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LOOKING FOR AN ANSWER

The reason for looking for an answer

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Mathematical physics developed in the 20-th Century regards the Universe as organized according to some mathematical concept.

First Einstein, assuming constant velocity of light, introduced the concept of the "curvature of Space", an abstract mathematical idea, then de Broglie transferred the wave theory of light on matter, creating the concept of "waves of matter", also an abstract mathematical idea. In consequence the theoretical physists considered mathematics as the primary source of information about the construction of the Universe.

These theories refer to light: the special theory of relativity to the constant velocity of light and the general one to propagation of light. The Planck constant *h* applies to photons – quanta of light. The expansion of the Universe was deduced from the changes in the wavelength of light emmited by atoms. The physical science is centered on light, and photons are complex entities.

Theoretical physics nowadays, with its purely mathematical character, tends to neglect innertial mass by introducting such concepts like "pure energy", or considering the electric charge as independent on electrons, protons or other particles, or treating entropy as an entity independent on energy and mass.

In the search for a theory unifying the electromagnetic field and the gravitational one obviously cannot start from the electromagnetic field, it is not possible to explain simple by more complex. Certainly one must start with the more subtle gravitional field, carried by the gravitons: the ratio of the electric force to the gravitional force is of the order 10^{42}.

But what is known about gravitons? Now the idea that the "Theory of Everything" must reach the Planck scale of reality is gaining ground. The reasonable starting point seems to be the acceptance of the Planck length of the order 10^{-33} cm as the diameter of the graviton and not as an abstract unit of length.

The aim of the “Looking for an Answer” is to show that logical analyses of known physical data lead to a coherent structure of science based on gravitons.

I. Wave mechanics or quantum mechanics?

Wave mechanics (the Schrödinger and the Heisenberg formulations are equivalent) is inherently lacking univocality and decisive results, what leads to a fuzzy reality. It is now obvious that the wave-mechanical outlook is not fully satisfactory. What de Broglie has done by replacing frequency, which represents discrete values of the natural numbers, by continuous wave lengths, is like replacing the Dirichlet function by a continuous one, and that would be an unreasonable act.

The de Broglie idea has lead to the dualism of particles and waves, hence to a schizophrenic kind of science, unhappily accepted as a dogma in the XX-Century physics.

The unsolved problems appearing in the wave – mechanical outlook are by some regarded a basically incomprehensible mystery, an attitude undesirable in science. We should search for a theory giving unequivocal results and not such that issue from the “superpositions” or made necessary a resort to a “reduction of the wave-packets”.

We must examine and try to explain the workings of the Universe basing on the assumption that exactly the same cause produces exactly the same result in the same circumstances. Othervise we would be compelled to resign from any such trials.

De Broglie has formally connected mass with wave length, according to equations $mc^2 = h\upsilon$ and $\upsilon = c/\lambda$. But as frequency υ assumes only discrete values, the last equation shows that only specific values of wave length fulfil this condition and not every possible one. Equation $E = h\upsilon$ applies to electromagnetic fields and waves. Quantification of energy can be easily and reasonably connected only with discrete values of frequency, application of continuous wave length leads to severe complications.

A machine gun fires bullets at constant velocity ν and constant frequency υ, hence this process can be formally described as "waves", with wave length $\lambda = \nu/\upsilon$, even if it is clearly a corpuscular one.

The only possible way of proving a theory is to compare its results with that of experiments or observations. Useful theory must predict correctly results of experiments.

The concept of waves of matter excludes corpuscular nature of photons and electrons but interpretation of waves as waves of probability does not exclude their corpuscular nature, as then waves describe the probability of finding a particle. In experiments electrons appear always as particles, hence wave mechanics is compelled to use the "Deus ex machina" concept of "reduction of wave packets", which does not result from wave mechanics.

The corpuscular double slit experiment

As the decisive confirmation of the wave-like nature of single photons, electrons, atoms and even of macroscopic objects, is regarded the effect of "interference" observed on a screen placed behind a wall of solid material in which two slits are cut (Fig. 1.). Such effect is not observed with a single slit. Especially the appearance of dark bands on the screen, when light is used, in the case of two slits, is regarded as inexplicable in the frame of classical physics, hence presenting the ultimate evidence for the wave-like nature of single photons, if such were used in the experiment. But slits are always formed by a pair of edges, and slits must have inner sides, with an area depending on the thickness of the wall used.

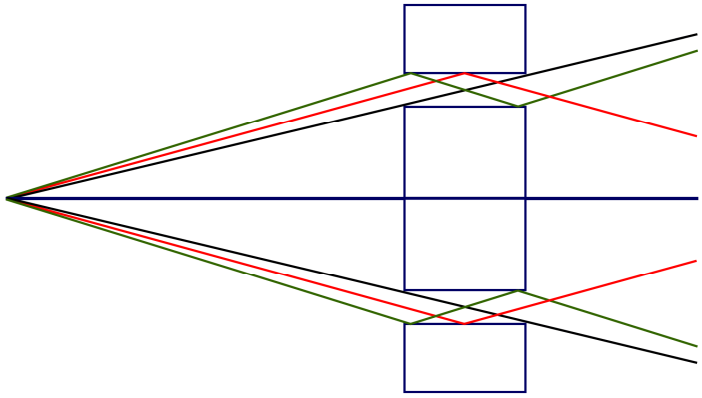

Fig. 1. The corpuscular double slit experiment (diagram) – red = single reflection (rebound) – green = double reflection (rebound).

A computer simulation (by A. T. Görlich) for one particle or photon enables "experiments" by changing distances between the two slits, their breadth, distance from the source of light or other emissions and the thickness of material in which the slits are made. Photons or other particles emitted from a source strike the inner sides of the slits at different angles, depending on the distance of the source and the distance between the two slits. As the inner side of the slits have surfaces with certain area, there appears some dispersion of these angles, hence on the screen behind the wall appear bands and not lines, if a number of particles or photons strikes elastically these inner sides of the slits. Roughness of surfaces may add to the dispersion (Fig. 1 and 2). The single elastic rebounds of particles produce an effect like that of converging lenses.

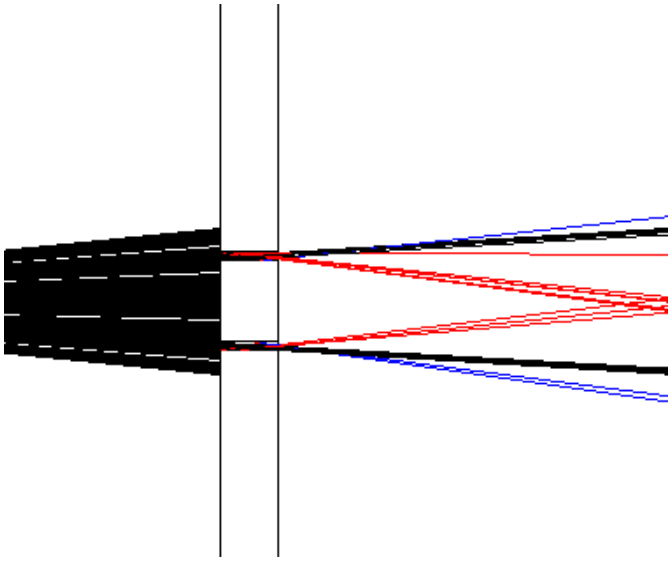

Fig. 2. Computer simulation of the corpuscular double slit experiment.

Double reflections are possible, with lesser intensity (Fig.1) at some thickness of the wall. Double reflections act like in the case of divergent lenses. In consequence of single reflections a bright band appears on the screen opposite to the part of the wall between the pair of slits, instead of a dark one, at proper distance of the screen (Fig. 2). The source must be concentrated to obtain good results. The particles or photons can strike the screen only in places allowed by the laws of elastic rebounds, hence at other places no particles or photons can strike the screen and "dark" bands appear where the probability of arriving of a particle is nil or in practice very low. Thus classical mechanics easily explains the effect of "interference". On the screen a set of bands appears in accordances with the angles of reflections or rebounds of particles. The only possible way of proving a theory is the arranging of a suitable experiment, on the proper scale we can obtain the effect of assumed "interference" even with the grains of sand.

The “double slit experiment” can thus be reproduced by computer simulation based on classical physical laws of reflection or rebounding of particles (Fig. 2). The familiar “wave interference pattern” with five bright bands and dark ones between them (Fig. 3) appears when single particles are emitted one by one in random directions from a source, in the number of few hundreds.

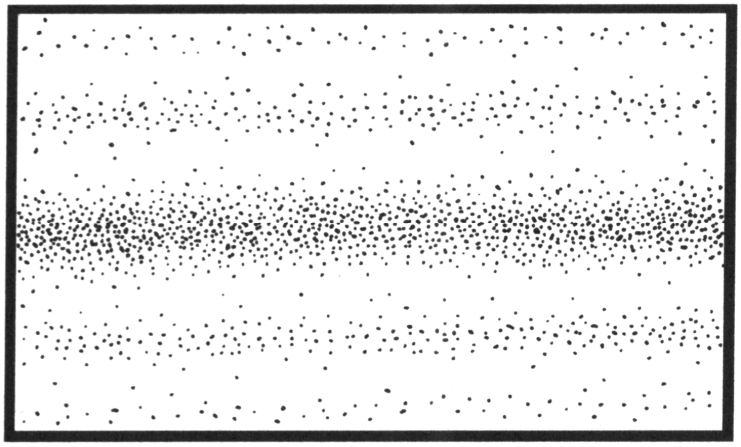

Fig. 3. Results of the double slit experiment according to Penrose [1].

Due to the limitation imposed by the size of the monitor screen and to the effect of the stochastic changes in the distribution of impact points at the same initial conditions, the patterns obtained are somewhat different at each series of emissions, with tendency to asymmetry of disposition of the impact points on either sides of the middle point. Would the distance of the source from the slits be much larger and emission not so much concentrated on a small surface, then this asymmetry will disappear due to the more even statistical chances of impact at both slits.

Diffraction is regarded as typical for the propagation of waves and the " double slit experiment" as explicable only on this basis. However this assumption is unwarranted as the purely corpuscular interpretation is obviously possible and, by the way, it fulfils also the "Ockham razor" principle. The X-ray and electron diffraction methods used to analyze crystal structures are based on interpretation of the process as reflections from the lattice planes.

II. The nature of gravitons.

A reasonable interpretation of the Einstein equation $E = mc^2$ can only be that mass and energy are inseparable, because if m = 0, also E = 0. The concept of photons as "pure energy" must be abandoned. For a single isolated photon $(\upsilon = 1) \rightarrow E = h$ and to the Planck constant h may be given the dimension of energy and not that of action. Hence the mass of a single photon is:

$$m_{ph} = \frac{h}{c^2} = \frac{6.6260755 \cdot 10^{-27}}{(2{,}99792458 \cdot 10^{10})^2} = 7{,}37250 \cdot 10^{-48} g,$$ as cgs units are used.

However, as velocity c includes the element of time, dimension of action returns to the constant h.

The ratio of the electric force to the gravitational force is $\frac{F_{el}}{F_{gr}} = \frac{E_{el}}{E_{gr}}$ and $E_{el} = h\upsilon_{Pl}$ as photons are carriers of the electromagnetic field. The ratio of the electromagnetic energy to the gravitational energy is equal to:

$$2\upsilon_{pl} = 2 \cdot 4.1754 \cdot 10^{42} s^{-1} = 8.3508 \cdot 10^{42} s^{-1}.$$

It follows that $E_{gr} = \frac{h}{2} = 3.3130378 \cdot 10^{-27}$ ergs. As $h = m_{ph}c^2$, hence $E_{gr} = \frac{1}{2} m_{ph}c^2 = m_{Pl}c^2$. The Planck mass m_{Pl} is the smallest mass in the Universe and should be the mass of a single graviton, the carrier of the gravitational field: $m_{Pl} = m_{gr} = 3{,}686252 \cdot 10^{-48}$ g. The smallest length in the Universe is the Planck length $L_{Pl} = d = \sqrt{\frac{1}{2}\frac{h}{2\pi} \cdot \frac{G_N}{c^3}} = 1.142718935 \cdot 10^{-33} cm$, where G_N is the constant of gravitation $= 6.672259(85) \cdot 10^{-11} m^3 kg^{-1} s^{-2}$ and $\frac{1}{2}\frac{h}{2\pi}$ is the minimum value of the Heisenberg uncertainty principle = 5.27286333 ·10^{-28} ergs. Planck frequency $\upsilon_{Pl} = \frac{1}{t_{Pl}}$ and t_{Pl} is the smallest quantum of time in the Universe.

Einstein velocity c is the natural unit of velocity in the Universe and d is the smallest unit of length in the Universe, however t_{Pl} is not among the fundamental quantities but follows from the ratio of the fundamental quantities d and c:

$$t_{Pl} = \frac{1.142718935 \cdot 10^{-33}}{2.99792458 \cdot 10^{10}} = 3.8117 \cdot 10^{-44} s = \frac{d}{c}.$$

One may say that motion has born time. The respective frequency is $\upsilon = \frac{1}{t_{Pl}} = 2{,}6235014 \cdot 10^{43} s^{-1}$ and $\upsilon_{Pl} = 4{,}1754 \cdot 10^{42} s^{-1}$ hence both values differ by $\frac{1}{2\pi}$, as $\frac{\upsilon}{2\pi} = 4{,}175432 \cdot 10^{42} s^{-1}$. This suggests a circling motion of gravitons with mass m_{gr} around the circle $2\pi d$ with velocity c.

Everything showing inertial mass represents matter, hence gravitons with mass m_{gr} represent the smallest quanta of matter.

The formal mathematical treatment used by de Broglie to connect mass (thus matter) with waves, leads to the “waves fo matter”. But mathematics cannot produce physics, it is physics which inspired mathematical methods.

According to de Broglie $\lambda = h / mc$, and *h* concerns quanta of the electromagnetic field. According to the gravitonic theory $h = 2m_{gr}c^2$, hence $\lambda = 2m_{gr}c^2 / m_c$ and as $m / m_{gr} = m'$, $\lambda = 2c / m'$, a relation which cannot be rationally explained. But

wave length λ can be replaced by frequency υ, as $\lambda = c/\upsilon = 2m_{gr}c^2/mc$ and $\upsilon = mc^2/2m_{gr}c^2 = m/2m_{gr} = m''$ is equal to mass expressed in "materions" masses as mass units. Hence this frequency υ=m'' represents the number of "materions" in mass *m* and this has a physical sense. Keeping to frequencies instead to waves we are on a safe ground, as frequency is expressed in natural numbers and can represent the number of particles.

III. The structure of the electron

The mass of the electron is expressed in arbitrary units of grams (or kilograms): $m_e = 9{,}1093897 \cdot 10^{-28} g$. The Planck rest mass of the graviton $m_{gr} = 3.686252 \cdot 10^{-48} g$ is the smallest natural unit of rest mass, which can be used instead of grams to describe the mass of the electron:

$$\frac{m_e}{m_{gr}} = m_e^{'} = \frac{9{,}1093897 \cdot 10^{-28}}{3{,}686242 \cdot 10^{-48}} = 2{,}471186 \cdot 10^{20} m_{gr} .$$

Let us now express the electron classical radius $r_e = 2{,}81794092 \cdot 10^{-13} cm$ in Planck length units d:

$$\frac{r_e}{L_{Pl}} = \frac{r_e}{d} = r_e^{'} = \frac{2{,}81794092 \cdot 10^{-13}}{1{,}14272 \cdot 10^{-33}} = 2{,}466 \cdot 10^{20} d .$$

This quantity differs from that of $m_e^{'}$ only by 0.21% and it might be assumed that both values are identical[1]. If $r_e^{'} = m_e^{'} = 2.4712 \cdot 12^{20} m_{gr}$ then $d = r_e / r_e^{'} = 1.14032 \cdot 10^{-33}$ a discrepancy of 0.21%, conforming the physical reality of the "classical" electron radius r_e, then d is the diameter of the graviton and as m_{gr} is the rest mass of the graviton, it follows that an electron is built of $2{,}47 \cdot 10^{20}$ gravitons. The mass of our Sun is equal to 10^{66} masses of protons or neutrons and nobody doubts their existence. Thus it may be assumed that gravitons are the ultimate particles of matter, from which all matter in the Universe is built. The controversial question, whether electric charge is connected with electrons (positrons) or presents some independent entity can be reasonably answered by the assumption that it is connected with the electron. Proton has the same dimension as the classical radius of the electron, has identical electric charge (e^+) and the same value of spin $\frac{1}{2}\frac{h}{2\pi}$. If electron is the source of the electromagnetic field, then according to the "gauge symmetry" U(1)

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[1] If $r_e^{'} = m_e^{'} = 2.4712 \cdot 10^{20} m_{gr}$ then $d = \frac{r_e}{r_e^{'}} = 1.14032 \cdot 10^{-33}$, a discrepancy of 0.21%, confirming the physical reality of the "classical" electron radius r_e.

governing the electromagnetic field which presents rotation around a circle in one plane, what is consistent with spin 1/2, electron should rotate in one plane. The spin of the electron is closely related with mechanical and magnetic momenta. The speed of rotation of the electron is $v_e = \alpha \cdot c$ where α is the fine structure constant, connected with electric charges. As $\alpha = \frac{v_e}{c}$, it can be described as the speed of rotation of the electron expressed in natural unit of speed c. The constant $\alpha = \frac{1}{137{,}03599} = 7{,}2973531 \cdot 10^{-3}$. The fine structure constant $\alpha = \upsilon_e / c$ represents the ratio of the velocity of propagation of the magnetic field to that of the electric field produced by the electron. This ratio is obtained from the ratio of the magnetic charge to the electric charge of the electron. Hence the fine structure constant is connected with the electron and constitutes one of its basic characteristics. In fact it describes the motion of semiphotons emitted by the semielectrons, hence the propagation of the electromagnetic fields. Velocity of rotation of the electron $v_e = \alpha \cdot c = 2{,}1876914 \cdot 10^8 cm \cdot s^{-1}$. We can connect this speed with the Compton wave length of the electrons $\lambda_C = \frac{h}{m_e c} = \frac{c}{\frac{1}{2} m_e^{'}} = 2{,}42631 \cdot 10^{-10} cm$, hence the Compton frequency of the electron $\upsilon_C = \frac{c}{\lambda_C} = \frac{2{,}99792458 \cdot 10^{10}}{2{,}42631 \cdot 10^{-10}} = 1{,}23559 \cdot 10^{20} s^{-1}$. This quantity is connected with the speed of rotation of the electron: $v_e = 2\pi r_e \cdot \upsilon_C = 2{,}1876918 \cdot 10^8 cm \cdot s^{-1}$.The classical radius r_e must thus have physical sense.

