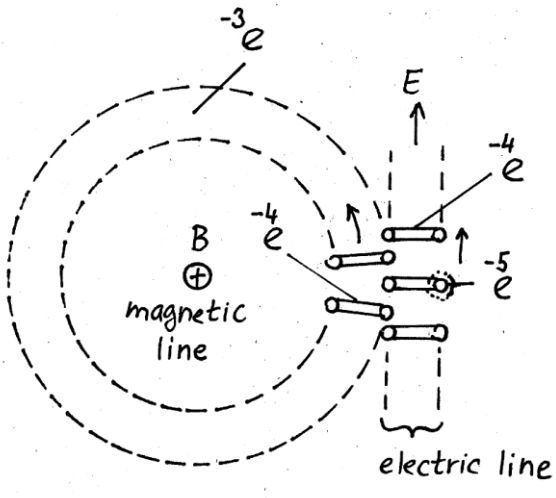


FIGURE 11. Structure of the electromagnetic field (the electric line is perpendicular to the line is perpendicular to the magnetic line)

Figure 11 explains a particle structure of the photon and a wave behavior of the light ray, which consists from more photons arranged in the series (sequence, string). A vortex pair is created from "bath" vortex V_B an a "tornado' vortex V_T with flow of energy E [8], [19], [23], [24].

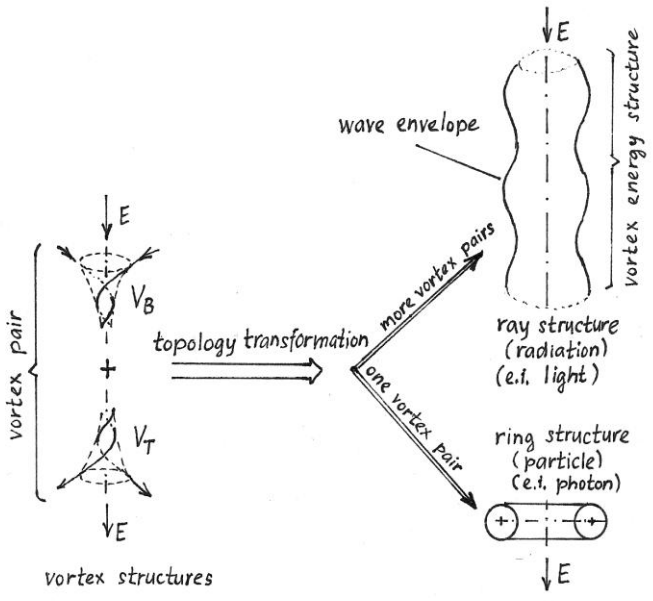


FIGURE 12. Structure of light as a ring particle or a wave energy structure

QUANTUM MODEL OF HYDROGEN

To calculate a quantum model of hydrogen we use radius re of the electron, which was derived in [8]:

$$r_e = \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{v_o^2}{v_e^2} \tag{22}$$

$$2\pi r_e = 2\pi \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{v_o^2}{v_e^2} \tag{23}$$

Let us assume that [18]:

$$v_o^2 = \frac{c^2}{2} = \frac{1}{2\varepsilon_o \mu_o} \tag{24}$$

On a circumference of a circle with r_e (see Fig.2) have to be n of a half-wavelength (9): $\lambda/2=h/2m_e v$ (n is quantum number) [8]:

$$2\pi r_e = 2\pi \frac{\mu_o e^2}{4\pi^2 m_e} \frac{v_o^2}{\bar{v}_e^2} = \frac{\mu_o e^2}{2\pi m_e} \frac{c^2}{\bar{v}_e^2} = \frac{e^2}{4\pi\varepsilon_o m_e} \frac{1}{\bar{v}_e^2} =$$

$$= n\frac{\lambda}{2} = n\frac{1}{2}\frac{h}{m_e \bar{v}_e} = n\frac{1}{2}\frac{h}{m_e \bar{v}} \tag{25}$$

$$\frac{e^2}{2\pi\varepsilon_o} \frac{1}{\bar{v}_e} = nh \tag{26}$$

$$\frac{e^2}{2\pi\varepsilon_o} \frac{\pi}{2v_m} = nh \tag{27}$$

where v_m is maximum velocity of the electron if the electron has distance d_o and minimum energy E_{qo} [8]:

$$v_{mn} = \frac{1}{n} \frac{e^2}{4\varepsilon_o h} \tag{28}$$

Energy E_t of translation movement of the electron is:

$$E_t = \frac{1}{2} m_e v_m^2 = \frac{1}{n^2} \frac{m_e e^4}{16\varepsilon_o^2 h^2} \tag{29}$$