Rotating electrons emit photons with the speed c as carriers of the electromagnetic field, but these acquire also, due to the speed of rotation of the electron v_e, a component of rotation, directed at 90° to the direction of translational motion. This component represents the magnetic component of the electromagnetic field, the translational motion with velocity c is the electric component.

The number of rotations of the electron in one second $1{,}23559 \cdot 10^{20}$ is identical in value with $\frac{1}{2} m_e^{'} = \frac{2{,}47118 \cdot 10^{20}}{2} = 1{,}23559 \cdot 10^{20}$. This means that not the electron as a compact whole is rotating, but in fact two identical “semielectrons” rotate in one plane around the circle $2\pi r_e$ with frequency υ_C.

From the principle of conservation of the rotational momenta follows that the mass $\frac{1}{2} m_e$ of the semielectron rotating with velocity v_e, at the distance $2r_e$ between

the semielectrons, has the same rotational momentum as a sphere with mass m_e and radius r_e rotating in one plane with the same velocity v_e: $\frac{1}{2} m_e v_e \cdot 2r_e = m_e v_e \cdot r_e$.

The semielectrons in the electron are rotating around their own axes with velocity c, in the same sense, as charges $0.5e^-$, hence the mirror symmetry plane between them causes that the emitted photons colliding "head on" with the opposite semielectron, are absorbed and the effect of recoil produces "attraction" (Fig.8, Fig.10). The distance between semielectrons in the electron is $2r_e$ (Fig. 4). Semielectrons must be kept together by the exchange of emitted photons and their bonding energy is enormous. The velocity of photons is c, the distance is $2r_e$, hence the respective frequency of exchange is $\upsilon_{se} = \frac{c}{2r_e} = 5{,}3119353 \cdot 10^{22} s^{-1}$ and the exchange energy is $E = h\upsilon_{se} = 3{,}5246436 \cdot 10^{-4} ergs$ for one photon. As $h = 2m_{gr}c^2$ and the electron is built of $2{,}471186 \cdot 10^{20} m_{gr}$ corresponding to $1{,}23559 \cdot 10^{20}$ photons, the energy of exchange is: $3{,}5246436 \cdot 10^{-4} \cdot 1{,}235593 \cdot 10^{20} = 4{,}3550240 \cdot 10^{16} ergs$, hence $4{,}3550247 \cdot 10^{16} \cdot 6{,}2415064 \cdot 10^{11} = 2{,}7181915 \cdot 10^{28} eV$ is the bonding energy of the semielectrons in the electron (or positron). The highest observed up to now energy of cosmic rays is $3{,}2 \cdot 10^{20} eV$. As the present resolving power of the high energy accelerators is insufficient to locate the electrons, hence the semielectrons must occupy a very small volume and have a very high density, probably that of small "black holes". The radius of the sphere circumscribed on the semiphoton id $d = 1.14272 \cdot 10^{-33} cm$, hence its volume is $V_{sf} = \frac{4}{3} d^3 \pi = 6.250 \cdot 10^{-99} cm^3$. Semielectron consists of $\frac{1}{4} 2.47 \cdot 10^{20} = 6.175 \cdot 10^{19}$ semiphotons. The volume of the densest packing of such a spheres is $6.25 \cdot 10^{-99} \cdot 6.175 \cdot 10^{19} \cdot 1.35 = v_{se} = 5.210 \cdot 10^{-79} cm^3$, hence the radius of the semielectron is $r_{se} = \sqrt[3]{\frac{3v_{se}}{4\pi}} = 2.3160 \cdot 10^{-26} cm$. Now a problem arises because such a small "black hole" is completely unstable and would at once vanish into a field.

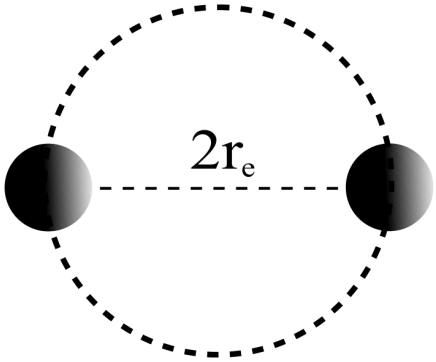


Fig. 4. The structure of the electron (not in scale).

The next problem is that if the electron emits continuously photons with some rest mass it looses mass and energy, but this does not effect its action as the constant source of the electromagnetic field, thus presenting a perpeetum mobile of the first class, against the first law of thermodynamics. The only rational solution is that its mass and energy are continuously supplied from the surrounding Universe by some kind of unknown field, on the basis of precisely equilibrated absorption and emission. A field giving mass to particles was proposed by Higgs (1964), such a kind of field is proposed in this work. These propositions assume corpuscular nature of fields as well as of electrons and other particles.

The question of connecting the electric charge with electron touches the nature of protons and mions (also other mesons). It seems that proton consists of 3 quarks which are confined by the positron, deciding on the radius of the proton. The bonding bosons, gluons, which have the strange property of increasing attraction with distance, are explained by the resistance of the positron to the pressure of the gluons. The mion has the Dirac magnetic momentum factor $g = 2.00319304$ which is exactly the same as that of the electron. The magnetic fields of electron and mion are identical, hence the rotation speed v_e must be the same as in the electron, and their radii the same. Some heavy particles must be confined by the electron (or positron), also in mions and in other mesons with two quarks. The neutron must contain two electrons, in perpendicular arrangement towards each other, giving the effect of electric neutrality, the same must be the case with neutral mesons.

The same mechanism, as in the case of semielectrons in the electron, must act beetwen two close protons in atomic nuclei, if their positrons are rotating in the same plane. Due to the extremely short distance between protons, a very strong attraction, caused by absorption of photons, issued and is interpreted as the" strong nuclear interactions".

In the case when two electromagnetic charges rotate in the same plane and in the same sense, attraction is not decided by the difference of signs of rotation of the emitter and the receiver, but by their reciprocal directions of motions, othervise repulsion occours.

Coulombic attraction or repulsion depending on signs of the electromagnetic charges occours when any number of photons, presenting chaotic distribution of directions is emitted.

The charge of the electron produces the electric field with photons as carriers. These cariers propagate with the Einstein velocity c, emitted with equal probability in any direction of 3D space.

Rotational motion of the electron produces the magnetic component of the electromagnetic field. This motion deflects, with velocity v_e, the direction of propagation of the photons perpendicularly the direction of their translational motion.

Due to the gyroscopic effect, rotation of the electron is maintained in one plane, as the gauge symmetry U(1) requires.

The electric component of the electromagnetic field is governed by the Coulomb law, which concerns only the electric (electrostatic) part of this field. The electric charge of the electron e_e is equal to its magnetic charge e_m.

Rotation of electrons, that is pairs of semielectrons, with velocity v_e cannot issue from the rotational motion of semielectrons with velocity c, so it must result from external conditions. If the Protouniverse was rotating with Einstein velocity c, this velocity with growing radius of the Universe must have been slowed down in consequence of the law of conservation of momentum. At some radius of the Universe the velocity of its rotation was equal to v_e, hence semielectrons must have been formed at this moment. Their apperance at suitable temperature and density of the Universe may be described as a "dew point" and than they became "freezed" at lower temperatures. Thus v_e and $\alpha = v_e / c$ contain some information about the Universe at the time of their formation.

Quarks are devoid of any electromagnetic charge, hence are probably of spherical shape, blobs of black holes, hundreds of times larger and heavier than the semielectrons. Their "dew point" must thus be at an earlier stage of expansion of the Universe, at its greater density. Quarks may present the possible candidates for particles of the "dark matter".

Latter formed electrons imprisoned them, forming barions with 3 quarks and mesons with 2 quarks.

IV. The hydrogen atom

The hydrogen atom presents an equilibrated system of two elementary electric charges with opposite signs: l e^+ (proton) and $1e^-$ (electron).Electrostatic attraction between them is equilibrated at the distance a_0, the Bohr radius $= 0.5291773 \cdot 10^{-8}$ cm, by the kinetic energy of the electron circling the proton. Fig. 5 shows that minimalization of total energy of hydrogen atom is possible only at the distance a_0 between proton and electron. Equilibrium is attained between the electric charges in spite of their opposite signs. Phenomenological approach based on energy relations leads to deterministic results. The distance a_0 can be calculated on the basis

of the minimum value of Heisenberg uncertainty principle, starting from two different relations, as shown by W. Jastrzębski in Table 1, the same value results also from application of the classical virial theorem (Rudolf Clausius, 1878) to the ground state of equilibrium of hydrogen atom, concerning its total energy. From the fact that the Heisenberg uncertainty principle has a minimum value $\frac{1}{2}\frac{h}{2\pi}$ follows that the Bohr radius a_0 can be calculated from minimalization of the sum of kinetic and attraction energies of the electron in the hydrogen atom (Fig. 5 and Table 1).

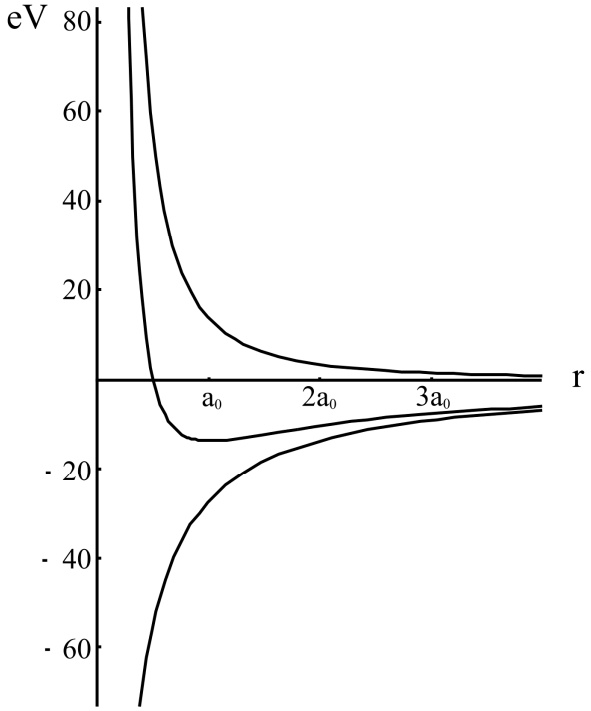


Fig. 5. Conditions for minimalisation of the potential energy of the hydrogen atom.

The virial theorem is a classical mechanical concept, but is accepted not only in classical physics but also in wave mechanics, and this means that the Heisenberg uncertainty principle is valid also in classical physics, not only in the wave mechanics. This fact can be exemplified by the relation $1Ry = \frac{1}{2}\frac{h}{2\pi a_0} \cdot \mathrm{v}_e \cdot f_2 = 13.605697\mathrm{eV}$ where f_2 is the units conversion factor from ergs to eV $= 6{,}241506363 \cdot 10^{11}$. From other relations: $1Ry = \frac{1}{2}\frac{1 \cdot 1}{a_0} \cdot f_1 = 13{,}60567 eV$, where f_1 is the units conversion factor from $\frac{e^2}{\mathrm{A}_0}$ to eV, $f_1 = \frac{e_{EM}}{e_{ES}^2} = 14{,}3996251773$ and $1Ry = \frac{1}{2} m_e v_e^2 \cdot f_2 = 13.605698 eV$. These two definitions relate to the virial theorem:

$E_{kin} = \frac{1}{2} E_{attr}$. Ionization energy of the hydrogen atom is related also with another important physical quantities: $1Ry = \frac{1}{2} h\upsilon_C \cdot \frac{2\pi r_e}{2\pi a_0} \cdot f_2 = 13.605696eV$. Because $\sqrt{\frac{r_e}{a_0}} = \alpha$ is the fine structure constant (see p. 14), hence $1Ry = \frac{1}{2} h\upsilon_C \cdot \alpha^2 \cdot f_2 = 13.605696eV$. From the relation $a_0 = \frac{1}{2}\frac{1\times 1}{Ry} f_1$ [Å], $a_0 = 0.5291764eV$. Hydrogen atom in the ground state, with minimalization of the total energy, is a convenient simple example illustrating important physical relations. Virial theorem is valid for the states of equilibrium, which are determined by the minimalization of total energy of the system. Ionization energy of 1 Ry concerns immobile proton and represents full energy of the hydrogen atom. Spectroscopic ionization energy of hydrogen atom is $I_H^0 = 13.59843873eV$ and this shows that some amount of energy is consumed by dragging the proton after the circling electron. Hence the rotational energy of the proton in hydrogen atom in the ground state is 0.00725727 Å and the radius of the "orbit" of proton is 0.000282412 Å. In following calculations the spectroscopic value I_H^0 is used and not Ry, because all other ionization energies used are also obtained by spectroscopic method, hence are compatible with I_H^0 and not with Ry. The spectroscopic ionization energies are independent on temperature, because in this case energy of the electromagnetic waves is used for the transfer of energy to the atoms and as $E = h\nu$, the chaotic motions of atoms in the gas phase are producing a Doppler shift. The positive and the negative changes in frequency are in this case equally probable, hence their effects cancel each other, leaving results which are falsely interpreted as independence of the ionization energy on temperature. If instead of this the old J. Franck, G. Hertz method (1914) would be used, in which the energy transfer is performed by collisions with thermal electrons, the result would confirm the dependence of the ionization energy of atoms on temperature.

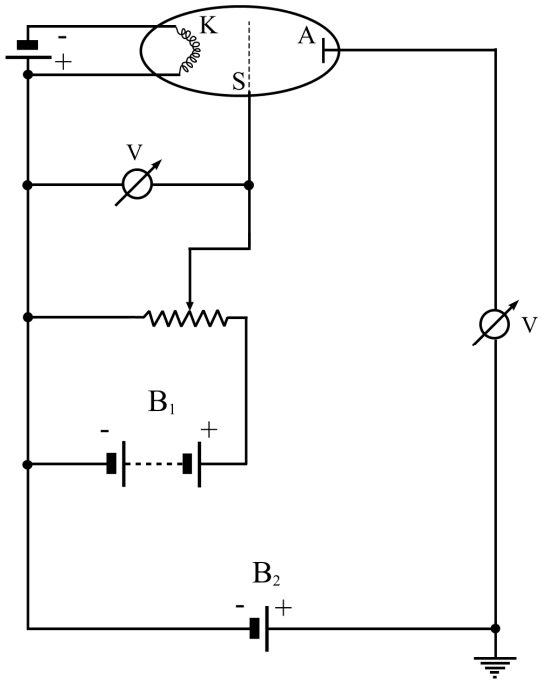
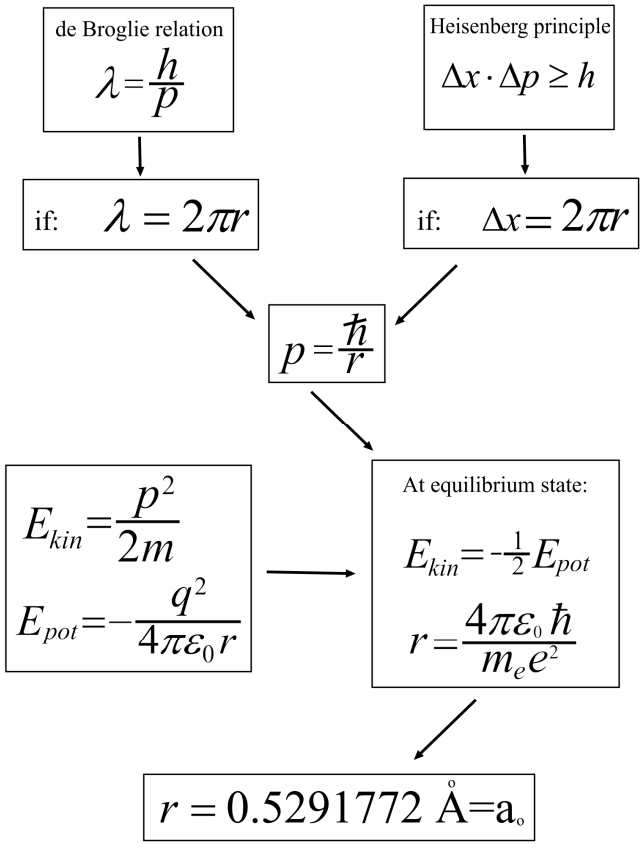


Fig. 6. The Franck-Hertz experimental arrangement.

Table I. The Bohr radius a_0 obtained from the de Broglie relation and the Heisenberg principle (by W. Jastrzębski).



With the present high standard of experimental techniques this would be easy, but nobody seems to be interested (Fig. 6), because atoms can absorb energy only in quantum h portions. But this postulate is valid for the excited equilibrium states, hovever absorption of thermal energy can be possible in equilibrated states if thermal energy is constantly and uniformly supplied by collisions. The absorbed amount of energy changes the basic level of energy but does not change differences of energy between the excited states of equilibrium (Fig. 7). Atoms can be heated and distended just like molecules. Ionization energy at 298K= I_H^{298} would be about 13.56 eV.

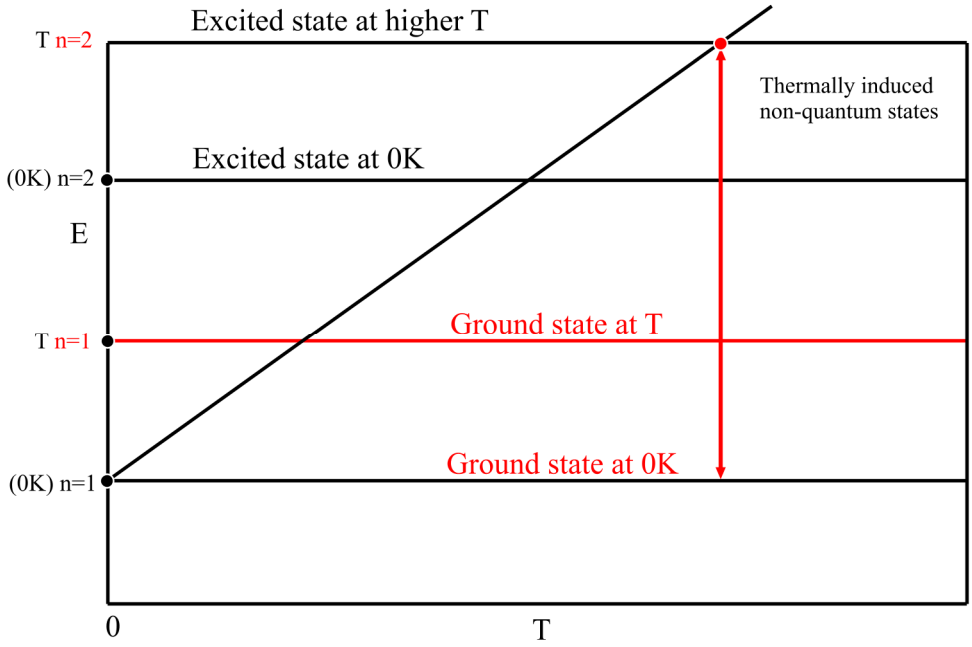


Fig. 7. Equilibrated states of the hydrogen atom at different temperatures.

The electric charge *e* is connected with electron and with proton, and they are sources of the electromagnetic field, which is governed by the gauge symmetry U(1) representing rotational motion on a circle in one plane. This means that the proton is circled by the electron in one plane. In this system proton is the center of the internal reference frame, and orientation in the 3D space of this circle, if no extermal interactions are present, has no effect on the energy of the system. All orientations are equally probable, hence with many hydrogen atoms, in relation to the external Cartesian coordination system, the time average of all orientations would produce a sphere. This is of course an abstract representation, not the real shape of the hydrogen atom. From the relation $1Ry = \frac{1}{2}\frac{h}{2\pi a_0} \cdot \mathrm{v}_e \cdot f_2$ eV follows that the position of the electron on the Bohr orbit $2\pi a_0$, which cannot be determined, in accordance with the Heisen-

berg principle, does not effect the total energy of the hydrogen atom. The velocity of rotation of the electron $v_e = 2.1876914 \cdot 10^8 cm \cdot s^{-1}$. The probabilistic interpretation of the "waves of matter" considers a_0 as a mean valueand not as a constant. This cannot be true. As $a_0 = \frac{v_e}{2\pi\nu_H}$, changes in the distance electron-proton in the hydrogen atom must depend on changes in the $\frac{v_e}{\nu_H}$ ratio. Since $e^2 = m_e v_e^2 a_0 = m_e c^2 r_e$ and c = constans, proton and electron would undergo changes of r_e, contractions and expansions. But as energy is inseparable from mass, hence as $E = \frac{1 \cdot 1}{r_e}\frac{e^2}{\text{o}}$ and $E = mc^2$, changes in r_e would produce changes in masses of the proton and electron, these however are constant.

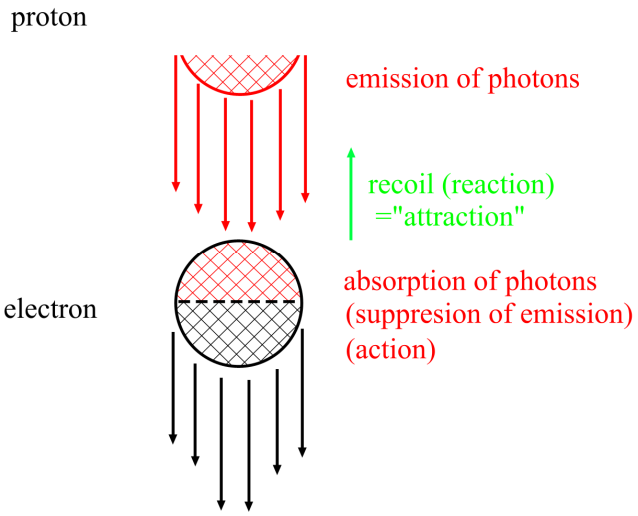


Fig. 8. The mechanism of electrostatic attraction in the hydrogen atom.

Attraction between electron and the proton, keeping them together in hydrogen atom is what is observed, but the mechanism of this attraction shows that there exists no such thing as attraction (Fig. 8). Carriers of the electromagnetic field, that is photons, are moving with the velocity c on a straight line, but in their motion is contained the component of rotational speed v_e, which is acting at the right angle to the velocity c. It is this component which drives the electron around the proton (Fig. 9). This component is connected with the spin of the electron and proton, hence with the magnetic momentum. The photons emitted by the proton arrive at the electron and are absorbed on one side of the electron. This absorption suppress emission of photons on this side of the electron, and emission of photons on the other side remaining unchanged is causing the effect of recoil, observed as " attraction". Of course absorption equals emission, and emission is always connected with recoil. The effect of "attraction" requires synchronization of phases of rotation between electron and the proton,

and such a synchronization can be realized only at the distance a_0, the Bohr radius (Fig. 10).

$$\frac{V_e^2}{C^2} = \frac{r_e}{a_0}$$

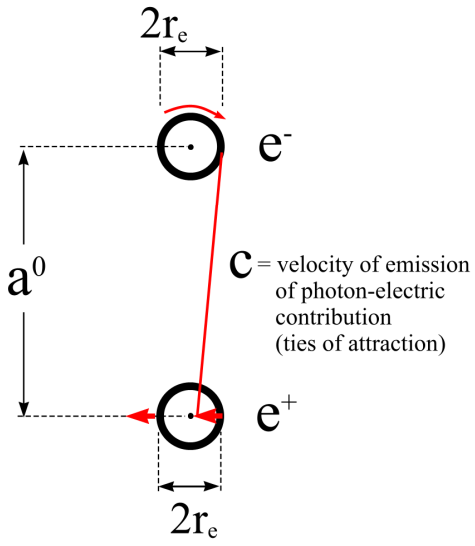


Fig. 9. The mechanism of the orbiting motion of the electron around the proton in the hydrogen atom.

Rotation of electric charges in one plane leads to circling the proton by the electron in one plane, and that is why the hydrogen atom exhibits no dipole momentum. In agreement with laws of electrostatics the negative charge of the electron acts as if positioned at the center of the circle, hence on the proton, neutralizing it completely. But this behavior can be observed only when a uniform, homogeneous electric field is used, like between plates oppositely charged. Against a point charge, for instance an electron, a rest charge is revealed, called "electron affinity". Electron in the hydrogen atom is not lying on the proton but is at the distance a_0 from it. Hence the positive charge $1e^+$ of the proton is not completely "screened" by the electron with charge $1e^-$, but a rest positive charge on the hydrogen atom is observed, $Z_{effH^0} = 0.7e$. Only due to this rest charge hydrogen can be liquefied and solidified. Without this rest charge a completely neutral hydrogen would not form any chemical compounds.

The effective nuclear charges result from the fact that electrons are orbiting the nuclei of the atoms at some distance.

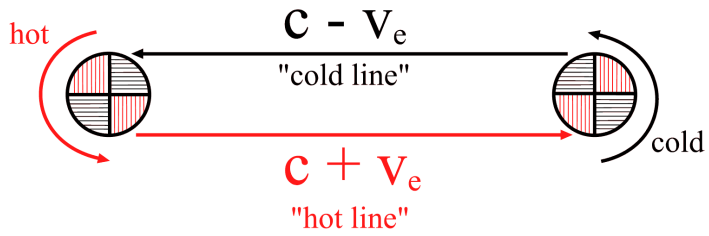
The mechanism of apperance of effective nuclear charges can be explained on the simplest example of the hydrogen-like systems: nucleus and a single K-shell electron. The circular orbit of this electron is $2\pi_{r_{1s^1}}$, and $r_{1s^1} = \frac{r_H^o}{Z}$. The electric elementary

charge e is thus distributedon the circle $2\pi r_{1s^1}$ and the charge $\frac{e}{2\pi r_{1s^1}}$ acts from the center of this circle, like located in the nucleus of the atom.

A hydrogen atom is not neutral, as $Z_{effH^o} = 1 - \frac{1}{2\pi r_H^o} = 0.6994e^+$ at O K and at 273 K $Z_{effH^o} = 0.7003e^+$. Hence the atomic hydrogen is very active chemically.

Minimalization of total energies of atoms, ions, molecules and crystals is enabled by the electromagnetic nature of interactions between the positive and the negative electric charges. It is the magnetic component, which is responsible for the appearance of kinetic energy of electrons circling nuclei in atoms.

$$\frac{v_e}{c} = \alpha = \sqrt{\frac{2\pi r_e}{2\pi a_0}}$$



$c - v_e$ = elastic collision, repulsion

$c + v_e$ = nonelastic collision, absorption and reaction (attraction)

rotation in phase

extinguishing by absorption

$E_{kin} = \frac{1}{2} m_e c^2 - \frac{1}{2} m_e v_e$ repulsion

$E_{kin} = \frac{1}{2} m_e c^2 + \frac{1}{2} m_e v_e$ attraction

Fig. 10. Synchronization conditions for the attraction of the electron by the proton in the hydrogen atom.

The so called "Casimir pressure" (1945) between clean plates of metals put together, is really due to the rest charges of the atoms involved. Not only hydrogen atom, but all free atoms have no dipole moments because in the uniform electric fields the negative charges of the electrons act like being placed in the center of the atom, together with the positive nucleus. This fact confirms the placement of electrons in atoms on the surfaces of respective spheres for each shell.

Equilibrium between opposite electric charges requires $E_{attr}=E_{kin}$, hence $\frac{1}{2}\frac{e^2}{r_e}=\frac{1}{2}m_e c^2$ and $\frac{1}{2}\frac{e^2}{a_0}=\frac{1}{2}m_e \upsilon_e^2$.

The electric charges are defined as $e=\sqrt{m_e c^2 \cdot r_e}$ and may be defined as:

$e_m=\sqrt{m_e \cdot \mathrm{v}_e^2 \cdot a_0}=4.803206815\cdot 10^{-10} cm^{3/2} g^{1/2} s^{-1}$. The elementary charge $e_e=\sqrt{m_e c^2 r_e}$ is the electric charge and $e_m=\sqrt{m_e \mathrm{v}_e^2 a_o}$ represents the magnetic charge of the electron. Both charges have equal values: $e_e=e_m$.

Hence $\frac{\mathrm{v}_e}{c}=\sqrt{\frac{r_e}{a_0}}=\alpha=\frac{2\pi r_e \upsilon_C}{2\pi d \upsilon_{Pl}^o}$, the fine structure constant which results from the law of conservation of the momentum. In hydrogen atom in the ground state $\mathrm{v}_e=c\cdot\alpha=2.1876914\cdot 10^8 \frac{cm}{s}$. Only in this state, in accordance with the law of conservation of the rotational momenta: $c^2\cdot r_e=\mathrm{v}_e^2\cdot a_0$, rotational velocity v_e is equal to the linear velocity of the electron at the tangent direction to the $2\pi a_0$ circle. In an excited hydrogen atom the respective ionization energy $I_n=\frac{1}{2}m_e\cdot f_2\times \mathrm{v}_n^2$, where n = 1,2,3...n are quantum states of the excited hydrogen atom and $\frac{1}{2}m_e\cdot f_2=\text{constans}=C=2.842815689\cdot 10^{-16}$, hence $\mathrm{v}_n=\sqrt{\frac{I_n}{C}}$. For n=2,

$\mathrm{v}_2=\sqrt{\frac{I_2}{C}}=\sqrt{\frac{10.204272}{2{,}842815689\cdot 10^{-16}}}=1{,}894596198\cdot 10^{8.5}=$

$=\mathrm{v}_2=1.894596198\cdot 10^8\times 3.16227766=5.9912392\cdot 10^8 cm\cdot s^{-1}$, hence it equals 2.74 v_e. Radius of the excited hydrogen atom in the state n = 2 according to relations introduced on page 25, is $r_2=\frac{f_3}{\sqrt{I_2}}=\frac{1.951918196}{\sqrt{10.204272}}=0.611041348\,\text{Å}$ where $f_3=\frac{f_1}{2\sqrt{I_H^o}}$, hence $\frac{r_2}{a_0}=1.1547$.

A single K-shell electron $1s^1$ in atoms other than hydrogen circles the respective nucleus on the circle $2\pi r_{1s^1}$ and $r_{1s^1} = \frac{a_0}{Z}$, where Z is the atomic number of the atom. Velocity of the rotation of the electron is $v_{e,}$ hence the time of single rotation $t_C = \frac{2\pi r_e}{v_e}$ and the time of a single rotation of the $1s^1$ electron is $t_{1s^1} = \frac{2\pi r_{1s^1}}{v_{1s^1}}$, where $v_{1s^1} = \sqrt{\frac{I_{1s^1}}{C}}$, and $C = \frac{1}{2} m_e f_2 = 2.842815689 \cdot 10^{-16}$. As $\frac{t_{1s^1}}{t_C} = \frac{v_e}{v_{1s^1}}$, hence $\frac{t_{1s^1}}{t_C} = \frac{2\pi r_{1s^1}}{2\pi r_e} = \frac{v_e}{v_{1s^1}} \cdot \frac{r_{1s^1}}{r_e} = \frac{v_e}{v_{1s^1}} \cdot \frac{a_0}{Z \cdot r_e} = \frac{v_e}{v_{1s^1}} \cdot \frac{1}{Z \cdot \alpha^2}$, and $v_{1s^1} = Z \cdot \alpha^3 \times c$, as $v_e = \alpha \cdot c$. Because $\alpha^3 \cdot c = \text{constans} = 1.164975462 \cdot 10^{10}$, hence $v_{1s^1} = Z \cdot Constans$.