Energy E_r of rotation of the electron is due to a maximal symmetry in the multiple double-helix structure of the electric field has the same size as energy E_t of translation movement. Total energy E_q of rotating and moving electron is:

$$E_q = E_t + E_r =$$

$$= 2E_t = \frac{1}{n^2} \frac{m_e e^4}{8\varepsilon_o^2 h^2} \tag{30}$$

For quantum number $n=1$

$$E_{qo} = \frac{m_e e^4}{8\varepsilon_o^2 h^2} \approx 13.6eV \tag{31}$$

$$E_{qo} = E_o \frac{3}{4} = \frac{e^2}{6\pi\varepsilon_o}\frac{1}{d_o}\frac{3}{4} = \frac{e^2}{8\pi\varepsilon_o}\frac{1}{d_o} \approx 13.6eV \tag{32}$$

$$E_{qo} = \frac{m_e e^4}{8\varepsilon_o^2 h^2} = \frac{e^2}{8\pi\varepsilon_o}\frac{1}{d_o} \tag{33}$$

$$d_o = \frac{\varepsilon_o h^2}{m_e e^2} \approx 5.29 \cdot 10^{-11} m \tag{34}$$

It is the same result as Bohr obtained [2] but with quite different hydrogen model.

$$d = n^2 \frac{\varepsilon_o h^2}{m_e e^2} = n^2 \cdot 2\bar{r}_e \tag{35}$$

where $\bar{r}_e$ is radius of the free electron and can be calculated following way:

$$\bar{r}_e \approx N^{2\cdot -2} r_e = \frac{\mu_o e^2}{4\pi^2 m_e} = 0.89 \cdot 10^{-15} m \tag{36}$$

where ${}^{-2}r_e$ is the radius of osmeron ${}^{-2}$e which is almost constant comparing it with radius r_e of the electron (see Fig.19):

$${}^{-2}r_e = \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{v_{-2}^2}{v_{-3}^2} \cdot \frac{1}{N^2} = \frac{\mu_o e^2}{4\pi^2 m_e} \cdot \frac{1}{N^2} = 0.50 \cdot 10^{-18} m \tag{37}$$

where $v_{-2}^2 = v_{-3}^2 = \frac{c}{\sqrt{2}}$ and $N = 42$

For quantum number n=1 we calculate the maximum velocity v_m from Eq.28 and the couple constant α is:

$$v_m = \frac{e^2}{4\varepsilon_o h} \tag{38}$$

$$\frac{c}{2v_m} = \frac{2\varepsilon_o hc}{e^2} = \frac{1}{\alpha} \approx 137.036 \tag{39}$$

In the hydrogen molecule H_2 the covalent bond has $n_e = 2$, $n_p = 1$ (see Fig.5d):

$$F = F_+ - F_- = \frac{e^2}{4\pi\varepsilon_o}\left(\frac{n_e n_p}{d^2} - \frac{d_o^2}{d^4}\right) \tag{40}$$

$$F = \frac{e^2}{4\pi\varepsilon_o}\left(\frac{2}{d^2} - \frac{d_o^2}{d^4}\right) = 0 \tag{41}$$

$$d_c = \pm\frac{d_o}{\sqrt{2}} \approx \pm 3.75 \cdot 10^{-11} m \tag{43}$$

$$d_{cp} = 2d_c \approx 7.5 \cdot 10^{-11} m \tag{44}$$

It is in coincidence with the distance between two protons for their covalent bond [22-29]. For the hydrogen molecule-ion H_2^+ is $n_e = 1$, $n_p = 1$ then d_{p+} (see Fig.5c)