The Compton wave length of the electron $\lambda_C = 2\pi\sqrt{r_e \cdot a_0} = 2.42631 \cdot 10^{10} cm$ is the function of the geometric mean of radii of the electron and of the hydrogen atom. Because $\alpha = \sqrt{\frac{r_e}{a_0}}$, hence $\alpha \cdot \lambda_C = 2\pi r_e$ and $\frac{\alpha}{\lambda_C} = 2\pi a_0$. The dependence of the orbiting motion of electron around the proton on the rotation of the electron is shown in Fig. 9. Rotation of the electric charge, of which electron is the source, proceeding in one plane, is consistent with the presence of spins $-\frac{1}{2}$ and $+\frac{1}{2}$, of the electron and of the positron in the proton.

Synchronization of the rotation phases, leading to "attraction" (Fig.10), can be realized in the excited hydrogen atoms only at integer values n of rotation times: nt_C.

Photons emitted by the positron in the proton are absorbed by the electron on its orbit $2\pi a_0$ in the hydrogen atom in the ground state, at points which cannot be observed, in accordance with the uncertainty principle. Absorbed energy of each photon is known, hence it is determined, but localization of the electron on its orbit at the moment of absorption is not possible at any time. The position is thus indeterministic, and only position, not energy. Minimalization of energy which decides on the structure of atoms, ions, molecules and crystals is determined, no indeterministic factors are in this case involved.

With static proton, ionization energy of the hydrogen atom in the ground state is $1Ry = \frac{1}{2} h \upsilon_H f_2$ eV, where $h = 2m_{gr}c^2$ and $\upsilon_H = \frac{v_e}{2\pi a_0} = 6.579683 \cdot 10^{15} s^{-1}$, since $v_e = 2\pi r_e \upsilon_C = 2\pi a_0 \upsilon_H$, velocity of rotation of the electron around the proton is the same asvelocity of rotations of the electron and the proton around their own axes.

As 1 Ry is equal to the kinetic energy of the electron orbiting the proton, which is caused by the rotating magnetic field, $1Ry = E_{kin} = \frac{1}{2}\upsilon_H f_2$ eV and $h = 2m_{gr}c^2$, $E_{Kin} = \frac{1}{2}2m_{gr}c^2 \frac{v_e}{2\pi a_0} f_2$ eV, hence $E_{kin} = m_{gr}c^2\upsilon_H$ and $m_{gr}c^2 = \frac{1}{2}2m_{gr}c^2$ is the kinetic energy of one semiphoton. Thus each circling of the electron around proton in the hydrogen atom produces emission of one semiphoton in translational motion in direction tangent to the $2\pi a_0$ circle. Synchronization of rotations of the proton and the electron with velocity v_e enables constant flow of semiphotons between the proton and the electron, producing "attraction" due to recoil.

V. The nature of photons

Electron is driven around the proton by the rotational magnetic field acting in the system of the hydrogen atom. The amount of the magnetic energy is exactly equal to one half of the electrostatic energy of attraction between proton and electron at the equilibrium distance and the other half must be supplied to the system in order to free the electron, that is the ionization energy of one rydberg (l Ry).

Frequency of circling the proton by the electron in hydrogen atom in its ground state is:

$$\upsilon_H = \frac{\mathrm{v}_e}{2\pi a_0} = \frac{2.1876914 \cdot 10^8}{2\pi \times 0.5291773 \cdot 10^{-8}} = 6.579683 \cdot 10^{15}\, s^{-1}$$

and $\frac{1}{2}h\upsilon_H \cdot f_2 = 13.60569629eV = 1Ry.$ As $\mathrm{v}_e = 2\pi r_e \upsilon_C$, hence $\upsilon_H = \frac{2\pi r_e}{2\pi a_0} \cdot \upsilon_C = \alpha^2 \cdot \upsilon_C$, showing other interrelations between important physical quantities. Planck frequency $\upsilon^0_{PL} = \frac{c}{2\pi d}$. The question is what can be circling around $2\pi d$ orbit with velocity c? Only graviton may be connected with diameter d and velocity c (and mass m_{Pl}). If velocity c is an inherent property of gravitons, the kinetic energy of a single graviton will be $\frac{1}{2}m_{gr}c^2$ and $h = 2m_{gr}c^2$, what is an equivalent of kinetic energy of four gravitons. Photon is a complex particle with spin 1 and has various energies depending on frequency: $E = h\upsilon.$ The electric vectors of light waves change alternately from + to – signs representing maxima and minima of a wave. If we plot a circular motion against time, a wave in sinusoidal form results, but wave can be also connected with frequency, as $\lambda = \frac{c}{\upsilon}$. Matter is build of materions

and they may be taken as natural units of mass, then $m' = \frac{m}{2m_{gr}}$. Hence the de Broglie relation $\lambda = \frac{h}{mc} = \frac{2m_{gr}c^2}{mc} = \frac{c}{m'}$ and $m' = \frac{c}{\lambda} = \upsilon$. Mass is connected with frequency through materions: $m = 2m_{gr}\upsilon$ and frequency means here the number of repetitions.

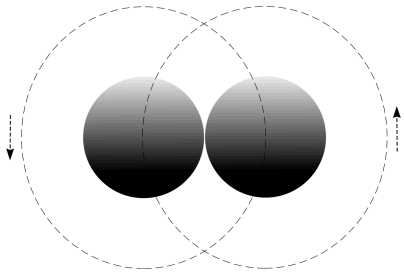


Fig. 11. The corpuscular model of semiphotons and materions.

Fig. 11 presents a model of two gravitons circling each other with their centers describing circle $2\pi d$. As c, m_{gr} and d are constant, the rotating gravitons exert a very strong constant pressure on each other and the system is extremely stable. The energy of this pressure is twice that of the kinetic energy of a single graviton: $2\times\frac{1}{2}m_{gr}c^2 = m_{gr}c^2 = \frac{1}{2}h,$ where ½ h is the energy connected with a single half-photon, which can be described as semiphoton. In the extreme magnetic fields of the stars called magnetars, photons can split into two particles (two semiphotons). Frequency $\upsilon = 1$ becomes a single event. At $\upsilon = \upsilon_{Pl} = \frac{c}{d}$ the wave length $\lambda_{Pl} = d$ and two semiphotons are in touch together, hence the single photon becomes one particle with energy $\frac{1}{2}\times 2m_{gr}c^2 + 2\times\frac{1}{2}m_{gr}c^2 = 2m_{gr}c^2 = h,$ as only the sum of energies of the semiphotons is what counts. As the circling of two gravitons around each other goes with velocity c, hence energy of bonding $2\times\frac{1}{2}m_{gr}c^2 = m_{gr}c^2$ is the result of kinetic energies of both gravitons. This amount of kinetic energy is stored in the semiphoton, becoming its potential energy: $E_{pot} = m_{gr}c^2 \cdot f_2 = 3.686252\times10^{-48}\cdot 8.9875519\cdot10^{20}\cdot 6.241506363\cdot10^{11} = 2.0678348\cdot10^{-15}eV.$

Gravitons are carriers of the gravitational field and are also the smallest quanta of matter in the Universe, if as matter can be regarded anything possessing a rest mass. Semiphotons can result from ideally inelasting collisions of two gravitons moving on antiparallel paths, if such occur. Translational motion becomes then a rotational motion, kinetic energy is transformed into potential energy.

The bonding energy of two gravitons in a semiphoton can be regarded as "strong gravitation". At collisions resulting in rotation, translational energy is lost, that is the translational motion is stopped, gravitons involved in collision are not anymore carriers of the gravitational field but become elements of matter, not of a field, as carriers of fields move in vacuum with the speed c (Einstein velocity). The smallest portion of matter fulfilling the Einstein relation $E = mc^2$ is $E = m_s c^2$ where m_s is $2m_{gr}$. Such a particle can be described as "materion", while semiphotons with the same mass move with the speed c, as carriers of the electromagnetic field. Kinetic energy contained in the Universe is much greater than the potential energy (stored energy) what explains the expansion of the Universe.

The quantum of energy $h = 2m_{gr}c^2$ represents total energy of a semiphoton: $E_{tot} = E_{kin} + E_{pot} = \frac{1}{2} \times 2m_{gr}c^2 + 2 \times \frac{1}{2} m_{gr}c^2 = 2m_{gr}c^2 = h.$ But h represents also translational energy of a single photon: $\frac{1}{2} \times 2m_{gr}c^2 + \frac{1}{2} m_{gr}c^2 = 2m_{gr}c^2$, a sum of translational kinetic energies of two semiphotons, hence $h\upsilon = 2m_{gr}c^2\upsilon = mc^2$.

Semiphotons rotate in one plane and have spins $+\frac{1}{2}$ and $-\frac{1}{2}$, like electrons. A single photon consist of two semiphotons each of them rotating in opposite sense.

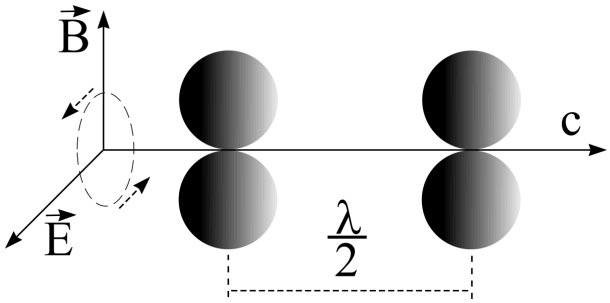


Fig. 12. The corpuscular model of a photon.

Each semiphoton can be described as having vector analogous to electric vector, perpendicular to the direction of the translational motion and a vector analogous to the magnetic vector, also directed perpendicular to the direction of motion (Fig. 12). The "magnetic" vectors are at a tangent to the circle of rotation. The fine structure constant $\alpha = \frac{v_e}{c}$ represents the ratio of the rotational velocity of semiphotons emitted by the electron to their translational velocity, hence that of the magnetic field to the electric field of the electron. The velocity of rotation of an electron is $v_e = 2\pi r_e \upsilon_C$ and the velocity of rotation of a semiphoton or of a materion is $c = 2\pi d \upsilon_{Pl}$, both electrons and semiphotons rotate in one plane and have spins $\frac{1}{2}$.

Gyrostatic effect stabilizes orientation in 3D space of electrons and of semiphotons (polarization). No interactions exist between semiphotons, as there exist no carriers smaller than gravitons. Frequency of photons is connected with separation between semiphotons forming photons. The distance between semiphotons is $\lambda/2$ (Fig. 12). Electromagnetic wave is a mathematical description, which however is only an approximation to the real situation: photons are complex particles and not parts of a continuum.

The electromagnetic field is connected with electrons emitting semiphotons in an ordered way. Before the appearance of electrons, the already existing immediately after time zero, semiphotons were involved in various chaotic and whirling motions.

VI. The "dark energy" field

If there exist aggregates of two gravitons rotating around each other and forming a compact entity, there can exist also aggregates of three, and possibly, with lesser probability, also of four and five gravitons rotating together. Such aggregates would be electrically neutral, as in such a case there are more than one axes of rotation. Such aggregates moving with the speed c would form a third kind of universal field, which must have existed already in the Protouniverse at the time zero. The carriers of this field with masses 3 or $4m_{gr}$ may be called “subneutrinos”. Their two axes of rotation would be directed perpendicularly to each other (Fig. 13).

In the electron, disc-like shaped by rotation, the two semielectrons are connected by elastic bonds, hence the electron can rebound elastically. The two gravitons in a semiphoton are joined inelastically, but semiphotons can rebound elastically from the elestic electrons, like in the case of mirrors.

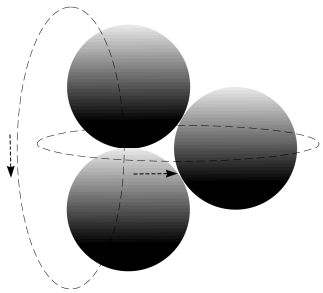


Fig. 13. The corpuscular model of the subneutrino $3m_{gr}$.

Only the disc-like electrons and semiphotons, with spin, can rebound, the neutral subneutrinos are reacting with electrons inelastically.

Such a subneutrinic field must be of highest importance, as it can, like the field proposed by Higgs (1964), supply mass and energy to "normal matter", notwithstanding the sign of their electric charges, thus constituting a cosmic fuel feeding matter. Would the density and potential of this field fall beneath a certain critical value then all matter would be "annihilated" into fields carried by gravitons, photons and subneutrinos, from which fields matter condensed at the early stages of

evolution of the Universe. After reaching this critical point, at a time which is presently unknown, the Universe would end, "finis mundi", no stars, no galaxies. With perishing atoms and their oscillations, all sources of electromagnetic radiations will be extinct. In Sanscrit “nirvana” means extinction, the Universe would be thus in the state of “nirvana”, being turned into fields. But “nirvana” must begin with a “Big Boom”, as energy stored in matter is being released explosively. Thus our Universe would exist between the Big Bang and the Big Boom. We, as all matter, exist at the cost of the "dark energy" contained in the subneutrinic field.

As “normal” matter (protons and neutrons) exist due to electrons, negative and positive, with them it consumes the “dark energy” of the subneutrinic field, “degrading” it irreversibly into the electromagnetic field. Hence in addition to the effect of the expansion of the Universe, the subneutrinic field is being attenuated also by the existence of matter.

Semielectrons appear to be like drops of boiling liquid, formed by semiphotons, in equilibrium with the surroundings subneutrinic field of “dark energy”. The subneutrinos colliding elastically in chaotic motions produce a kind of “gas” which exerts a hydrostatic pressure on semiphotons in the semielectron, maintaining its size and globular shape. This pressure leads probably to the densest packing of the spheres circumscribed on the semiphotons. In such a case the radius of the semielectron would be $4.5 \cdot 10^{-26} cm$, hence making the electron “invisible” in accelerators, as the most powerful of them aims at 1TeV that is to the 10^{-12}cm limit of visibility.

At some early stage of expansion of the Universe density of the “dark energy” must have fallen to the “dew-point” of condensation of the semielectrons.

The dark matter in the Universe is attracted by the gravitation of big masses, the X-ray spectra showing some concentration of the dark matter around them. There must thus exist unelestic collisions of the gravitons with particles of the dark matter, but these particles does not consist of atoms, as they do not send any semiphotons, and must present a kind of elementary particles. Such particles may be formed in the subneutrinic field. Subneutrinos supplementing the mass of the atoms change into semiphotons and these colliding in the vicinity of massive celestial bodies with the subneutrinos of the surrounding field may produce some kind of elementary particles.

VII. Quantized gravitation

Carriers of the gravitational field and that of the subneutrinic field are electrically neutral. It is in the process of the tranformation proceeding within the matter that negative and positive semiphotons are “born” and with them the positive and negative electromagnetic fields, which may thus be called “secondary”. The primary semiphotons in the Protouniverse were probably not organized in separate positive and negative fields. The appearance of matter instead of antimatter must have occurred after the appearance of electrons and quarks.

„Strong gravitation" results from direct mechanical contact between two gravitons rotating around each other with velocity c (Fig. 11). Kinetic energies of these gravitons act against each other producing cohesion energy binding them together. This represents the potential energy of materions and semiphotons: $E = 2 \cdot \frac{1}{2} m_{gr} c^2 = m_{gr} c^2$, consistent with Einstein relation $E = mc^2$. This potential energy constitutes the "strong gravitation". Strong gravitation is presented as $E_{\max} = h\upsilon_{PL} = 1.727 \cdot 10^{19} GeV$ and this is the energy h of a single photon repeated υ_{PL} times, hence it is a relativistic energy, accumulated during one second. The base value is the bonding energy in a semiphoton (or materion) = h = $4.135669239 \cdot 10^{-15}$ eV. Strong gravitation represents maximum ektropy $э_{\max}$. The Planck relation $d = \sqrt{\frac{1}{2} \cdot \frac{h}{2\pi} \cdot \frac{G_N}{c^3}}$ cm represents the Planck length unit $L_{Pl} = d$, G_N is the Newton constant of gravitation: $G_N = \frac{2 \cdot 2\pi}{h} \cdot d^2 \cdot c^3$ $\mathrm{cm}^3 g^{-1} s^{-2}$ and if we give to the minimum value of the Heisenberg uncertainty $\frac{1}{2}\frac{h}{2\pi}$ the symbol H we obtain $G_N = \frac{d^2 \cdot c^3}{H}$ cgs.

The values of the Planck length d obtained from the relation $d = \sqrt{\frac{1}{2}\frac{h}{2\pi}\frac{G_N}{c^3}}$ and that obtained from the ratio $\frac{r_e}{r_e'} = d$ agree within 0.21% and both relate to graviton, whereas Planck constant $h = 2m_{gr}c^2$ relates to the semiphoton, hence to two gravitons. Putting $2m_{gr}c^2 = h$ we obtain $G_N = 2d^2\pi c / m_{gr}$, where $d^2\pi$ is the surface area of the ideally spherical graviton, but if the surface area increases with the Einstein speed c, it grows up to infinity and the probability of finding a concrete graviton on this surface tends towards zero. The factor 2 in $G_N = 2d^2\pi c / m_{gr}$ compensates for greater probability of finding one graviton when two are present due to $h = 2m_{gr}c^2$.

The physical meaning of the Newton constant of gravitation can be deduced from the "gravitonic" relation $2d^2\pi c / m_{gr}$. The fundamental, absolute constants *d*, m_{gr} and *c* are deterministic in character, but G_N is connected also with probability. Necessity and chance represented by the constant G_N characterize the basic properties of the whole Universe in a nutshell. The surface $2d^2\pi c$ represents the actual limits of the Universe, spherical in shape, and gravitional field creates the frontier between the Universe and surrounding Void, advancing at the rate *c*. That means expansion of the

Universe and growth of entropy, that is dilution of energy and mass with time. The first and the second Laws of the Universe, hence also the respective Laws of thermodynamics are represented in the Newton constant of gravitation G_N.

Any future mathematical theory describing the Universe must base on the factors contained in the constant G_N, which appears as the most important universal constant in cosmology but also in physics.

Between any two masses there is an exchange of gravitons, hence these masses neither grow or become smaller in the process of gravitational attraction. But masses, as gravitational charges, emit gravitations in all directions and this must produce a gravitational decay of masses, however slow. Hence there must exist a cosmic supply of gravitons absorbed by masses which keeps them constant. The mass of electron is constant from the beginning up to now. The electric charges are maintained constant by supply of mass and energy by the cosmic subneutrinic field, presenting the "dark energy".

Everything showing inertial mass represents matter, hence gravitons with mass m_{gr} represent the smallest quanta of matter.

The density of the gravitonic matter calculated from $d = 1.14272 \cdot 10^{-33} cm$ is $2.88 \cdot 10^{51} g/cm^3$. Hence one cubic centimeter of the gravitonic matter has mass of $1.45 \cdot 10^{18}$ Suns!

The electromagnetic energy is $E_{el} = h\upsilon_{Pl} = 2m_{gr}c^2 \cdot \upsilon_{Pl}$, the force of the electromagnetic field is $F_{el} = 2m_{gr}c^2 \cdot \frac{\upsilon_{PL}^2}{2\pi d}$.

Quanta of the "dark energy" field – the subneutrinos – are absorbed by matter, and absorption equals emission (action equals reaction). Emission results in recoil, hence "dark energy" acts like gravitational "attraction".

Table II. The subneutrinic field mechanism

Absorption	Transformation	Emission	Attraction
$2 \cdot 3m_{gr}$ "dark energy"	$3 \cdot 2m_{gr}$ semiphotons	electromagnetic field	recoil

Atoms emit gravitons (gravitation) and semiphotons (the electromagnetic field), but the subneutrinic field is primary, produced by the "Big Bang" event ("dark energy" and also the "dark matter" effects). There exist thus three kinds of physical interactions.

An interaction between the opposite charges can lead to their equilibration only if these charges are "spinning" in one and the same plane in synchronous motions. This means that between the electrons in the electronic shells of atoms and the protons in the respective nuclei an order in their mutual arrangements must issue, due to the

interdependance of orientations and motions of electrons and protons. Thus a nucleus cannot represent a drop of fluid.

VIII. Edward Görlich and Witold Jastrzębski.

The chemical bonds and the rigid electronic structures

The nature of the chemical bonds is electromagnetic[2]. Chemical bonds mean constant distances not only between two nuclei but also between the bonding electrons and these nuclei. Constant distances between opposite electric charges are only possible due to the fact that the charges of electrons and protons are not only electric but are magnetic as well. The negative and positive electric charges produce "attraction", the magnetic charges through the rotating magnetic fields produce kinetic energy opposing attraction. The attraction and the kinetic energies can be equilibrated only at the distances at which rotations of magnetic fields of bonding electrons and the protons are synchronized.

The term "rigid electronic structures" refers to constant distances between the bonding electrons and the bonded nuclei.

The Coulomb law relates only to the electric component of the interactions between the electromagnetic charges. The electrostatic forces cannot lead to formation of chemical bonds, they can only shorten or lengthen them according to the Coulomb law.

1. The rigid electronic structure of the hydrogen atom

The rigid electronic structure of hydrogen atom in the ground state results from minimalization of potential energy which decides on the equilibrium distance between proton and electron, that is the Bohr radius $a_0 = 0.5291773 \cdot 10^{-8} cm$. The energy content of this system is not dependent on the position of the electron on the $2\pi a_0$ circle, but only on the distance a_0 between the point charges $1e^+$ and $1e^-$. It is just that distance which represents the rigid electronic structure of the hydrogen atom; RES H^0 (Fig. 14). With constant distance a_0 this construction is rigid. All rigid electronic structures result from minimalization of energy, like in the case of hydrogen atom.

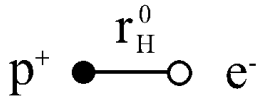


Fig. 14. The rigid electronic structure of the hydrogen atom (RES H^0).

[2] More precisely: electric and magnetic, a division of functions

2. Rigid electronic structure of the helium atom

The rigid electronic structures of multielectronic atoms represent fixed distances of negative electric charges (electrons) in relation to the respective nucleus as the center of the internal reference frame. A rigid electronic structure must fulfil the requirement of minimalization of total energy of such construction.

Ridgidness of the electronic structure in relation to the nucleus remains unchanged notwithstanding the circling of electrons around the nucleus, the entire configuration is rigid.

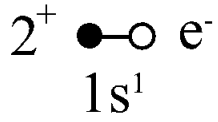


Fig. 15. The rigid electronic structure of the helium cation He^+.

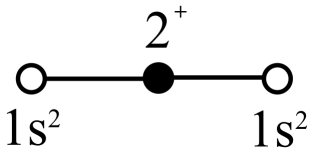


Fig. 16. The rigid electronic structure of the helium atom.

Rigid electronic structures of atoms represent equilibrium distances of electrons from the nucleus and between the electrons, hence they are motionless and massless arrays of dimensionless electric point charges thus presenting a geometric abstraction, a pseudostatic system. Fig. 15 shows RES of the cation He^+ with a single $1s^1$ electron in the $K-$shell. The spectroscopic ionization energy of this electron is $54.417616eV$ and $4Ry = 54.422792eV$. Ionization energy is equal to the total energy and the equilibrium distance of the $1s^1$ electron from the nucleus He^{2+} is obtained from the relation:

$$r_{1s^1} = \frac{1}{2} \cdot \frac{2 \cdot 1}{54.422784} \cdot 14.399651773 = 0.264588665\,\text{Å},$$

based on the virial theorem, or from the relation $\frac{a_0}{Z} = \frac{0.52917733}{2} = 0.264588665\,\text{Å}$ and from $\frac{r_H^o}{Z} = 0.264729382\,\text{Å}$.

From the virial theorem follows that $Ry = \frac{1}{2} \cdot \frac{1 \cdot 1}{a_0} \cdot f_1$ and generally $I = \frac{1}{2} \frac{Z_{eff} \cdot 1}{r} \cdot f_1$, hence $r = \frac{1}{2} \cdot \frac{Z_{eff} \cdot 1}{I} \cdot f_1$ and as $Z_{eff} = \sqrt{\frac{I}{I_H^o}}$ (I_H^o is compatible

with spectroscopic ionization energy), we obtain $r = \frac{f_1}{2\sqrt{I_H^o}} \cdot \frac{1}{\sqrt{I}} = \frac{f_3}{\sqrt{I}}$. Constant $f_3 = 1.952435373.$

Helium atom has two electrons in the $K-$shell with the same spectroscopic ionization energies $24.587165eV$, hence both should be described as $1s^2$ electrons as in the process of ionization they are undistinguishable (Fig. 16) From the "virial" equation the radius of helium atom:

$$r_{1s^2} = r_{He^o} = \frac{1}{2} \cdot \frac{Z_{effHe^+} \cdot 1}{I_H^o} \cdot f_1 \text{ and } Z_{effHe^+} = \sqrt{\frac{24.587165}{13.59843873}} = 1.344651385,$$

$$\text{hence } r_{He^o} = \frac{1}{2} \cdot \frac{1.344651385 \cdot 1}{24.587165} \cdot 14.3996251733 = 0.393751697 \text{ Å}.$$

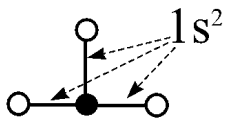


Fig. 17. Nonexistence of the helium anion He^- due to the overbalance of repulsion energy.

This distance equals about $1.487 \cdot r_{1s^1}$. Evidently the presence of the second electron leads to this effect by mutual repulsion and by the change of the rotational energy, an effect not appropriately described as "screening". An anion He^- with 3 electrons in the shell K cannot exist due to the large overbalance of the repulsion energy: $+15.1479$ eV (Fig. 17). Helium atom cannot adjoin a proton to form a HeH^+ composite cation, due overbalance of the repulsion energy: $+47.2815$ eV (Fig. 18). Electrostatic repulsions forbid inclusion of more than two electrons into the $K-$shell of an atom, what explains the Pauli exclusion principle. A free neon atom has 10 electrons, two of them in the $K-$shell, the remaining 8 in the $L-$shell, at a greater distance from the nucleus. This outer $L-$ shell must obey the demands of the minimalization of total energy including attraction of electrons by the nucleus and repulsions between electrons in the $L-$ shell. In the case of multielectronic atoms wave mechanics uses wave functions for hydrogen – like systems. Such system is obtained by introducing the concept of the effective nuclear charge that is the charge which is the source of electric field giving to electron total energy equal to ionization energy which includes the effects of "screening" of the electron by the inner shells electrons. A hydrogen – like system is formed with one positive charge of the effective nucleus and one electron with main quantum number $n = 1$. The effective nuclear charge is

defined as $Z_{eff} = \sqrt{\frac{I}{Ry}}$ or $\sqrt{\frac{I}{I_H^o}}$ [3]. Thus defined Z_{eff} represents the amount of elementary electric charges e^+. As $Z_{eff} = \sqrt{\frac{I_v}{R_y}} = \sqrt{\frac{energy}{energy}}$ it is a dimensionless quantity, like α, and only $Z_{eff} \cdot e$ really represents the effective nuclear charge, but we can use e as the natural unit of the electric and magnetic charge and then Z_{eff} becomes the measure of these charges.

From $Z_{eff_v} = \sqrt{\frac{I_v}{Ry}}$ we obtain $Z_{eff_v} = \sqrt{\frac{a_o}{r_v}}$, because $I_v = \frac{1}{2}\frac{e^2}{r_v} \cdot f$ eV and $Ry = \frac{1}{2}\frac{e^2}{a_o} \cdot f$ eV, thus Z_{eff_v} shows some analogy to $\frac{1}{\alpha} = \sqrt{\frac{a_o}{r_e}}$.

The second definition is used if ionization energy I is obtained by spectroscopic method, as the compatible one. Effective nuclear charges describe the observed electrostatic interactions.

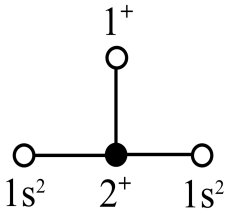


Fig. 18. Nonexistence of the composite cation HeH^+ due to the overbalance of the repulsion energy.

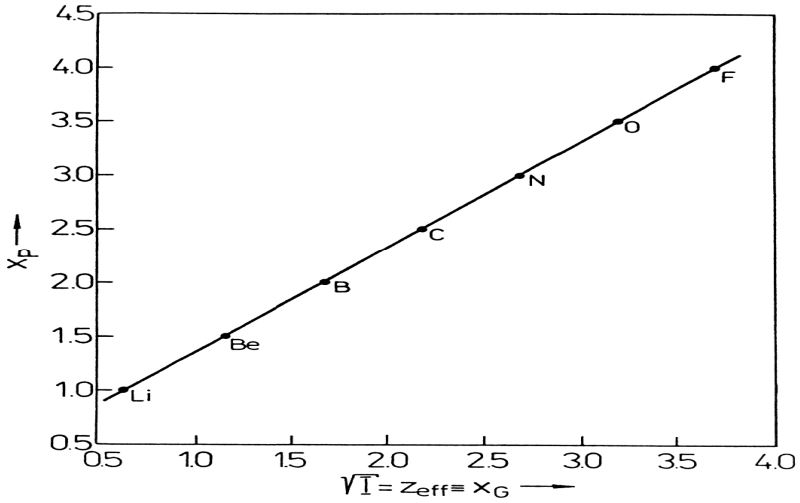


Fig. 19. Pauling electronegativities of elements vs. the effective nuclear charge Z_{eff} (second period).

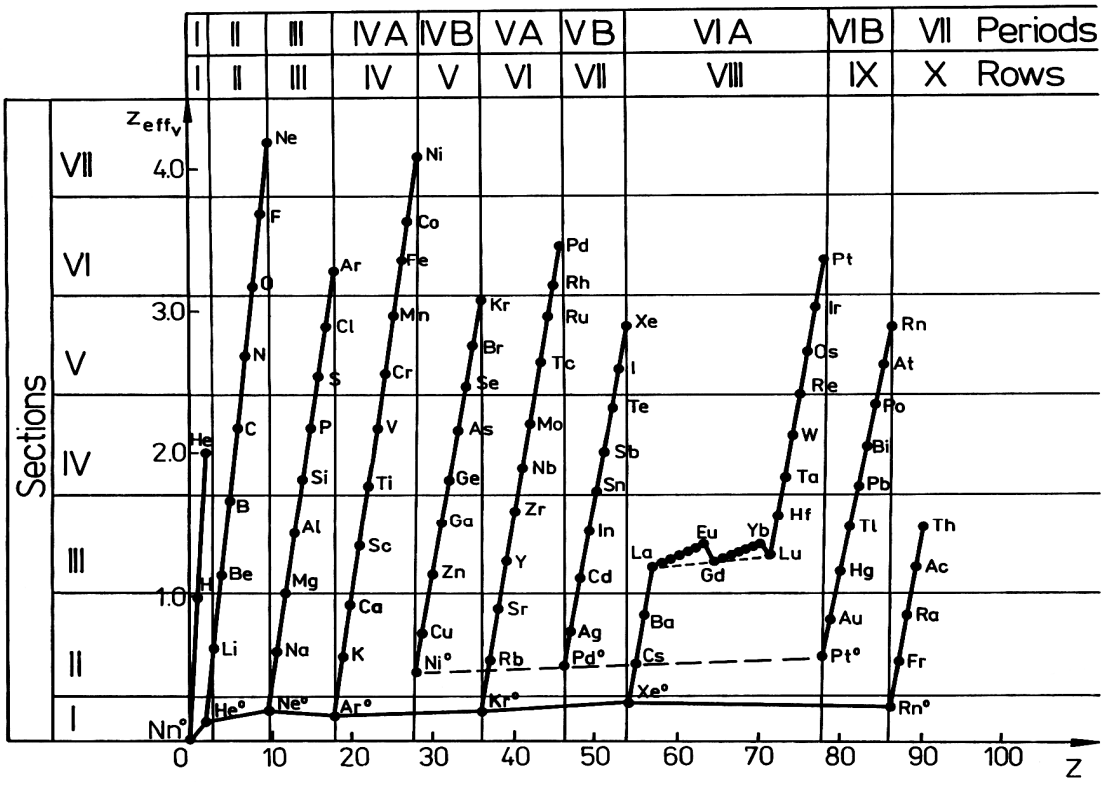


Fig. 20. The periodic chart $Z_{eff}v$ –Z.