$$: \qquad d_{p+} = 2r_o \approx 10.6 \cdot 10^{-11} m \tag{45}$$

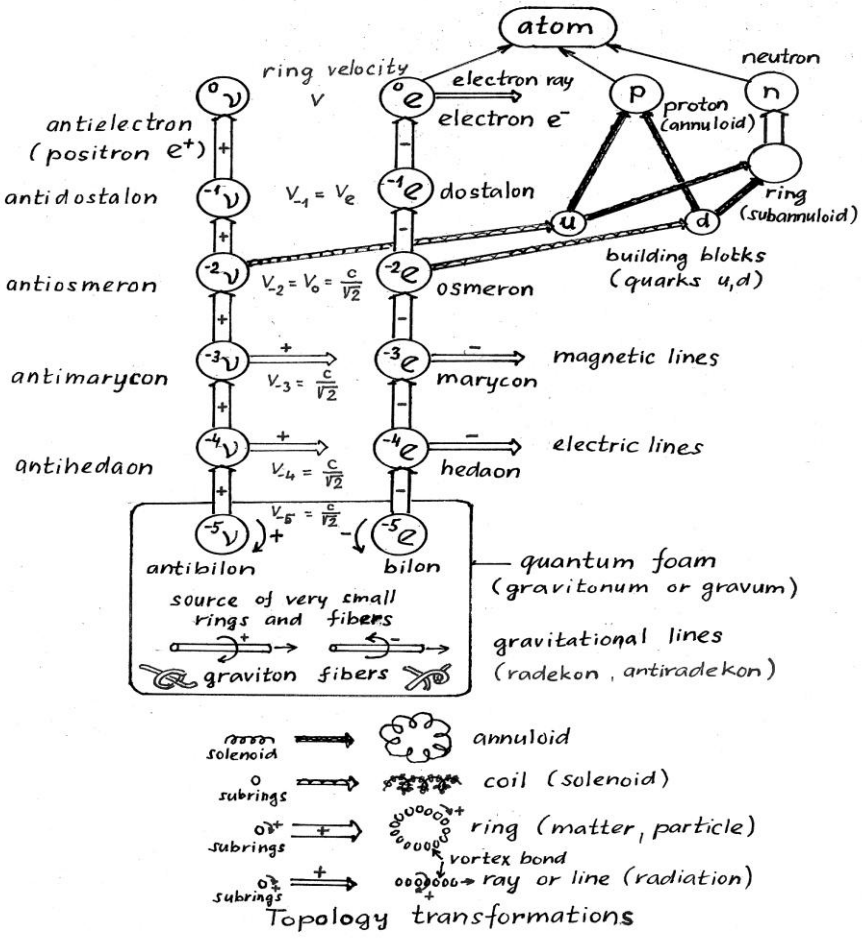


FIGURE 13. Fractal-ring structure of Universe (ring theory) [5], [6], [8]

EXAMPLES OF NUCLEUS STRUCTURES

In the next figures the protons are the black rings, the neutrons are the grey rings.

FIGURE 14. Structure of helium nucleus (alpha particle) [12]

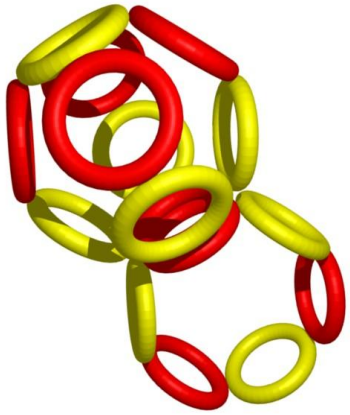
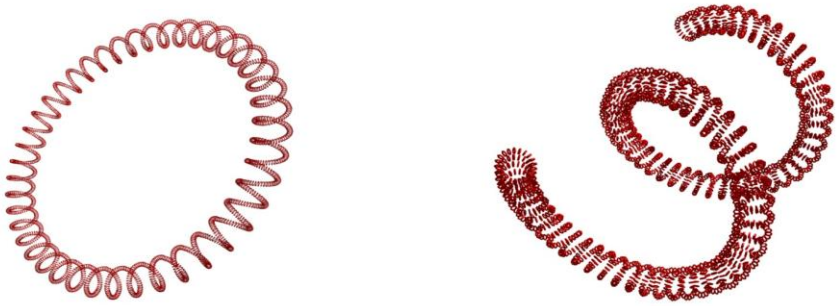


FIGURE 15. Structure of oxygen nucleus [12]

a) b)

FIGURE 16. Structure of carbon nucleus
a) in the methan CH [12]
b) carbon $_{6}^{12}C$ which can create the benzene molecule C_6H_6 [26]



a) b)

FIGURE 17. a) The coil-fractal structure of the proton [25]
b) Two threads of the coil-fractal structure of the proton

CONCLUSIONS

It seems that gravitation lines (from graviton fibers) are in the same axes as levitating electrons [8]. Gravitation lines repel each other and due to the two bodies are attracted. The gravitation lines are braids, which are created from graviton fibers. A quantum-foam-space that is full of graviton fibers and ring structures we would like to call *gravitonum* (or shortly *gravum)* to distinguish from the terms: vacuum, ether etc. The gravum is a space where are highly organized and lower organized substructures. It means they are in a different level of self-organizational state (see Fig.13). Smaller substructures can create dark matter and dark energy. The name osmeron (see Fig.13) was derived from the name "Osmera" of Egyptian deity with 4 pairs of gods as primary creative forces (from a chaos beginning). Osmerons are very small. It explains why they have immeasurable size and mass. From the basic osmeron substructure the electron, proton and neutron can be created [8].

The exact analysis of real physical problems is usually quite complicated, and any particular physical situation may be too complicated to be analyzed directly by solving the differential equations. Ideas as the field lines (magnetic and electric lines) are very useful for such purposes. We think they are created from self-organized subparts of gravum (see Fig.13, Fig.9 and Fig.10). A physical understanding is a completely nonmathematical, imprecise, and inexact, but it is absolutely necessary for a physicist [1]. It is necessary to combine an imagination with a calculation in the iteration process [4]. Our approach is given by developing gradually the physical ideas – by starting with simple situations and going on towards the more and more complicated situations. But the subject of physics has been developed over the past 200 years by some very ingenious people, and it is not easy to add something new that is not in discrepancy with them. The vortex model (see Fig.8) of the electron was inspired by vortex structure in the PET-bottle experiment with one hole connector ($3 souvenir toy, Portland, Oregon 2004) [7], our connector with 2 or 3 holes [7], [8] and levitating magnet "levitron" (physical toy). The "ring theory" is supported by experiments in [9] and [11] too. Now we realize that the phenomena of chemical interaction and, ultimately, of life itself are to be understood in terms of electromagnetism, which can be explain by vortex-ring-fractal structure in different state of self-organization inside gravum.

In future we would like to optimize proposed models by evolutionary optimization [4], [5].

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