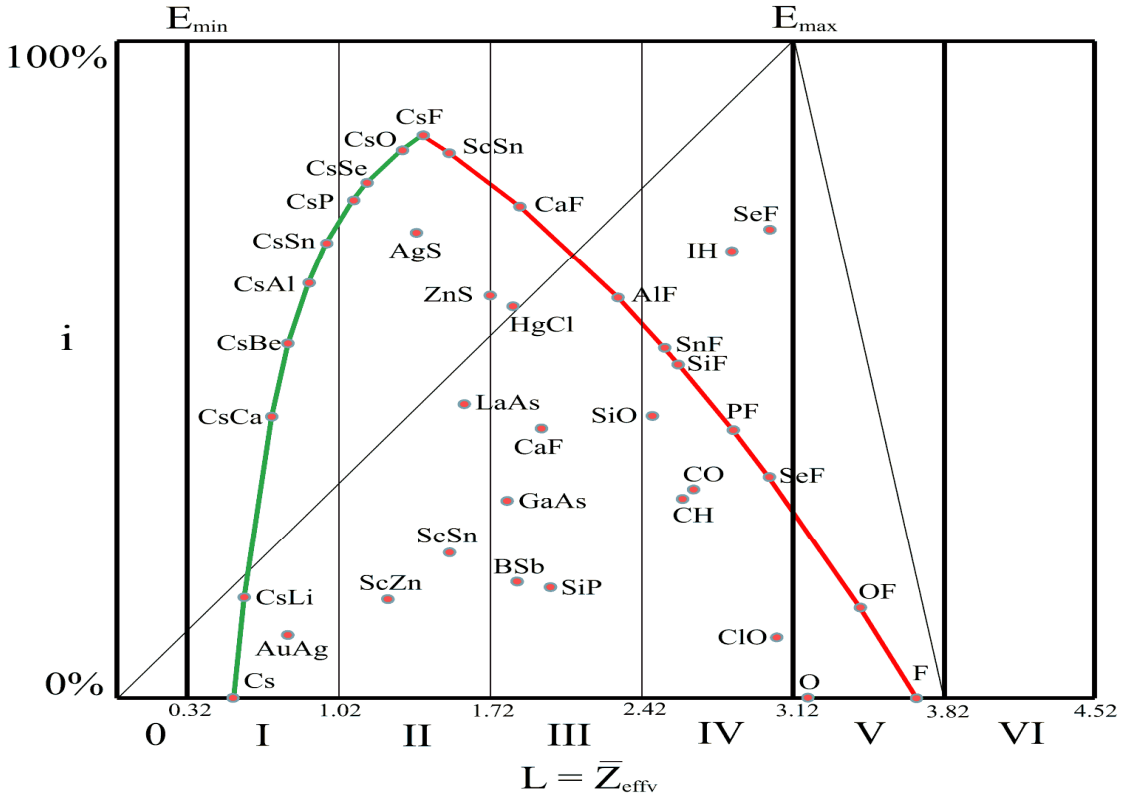


Fig. 21. The triangle of the character of chemical bonds in $Z_{eff}v$-i coordinates.

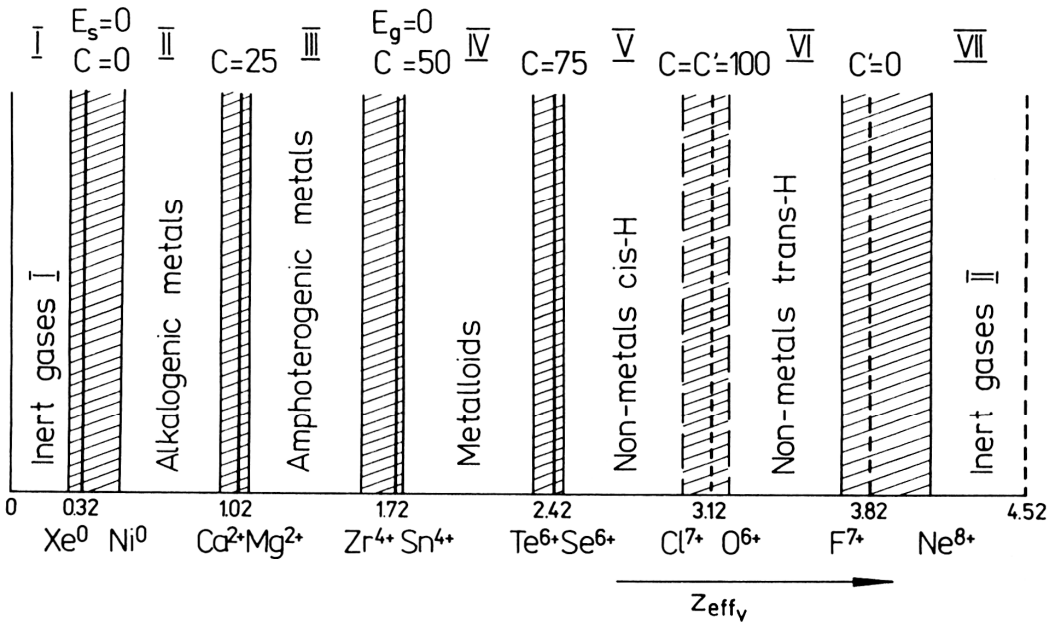


Fig. 22. The boundaries of sections (experimental).

3. The effective nuclear charges and electronegativity

The effective nuclear charge so defined has dimension of $\sqrt{energy}$, that is the same as that proposed by Pauling for his electronegativity concept. It can be shown that the effective nuclear charges measure electronegativity of the chemical elements when $I=I_v$, the ionization energy of the last single valency electron of the atom, leaving the respective atomic core.

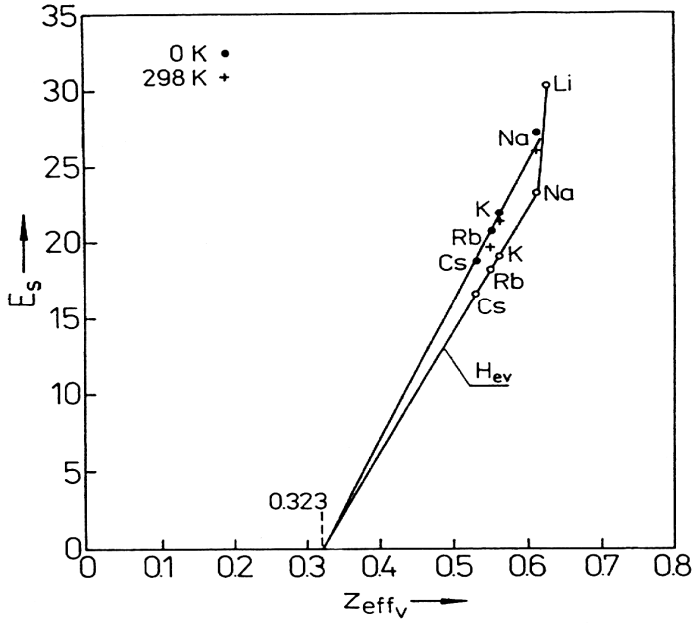


Fig. 23. Sublimation energies of alkali metals (v=1) vs. Z_{effv}.

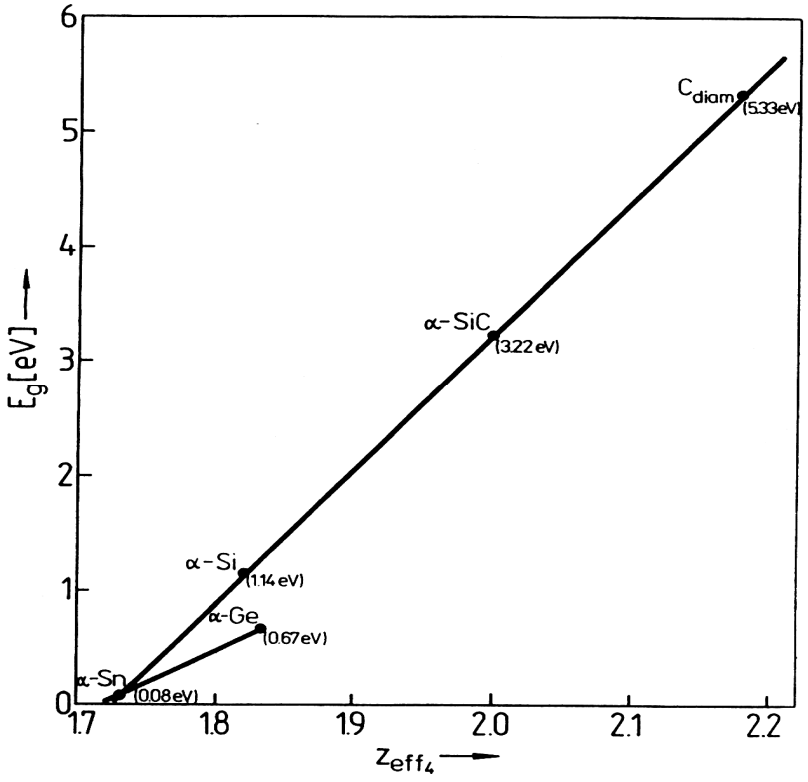


Fig. 24. Linear dependence of energy gap E_g in a series of v=4 elements of the effective nuclear charges.

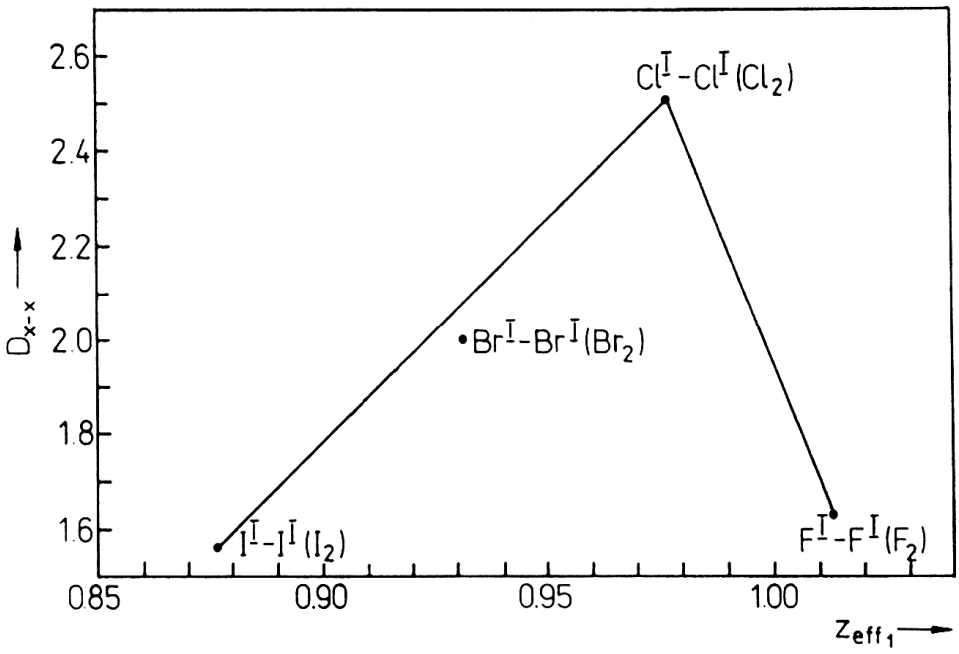


Fig. 25. Dissociation energies of the halogen molecules X_2 vs. the effective nuclear charges Z_{eff1}.

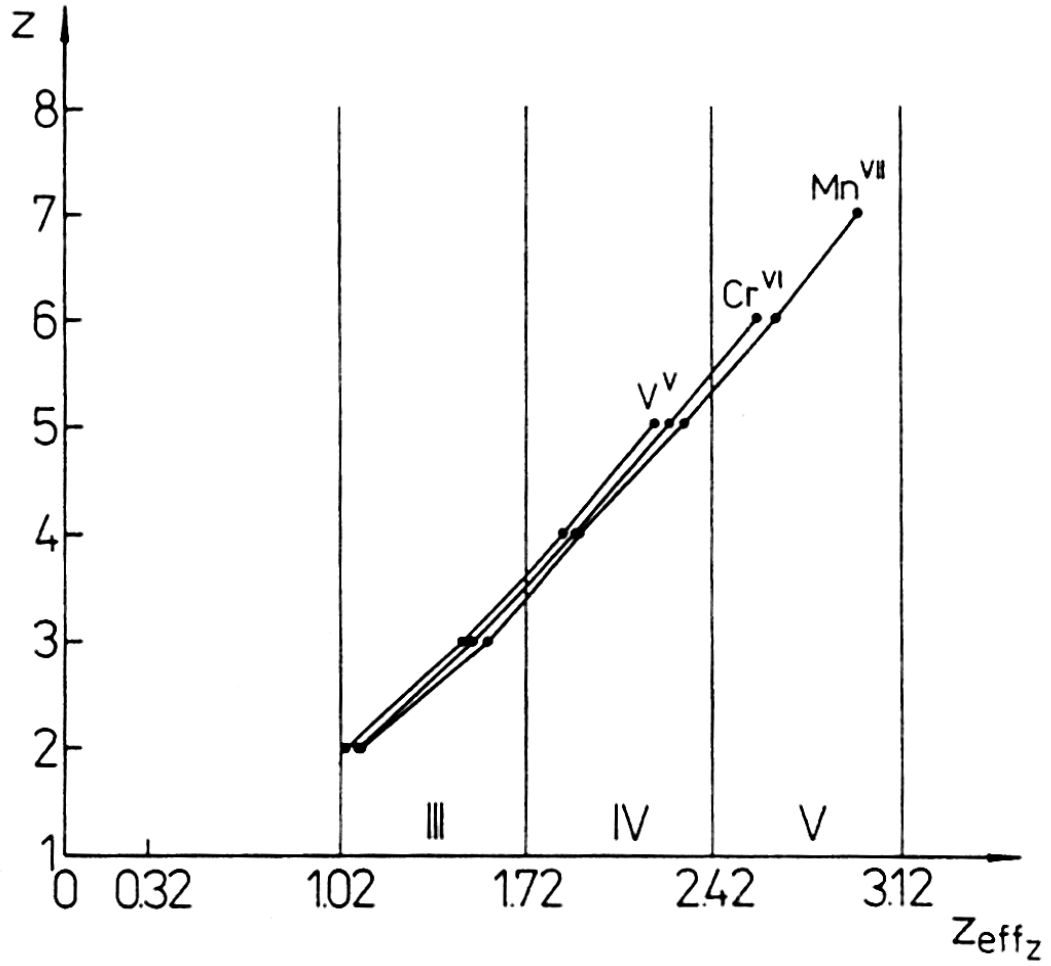


Fig. 26. The number z of bonding electrons in the case of vanadium, manganese and chromium cations and the division into sections.

The electronegativity scale proposed by Pauling [2] is a relative one, based on indirect relations, such as dipole moments of molecules, the physical basis of the electronegativity concept was not clear. Electronegativity scale based on the effective nuclear charges [3] is an absolute one, direct and very precise. The Pauling electronegativity scale and the effective nuclear charges scale are however in a very good compatibility, especially for the lighter atoms.

Table III. Electronegativity $x_G = Z_{effv} = \sqrt{\frac{I_v}{I_H}}$

Atomic core	Electrone-gativity x_G	Atomic core	Electrone-gativity x_G	Atomic core	Electrone-gativity x_G
Fr^{+}	0.531	Th^{4+}	1.453	At^{7+}	2.60
Cs^{+}	0.535	Tl^{3+}	1.481	Tc^{7+}	2.63
Rb^{+}	0.554	Ga^{3+}	1.503	N^{5+}	2.863
K^{+}	0.565	Hf^{4+}	1.57	Os^{8+}	2.70
Na^{+}	0.615	Zr^{4+}	1.589	Br^{7+}	2.753
Li^{+}	0.630	B^{3+}	1.670	$Ir^{8}+$	2.77
Ag^{+}	0.746	Sn^{4+}	1.731	Pt^{8+}	2.83
Cu^{+}	0.754	Pb^{4+}	1.764	Xe^{8+}	2.845
Au^{+}	0.824	Ti^{4+}	1.783	Rn^{8+}	2.86
Ba^{2+}	0.858	Ta^{5+}	1.82	Cl^{7+}	2.898
Ra^{2+}	0.864	Si^{4+}	1.822	Mn^{7+}	2.962
Sr^{2+}	0.901	Ge^{4+}	1.833	Ru^{8+}	2.96
Ca^{2+}	0.934	Nb^{5+}	1.928	Rh^{8+}	3.04
H^{+}	1.000	Sb^{5+}	2.024	Kr^{8+}	3.06
Mg^{2+}	1.051	Bi^{5+}	2.03	Pd^{8+}	3.116
Cd^{2+}	1.115	W^{6+}	2.118	$H^{+}_{(in\ H_2)}$	[3.12]
Zn^{2+}	1.149	As^{5+}	2.147	O^{6+}	3.187
Be^{2+}	1.157	C^{4+}	2.178	Ar^{8+}	3.248
Hg^{2+}	1.174	P^{5+}	2.187	Fe^{8+}	3.335
La^{3+}	1.188	V^{5+}	2.191	Co^{8+}	3.48
Ac^{3+}	1.213	Mo^{6+}	2.22	Ni^{8+}	3.536
Ce^{3+}	1.219	Te^{6+}	2.28	Co^{9+}	3.667
Y^{3+}	1.228	Po^{6+}	2.32	F^{7+}	3.690
Gd^{3+}	1.232	Re^{7+}	2.41	Ni^{10+}	4.045
Lu^{3+}	1.241	Se^{6+}	2.451	Ne^{8+}	4.183
Sc^{3+}	1.349	S^{6+}	2.545		
In^{3+}	1.436	I^{7+}	2.58		
Al^{3+}	1.446	Cr^{6+}	2.581		

An important observation is that the effective nuclear charges Z_{effV} plotted against the atomic number Z recreate the initial short form of the Mendeleevian periodic chart (Fig. 20). From the extrapolations on the Z-Z_{effV} chart rest charges of the "neutral" free atoms can be obtained. Hydrogen atom H° has the rest charge Z_{eff}=0.23e^{+}, Z_{eff}He°=0.14e^{+}, Z_{eff}Xe°=0.26e^{+}, Z_{eff}Ni°=0.49e^{+}, Z_{eff}Pt°=0.59e^{+}.

As in the case of the Pauling scale of electronegativity, ionicity of chemical bonds can also be established using the effective nuclear charges Z_{eff} and the relation $i = 1 - \frac{Z_{eff_1}}{Z_{eff_2}}$, where $Z_{eff_1} > Z_{eff_2}$. In this definition ionicity means asymmetry of bonds, as $Z_{eff} = \frac{a_0}{r_{eff}}$.

The effective nuclear charges can also be used to estabilish the degree of localization of the bonding electrons in homonuclear and heteronuclear bonds. In alkali metals electrons are weakly localized, in diatomic molecules such as H_2 they are strongly localized. The degree of localization in homonuclear bonds is described by $L = Z_{eff_V}$ and in heteronuclear bonds $L = \sqrt{Z_{eff_1} \cdot Z_{eff_2}}$, a geometric mean of the effective nuclear charges involved.

Using *L* and *i* as Cartesian coordinates a systematics of the chemical bonds character can be constructed (Fig. 21).

Regularities appear in the observed changes of the bond character, hence in the physical and chemical properties of chemical elements in their natural state at normal temperature and pressure, along the Z_{eff_V}, that is L-axis (Fig. 22).

Homonuclear chemical bonds between atoms of elements can come into being only above $Z_{eff}>0.323e^+$. From this value electronegativity x_G begins to describe the bond character (Fig. 23.). From the plot in Fig. 24 through extrapolation follows that the energy gap in elements begins at $Z_{eff_V} = 1.72e^+$. This value is confirmed by E_g=0.08eV in the grey tin (α-Sn) as $Z_{eff}Sn=1.731e^+$. At about 18°C grey tin transforms into white β-Sn with metallic properties. Thus the boundaries $0.32e^+$ and $1.72e^+$ can be estabilished experimentally. Between 0.32 and $1.72e^+$ there is the distance of $1.4e^+$ on the x_G=L scale. Fig. 22 shows in this span of values two sections: II and III. In the first one are included the alkalogenic metals from Cs to Li, in the second one the amphoterogenic metals from Mg to Zr. Hence each of the two sections has the span of $0.7e^+$ if both are equal. Adding 0.7 to $0.32e^+$ a value $1.02e^+$ is obtained. Now $Z_{eff2}Ca^{2+}$ is $0.934e^+$ and $Z_{eff2}Mg^{2+}$ is $1.051e^+$. As calcium is alkogenic and magnesium weakly amphoterogenic the boundary lies about the value $Z_{eff}=1.0e^+$ in good agreement with the value $1.02e^+$.

On assumption that the period $0.7e^+$ is valid for all sections on the $x_G=L=Z_{eff}$ axis we obtain a set of boundaries: 0.32–1.02–1.72–2.42–3.82–(4.52) in e^+ units, in good agreement with observed properties of the elements (Fig. 22). Selenium is close to the 2.42e+ boundary: $Z_{eff6}=2.451e^+$. Black selenium is metalloidic (section IV) and red selenium is nonmetallic (section V). At the boundary 3.12e+ oxygen ($Z_{eff6}O=3.187e^+$) belongs to nonmetals in section V.

The existence of a boundary inside the nonmetallic character results from the fact that with Z_{eff_V} values above 3.12e+ repulsion between the effective nuclei counteracts the attraction of the bonding electrons. This is made evident by the diagram $Z_{eff_V} - D_{A-A}$ where D_{A-A} is the dissociation enthalpy of the molecules A_2 (Fig. 25). Dissociation enthalpy of the oxygen molecule O_2 is also relatively low. Somewhere between Cl_2 and O_2 molecules on the x_G scale lies the turning point, probably at $3.12e^+$. Above $Z_{eff_V} = 3.82e^+$ repulsion between the effective nuclei becomes so

strong that formation of stable homonuclear bonds becomes impossible at normal conditions.

Each step of ionization of a given atom produces cation in a respective "oxidation" step I^n, with corresponding Z_{effn} value, where n is the oxidation degree.

Fig. 26 shows that the chemical behaviour of cations also falls in proper sections, evidently Z_{eff} values decide on the chemical properties, not only of the elements in their natural state, but also of the cations. Hence also the radii of cations can be calculated in the same way as that of the atoms: $\frac{a_o}{Z_{eff_n}}$. Thus $r_{eff}Na^+ = 0.87\,\mathring{A}$, $r_{eff}Si^{4+} = 0.29\,\mathring{A}$ represent their real radii. A problem arises with hydrogen molecule H_2. According to the definition $Z_{efff_1} = \sqrt{\frac{I_H}{I_H}} = 1$. This value places hydrogen as the element between the alkalogenic metals which it is not. The elementary hydrogen at normal conditions, hence in natural state, is a diatomic molecule H_2, as further hydrogen atoms cannot be joined.

Among the diatomic molecules of elements the H_2 molecule shows by far the greatest stability, its $D_{H\text{-}H}$=4.5316eV at 25°C, whereas the Cl_2 molecule shows $D_{Cl\text{-}Cl}$=2.5095eV.

It must be stressed that the concept of electronegativity (x_G) applies to chemical elements in their natural state at normal external conditions, as homonuclear compounds. The effective nuclear charges on the other hand refer to ionization energies of free atoms and to removing of a single electron connected with a single effective nucleus.

Electronegativity of the hydrogen molecule with RES square symmetry D_{2h} represents the sum of the effective nuclear charges of the virtual 4 hydrogen atoms forming the sides of the RES square. Would only the attractions been accounted for, this sum would be x_{H2} = 4, but as the repulsions are also acting, the electronegativity of the hydrogen molecule H_2 must be calculated from its internal energy (stability energy) = 15.9 eV; hence for one hydrogen atom 15.9/2 = 7.95 eV. This energy expressed in the natural atomic units of energy 13.6 eV (1Ry) is 7.95/13.6 = 0.585, hence the respective effective charge is $\sqrt{0.585} = 0.765e$ and $4 \cdot 0.765 = 3.06e$. The hydrogen molecule electronegativity which follows from the considerations concerning the electronegativity scale x_G is 3.12 e, the discrepancy of about 2% is due to some inaccuracy of data used in the process. We may assume the value 3.1 e as electronegativity of the H2 molecule (Pauling assumed 2.1). Hydrogen molecule is the strongest bonded one among the diatomic molecules.

As there is an evident concurrence between the Z_{effv} scale and electronegativity x_G scale it must be assumed that electronegativity x_G concerns a one electron bond in the element as the homonuclear compound, as Z_{eff} concerns one electron in the un-

bounded atom. Hence electronegativity x_G refers to $A \cdot A$ bonds and not for instance to $A : A$ bonds. It follows that the attraction of a single bonding electron by two equal effective nuclei is a reliable gauge of the properties of chemical bonds in the elements in natural states. In the special case of hydrogen with $p^+ = e^- = 1e$, $Z_{eff}H°$ refers to the rigid electronic structure of the hydrogen atom (Fig. 14) and x_GH refers to the rigid electronic structure $H^+ \cdot H^+$ (Fig. 27). Hence statistically and formally it falls $0.5e^+$ on each effective nucleus that is in this case on each proton. As $Z_{eff1}H°e^+=1e^+$, hence $\sqrt{0.5} = 0.707e^+$. As the span $0.7e^+$ is the distance between the boundaries of sections on the x_G electronegativity scale, so the $H^+ \cdot H^+$ bond length seems to be the yardstick for the section length. The discrepancy 0.707-0.7=0.007 (0.99%) seems to be acceptable.

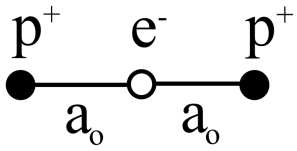


Fig. 27. The rigid electronic structure $H^+ \cdot H^+$

We can thus rely on the precision of the x_G electronegativity scale within the 1% limit at least.

As the 0.7e+ span of sections on the x_G scale seems to be connected with the $H^+ \cdot H^+$ one electron bond, and as $3.12e^+ - 0.32e^+ = 4 \cdot 0.7e^+ = 2.8e^+$ and $2.8 + 0.32 = 3.12e^+$ the value $3.12e^+$, as electronegativity of hydrogen, becomes the most probable one. Pauling proposed 2.1 as the electronegativity x_P of hydrogen. The ionicity of the M^I-H bonds in the hydrides of the alkalogenic metals (Table IV) shows that the Pauling ionicity values i_P are not only much less precise than the i_G values, but also give erroneous results. For instance i_PLiH=28% and I_PHCL=24%, but actually LiH is a crystalline salt at normal conditions and not a gas of diatomic molecules. The rigid electronic structure of the bond $H^+ - e^- - H^+$ shows that repulsion energy is $\frac{1 \cdot 1}{2a_o} \cdot \frac{e^2}{\text{Å}}$ and attraction energy is $2 \cdot \frac{1}{2} \cdot \frac{1 \cdot 1}{a_o} \cdot \frac{e^2}{\text{Å}}$, hence $E_{attr}=2E_{rep}$ and assures stability of the H_2^+ molecular ion.

Table IV

A · H	I_G [%]	I_P [%]
Cs · H	**82.85**	**39**
Rb · H	**82.24**	**35.5**
K · H	**81.89**	**34.5**
Na · H	**80.29**	**30**
Li · H	**79.81**	**28**
…	…	…
H · Cl	***7.12***	***24***

A one-electron bond joins atoms in their first step of "ionization": A^+. Hence $Z_{eff1}H^+e^+=1e^+$ the bond $Cl^+–e^–Cl^+$ is accordingly weaker than the bond $H^+ - e^- - H^+$. But Z_{eff1} $F^+e^+=1.281e^+$ and on this basis the bond $F^+ - e^- - F^+$ should be stronger than the bond $H \cdot H$, but this is not, due to strong repulsion between the F^+ "cations" weakening the effects of attraction by the bonding electron. Neverthless it is finally the effective nuclear charge Z_{effv} of the atomic cores which in effect decides on the $Z_{eff1}A^+e^+$ value in the multielectronic atoms.

The periodic chart $Z_{effV} - Z$ (Fig. 20) shows two kinds of periodicities and not only one, as the Mendeleevian short form which concerns in fact free "neutral" atoms of elements (7 periods). There is a second periodicity revealed in the $Z_{effV} - Z$ periodic system which concerns atoms of the chemical elements bonded together in the natural states of these elements (7 sections). Thus $Z_{effV} - Z$ chart represents a double periodicity (sections as well as periods).

What is remarkable is that there is something very special in the existence of the electronegativity scale at all. It orders physical and chemical properties of elements at normal conditions only. The adjective "normal" means such conditions as prevail on Earth. At the very high temperatures no chemical bonds can exist and at very high pressures all bonds (even in hydrogen) become metallic. Conditions on Earth are thus special in many ways, enabling the existence of life, and the diversity of the properties of the elements is among them.

4. The rigid electronic structures of closed electronic shells in atoms

An inner periodicity within the lanthanides is shown in Fig. 28. Contraction of lanthanides is explained by the confinement of 32 electrons in one shell N, all at the same distance from the nucleus.

In a free neon atom each of all 8 electrons in the $L-$ shell, if it is full, shows the same ionization energy, hence they all are at the same distance from the nucleus and this distance is the proper radius of the neon atom. All electrons in one full shell are energetically undistinguishable from one another, hence are equivalent. They are all

placed on a sphere with the radius of the atom and the condition of minimalization of energy requires even spacing of electrons on this sphere. A closed, fully occupied $L-$ shell has the same symmetry in any atom, if all outer electrons are removed. The presence of outer shells requires adaptations of orientation of the inner shells. $L-$ shell contains up to 8 electrons (Fig.29).

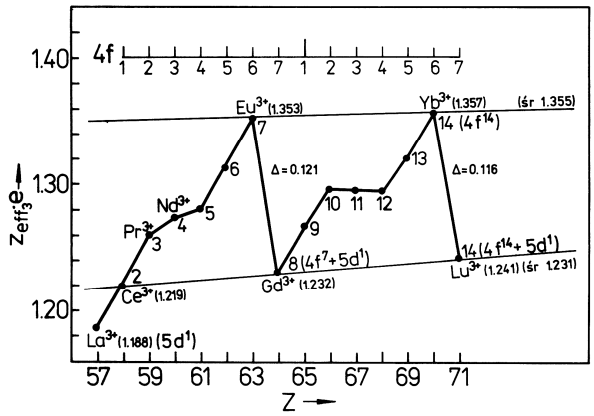


Fig. 28. The subperiodicity of the lanthanides.

Periods concern effective nuclear charges Z_{eff_v} of the free atoms and sections concern electronegativities x_G, of the elements as homonuclear compounds. In all cases with the exception of hydrogen $Z_{eff_v} = x_G$, but for hydrogen atom $Z_{eff_1} = 1e$ and for the molecular ion H_2^+, x_G=3.12e. In the plot $\overline{Z}_{eff_v} - E$ (Fig. 21 and Fig. 25) bonding energy E at first is growing with growing effective nuclear charge Z_{eff_v}, reaches an apex at $Z_{eff}H^+$, and then falls down with growing repulsion between the effective nuclear charges. Repulsion weakens attraction between bonding electron and the wffective nuclear charges. Beyond $Z_{eff}H^+ = 3.12e$ the effect of repulsion is stronger than the effect of attraction with growing Z_{eff_v}. In the case of hydrogen there is no repulsion between protons as effective nuclear charges of hydrogen, hence it is only attraction which counts, thus making the single electron bond in H_2^+ the strongest (E_{max}). In alkali metals hydrides proton and electron are in neutral position, hence alkali metals in hydrides behave as their free atoms, as only forces between their effective nuclear charges and the bonding electrons in their valency shells are active. Thus x_G=3.12e for hydrogen applies also in this case (Table IV, p.33.). Above Z_{effv}=3.82e repulsion accedes attraction and no chemical bonds can be formed between identical atoms at normal external conditions.

Closed M and N shells contain 18 electrons each (Fig. 30.) and O-shell contains 32 electrons (Fig.31.). These electrons are placed on the surface of a sphere with

atomic radius of the respective inert gas element. As the electrons are orderly distributed on the surface of a sphere, then the resulting negative charge, in accordance with the laws of electrostatics, acts like being placed at the center of the respective circle, “neutralizing” the nuclear charge. Of course electrons are not falling on the nucleus but remain at some distance from it, hence the electron affinity of a neutral atoms appears if a concentrated electric field is applied, such as produced by a single electron “probe”. Only in the uniform, homogenous fields, such as used to establish the dipole moments, these charges are in the case of neutral atoms not detectable. Without the rest charges neither condensed states of matter nor forming of chemical bonds would be possible. The so called “Casimir pressure” (1945) between completely clean metal plates is due to this rest charges and not to any other factor. It resembles the van der Waals forces acting between “neutral” molecules.

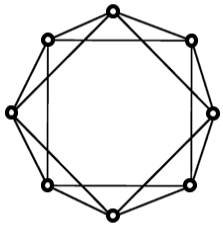


Fig. 29. The rigid electronic structure of the L - shell.

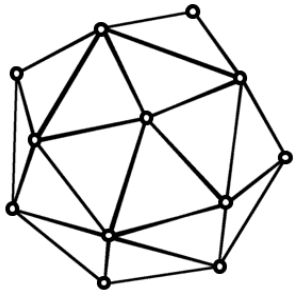


Fig. 30. The rigid electronic structure of the M and N - atomic shell.

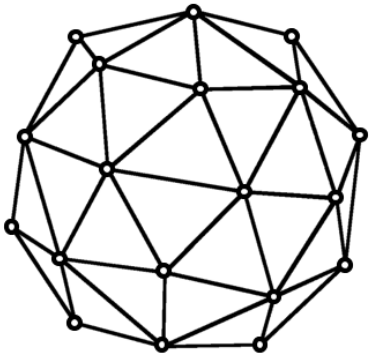


Fig. 31. The rigid electronic structure of the O - atomic shell.

The universally accepted view is that the electronic configurations established from the respective ionization energies represent electronic structures of isolated neutral atoms, but this not so. Ionization energies consecutively remove electrons from the atom and this means decomposition of the electronic configuration of this atom. At each step of ionization a new equilibrium, depending on the minimalization of total energy of the system, is established and a possibly highest symmetry of the distribution of electrons in the respective electron shell results. Each step of ionization leads to a new state of equilibrium, a new symmetry of configuration of the electrons in the incomplete shell. These new states have nothing in common with the distribution of electrons in isolated atoms with full set of electrons, equal to the atomic number Z. The configurations appearing in the course of ionization process are not, and cannot be, preserved in “neutral” atoms. Full electronic shells are formed consecutively:

K, L M, N and O with respectively 2, 8, 18, 18 and 32 electrons in closed shells. Shell K ends with He, shell L ends with Ne, shell M ends with Ni, shell N ends with Pd and shell O ends with Pt (see Fig. 20, p. 33). In each shell electrons are at the same distance from the nucleus of the respective atom and are evenly distributed on the surface of a sphere, as demands the minimalization of total energy (Fig. 29, 30, 31). The two $K-$shell electrons are placed on a circle opposite to each other, and Fig. 32 shows the arrangement of electrons in the $L-$ shell of the neon atom, according to their ionization energies and Fig. 33 shows their real arrangement, satisfying the energy minimalization requirements. Very strong repulsions between electrons makes the arrangement shown in Fig. 32. impossible, due to the excess of internal energy.

The "onion-like" relative configuration of the electronic shells in atoms must produce an exact replica in the distribution of the protons in the respective atomic nuclei due to the constant equilibrium distances between electrons and protons which are bonded with these electrons. Hence the "rows" in the periodic system Z_{effv}–Z (Fig.20) are connected with both these structures.

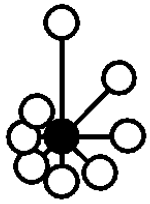


Fig. 32. The L – shell of the neon atom according to consecutive ionization energies.

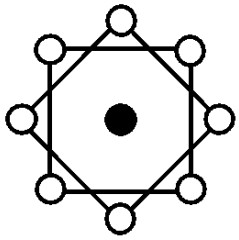


Fig. 33. The real distribution of electrons in the neutral neon atom L – shell.

The atomic radius of an isolated atom is defined as the distance of the outermost electron from the nucleus. Atomic radius of lithium atom is determined by the distance of its single valency electron in the shell L, that is $2s^1$ electron from the nucleus Li^{3+}. The two inner, $K-$ shell electrons with $1s^2$ symbol, are at the distance $r_{effK} = r_{1s^2}$ from the nucleus. The effective nuclear charge acting on these electrons is $Z_{effK} = \sqrt{\frac{75.64}{13.59843873}} = 2.358474775e^+$. The radius of the $K-$shell in lithium atoms is $r_{eff\,1s^2} = \frac{f_3}{\sqrt{I_L}} = \frac{1.952435}{\sqrt{75.64}} = 0.224492\,\text{Å}$. The rigid electronic structure of the lithium atom is shown in Fig. 34. The radius of the $L-$shell is $r_{effL} = \frac{1.952435}{\sqrt{5.39172}} = 0.8408393\,\text{Å}$, as $I_L^o = 5.39172eV$. Repulsion by the valency electron $2s^1(L)$ places the two $K-$shell inner electrons perpendicularly to the atomic radius on the plane on which they circle around the nucleus Li^{3+}. Because $\cos 90^o = 0$, the radius of the lithium atom is not altered by the presence of the $K-$shell electrons.

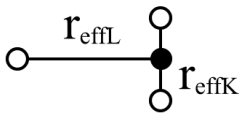


Fig. 34. The rigid electronic structure of the lithium atom Li^0.

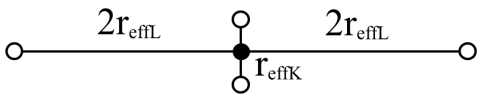


Fig. 35. The rigid electronic structure of the lithium anion Li^-.

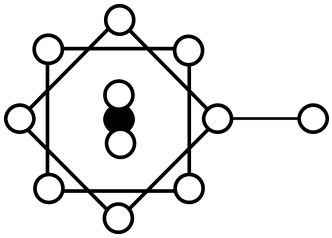


Fig. 36. The rigid electronic structure of the sodium atom Na^0.

Rigid electronic structure of the lithium anion Li^- is shown in Fig. 35. General relation is $r_{eff} = \frac{1}{2}\frac{Z_{eff}\cdot n}{I}\cdot f_1$ and as in this case $n=2$, hence $r_{effLi^-} = 2r_{effLi^o}$, as for lithium atom $n=1$. The radius of the lithium atom in the lithium anion Li^- is twice that of the free atom Li^o : $2\cdot 0.8408393 = 1.6816786\,\overset{o}{A}$. Atomic radius of the sodium free atom presents a more complicated problem. Sodium atom consists of two electrons in the innerst $K-$shell, 8 electrons in full $L-$ shell and one electron in the valency shell M. Fig. 36. shows RES of the sodium atom. The $L-$ shell (Fig. 33) is oriented towards valency electron in such a way as to minimize repulsion energy, hence r_{effL} contributes only $r_{effL}\cdot\cos 45^o$ to the radius. The two $K-$ shell electrons are oriented at 45^o towards $L-$ shell electrons. The resulting formula for the sodium atomic radius is: $r_{Na^0} = (r_{effK} + r_{effL})\cos 45^o + r_{effM}$. Atom which lost all his valency electrons is described as “atomic core”. The atomic core of the sodium atom has radius $r_{effK}\cos 45^o + r_{effL}$, the same as cation Na^+. To obtain the radius of the neutral sodium atom we must first calculate the respective effective radii from the ionization energies:

$$r_{effK} = \frac{1.952435}{\sqrt{1465.09}} = 0.051087\,\overset{o}{\text{A}}$$

$$r_{effL} = \frac{1.952435}{\sqrt{47.28}} = 0.283947\,\overset{o}{\text{A}}$$

$$r_{effM} = \frac{1.952435}{\sqrt{5.13908}} = 0.861259\,\overset{o}{\text{A}}$$

Ionization energies were taken from [*www.webelements.com*] (spectroscopic values). The resulting atomic and anionic radii of sodium are shown in Table V.

Table V. Composite construction of the radius of the sodium anion Na^-.

$$r_{Na^-} = (r_{effK} + r_{effL}) \cdot \cos(45^0) + r_{effM} + r_{effM}$$

Radius of the atomic core (contribution)

0.2368502 $\overset{o}{\text{A}}$

Radius of the free sodium atom Na^o 1.0981112 $\overset{o}{\text{A}}$

Radius of the sodium anion Na^- 1.9593722 $\overset{o}{\text{A}}$

5. The hydrogen molecule

In the hydrogen molecule H_2 there is repulsion between two electrons and repulsion between two protons which is not acting in the hydrogen atom. Attraction energy and kinetic energy of electrons in the bonded hydrogen atom remain the same as in free atoms.

Elementary electric charges of the electron e^- and of proton e^+ remain constant at all possible physical conditions in the Universe, from their birth about $10^{-11} s$ after the Big Bang, up to now.

Hydrogen atoms represented by their rigid electronic structures assume the configuration of a dipole (Fig. 14). Their joining together into hydrogen molecule can be realized only in one way: with e^+ charges of the protons against the e^- charges of the electrons, otherwise they would repel each other, what in quantum mechanics is described as antibonding orbitals. The distance between these two equal electric charges with opposite signs is a_o at the ground state and at O K, hence through mutual attraction the two hydrogen atoms in the hydrogen molecule H_2 must form rigid configuration with electric charges at the corners of a square. The rigid electronic structure hydrogen molecule has thus symmetry D_{2h} (Fig. 37). The rigid electronic structure of hydrogen molecule with square D_{2h} symmetry is stable because energies of attraction and repulsion equilibrate each other at the four apices of thesquare, energy of attracion = – 19.23109837 eV and energy of repulsion = + 19.23109837 eV. Hence the Bohr radius a_0 at each of the four sides remains unchanged. Due to the planar symmetry of the electromagnetic fields of electric charges involved they all are on one plane and a flat molecule results. Herschbach [4] suggested that the RES of the hydrogen molecule is not flat and has C_{2v} rhombic symmetry, but electrostatic repulsions and the character of the electromagnetic field make such a configuration impossible. If no external electromagnetic fields are acting on a hydrogen molecule its orientation in 3D space has no constraints, hence to an outside observer in the time

average this molecule assumes spherical shape, but this does not represent the real shape of the hydrogen molecule.

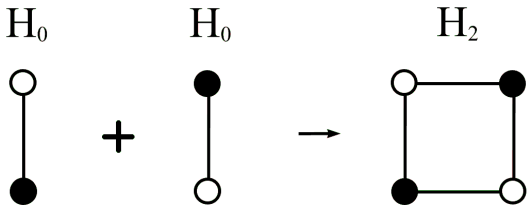


Fig. 37. The rigid electronic structure of hydrogen molecule H_2.

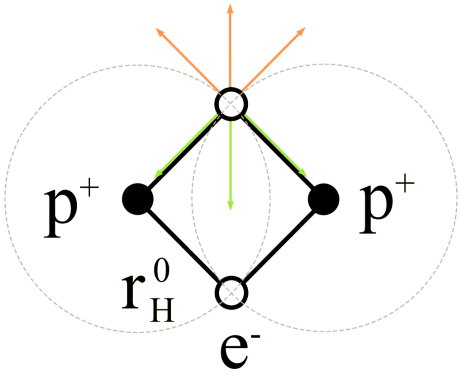


Fig. 38. Fixed position of the bonding electrons in the hydrogen molecule rigid electronic structure.

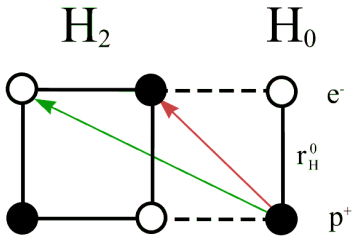


Fig. 39. Nonexistence of the H_3 hydrogen molecule due to overbalance of the repulsion energy.

The antiparallel arrangement of two RES H^o „dipoles" leads to fixed positions of electrons in the molecule. This results from opposite senses of rotation of bonding electrons, counteracting their motions, (Fig. 38). The structure of the hydrogen molecule is in fact rigid. Hydrogen molecule H_3 cannot be formed due to strong overbalance of the repulsion energy (Fig. 39): $H_2 + H^0 \rightarrow H_3 + 26.31\text{eV}$.

The D_{2h} square planar structure of the hydrogen molecule results from minimalization of the potential energy.

Attraction and repulsion energies acting on one electric charge at the apex of the D_{2h} square hydrogen molecule structure, along the diagonal, are:

$E_{attr} = 2 \cdot \frac{1}{2} \cdot 1 \frac{1 \cdot 1}{r_H} \cdot \cos(45) \cdot f$ eV and $E_{rep} = \frac{1 \cdot 1}{r_H \sqrt{2}} \cdot f$ eV.

As $r_H = 0.5294597 \overset{o}{\text{A}}$ and $f = 14.399652$ hence :

$E_{attr} = -19.23109837$ eV and $E_{rep} = +19.23109837$ eV, producing the equilibrium state od D_{2h} structure of the hydrogen molecule H_2.

Only RES D_{2h} symmetry satisfies the condition of minimalization of total energy of the hydrogen molecule H_2 and no other one. The internal energy of hydrogen molecule is $-15.8578eV$, on two moles of hydrogen atoms, or –31.7156eV on one mole of molecules at 25^0C (298.18 K). The internuclear distance (bond length) at this temperature is $0.7510845 \overset{o}{\text{A}}$, as calculated and $0.751 \overset{o}{\text{A}}$ from thermochemical experiment [5]. The difference between attraction energy and repulsion energy in the RES D_{2h} H_2 at $298.18K$ is $-54.22597646eV + 38.34355567 = -15.882079eV$, a discrepancy of 0.155%.

It is widely assumed that the bond length d_{H-H} at 0 K is $1.4 \times 0.53 = 0.742 \overset{o}{\text{A}}$. According to the more precise calculations $d^o{}_{H-H} = 0.7414 \overset{o}{\text{A}}$. The factor 1.4 represents an arbitrary adjustment, but from the rigid structure symmetry D_{2h} results $d^o_{H-H} = a_o \sqrt{2} = 0.7483697 \overset{o}{\text{A}}$. By introducing a correction factor $\frac{\sqrt{2}}{1.4} = 1.01015245$ the distance $0.7414 \overset{o}{\text{A}}$ becomes $0.748927026 \overset{o}{\text{A}}$, the discrepancy with $r^o_H \sqrt{2} = 0.7487677 \overset{o}{\text{A}}$ is 0.02% (the experimental bond length is obtained from spectroscopic data, relating to $13.59843873eV$, $r^o_H = 0.5294597 \overset{o}{\text{A}}$). Gaussian 94, commercial quantum mechanical computations (Table VI) which are not applying the so called “scaling factor”, relating to the 1.4 factor, such as BLYP 3-21G and $6-31G(d,p)$ result in the mean distance $d_{H-H} = 0.7488 \overset{o}{\text{A}}$ (discrepancy 0.004%) and a more advanced BLYP LANL2DZ result in distance $0.7482 \overset{o}{\text{A}}$, a discrepancy 0.076%. In table IV $d^o_{H-H} = 0.74158 \times 1.01015245 = 0.7491 \overset{o}{\text{A}}$ a discrepancy of 0.04%. The most advanced Gaussian 94 B3LYP method, which uses the scaling factor (Grid 0.99434, gives factor 1.408) results in the calculated bond length $0.7427 \overset{o}{\text{A}}$, which is near $1.4 \times 0.53 = 0.742 \overset{o}{\text{A}}$.

Rigid electronic structure of the hydrogen molecule is elastic and can vibrate in accordance with its symmetry. The inherent elasticity of the $H-H$ bond is connected

with the harmonic bond stretching force constant which can be calculated from the relation $f_r = \frac{1 \cdot 1}{d_{H+H}^3} \cdot 2.307 \frac{mdyn}{\text{Å}}$, where 2.307 is the units conversion factor from $e^2 / \text{Å}^3$ units to $\frac{mdyn}{\text{Å}}$. For $a_o\sqrt{2} = d_{H-H} = 0.74837\,\text{Å}$ (0 K) $f_r = 5.50425$ $\frac{mdyn}{\text{Å}}$ and for $d_{H-H}^{298} = 0.751\,\text{Å}$, $f_r = 5.4466$ $\frac{mdyn}{\text{Å}}$.

The two bonding electrons in a hydrogen molecule can rotate around their own axes in the same or in the opposite directions, forming orto- para-hydrogen molecules. Opposite rotations (antiparallel spins) produce magnetic attraction between the bonding electrons and unison rotations (parallel spins) produce magnetic repulsion, hence there is some difference of energy between both forms, orto and para.

Table VI. Comparison of the results of the Gaussian 94 [9] commercial quantum mechanical computations of the interatomic distances with those obtained by the rigid electronic structure methods.

		RES		Gaussian 94													
				HF						BLYP						B3YLP	
				3-21G		631+G(d,p)		LANL2DZ		3-21G		631+G(d,p)		LANL2DZ		6-311++G(3df,3pd)	
		d	%	d	%	d	%	d	%	d	%	d	%	d	%	d	%
Li_2	2.673	2.6689	0.2	2.8157	5.3	2.8145	5.3	2.4164	9.6	2.7286	2.1	2.7302	2.1	2.7243	1.9	2.7010	1.0
Na_2	3.078	3.0725	0.2	3.2286	4.9	3.1904	3.7	3.3034	7.3	3.0780	0.0	3.0480	1.0	3.2861	6.8	3.0395	1.3
K_2	3.9			4.2209	8.2			4.1957	7.6	4.0021	2.6			3.9873	2.2		
Rb_2	4.174			4.5996	10.2			4.5292	8.5	4.3589	4.4			4.2624	2.1		
Cs_2	4.646							5.0386	8.5					4.7737	2.7		
Fr_2	?																
LiH	1.595	1.5962	0.1	1.6404	2.8	1.6295	2.2	1.6322	2.3	1.6382	2.7	1.6211	1.6	1.6252	1.9	1.5895	0.3
NaH	1.8873	1.8873	0.0	1.9255	2.0	1.9132	1.4	1.9368	2.6	1.9139	1.4	1.8902	0.2	1.9425	2.9	1.8764	0.6
KH	2.244			2.3609	5.2			2.3531	4.9	2.3407	4.3			2.3316	3.9		
RbH	2.367			2.5383	7.2			2.5177	6.4	2.4978	5.5			2.4872	5.1		
CsH	?							2.7476						2.7109			
FrH	?																
H_2	0.74158	0.7488	1.0	0.7346	0.9	0.7324	1.2	0.7308	1.5	0.7506	1.2	0.7470	0.7	0.7482	0.9	0.7427	0.2
CH_4	1.091	1.089	0.2	1.0829	0.7	1.0839	0.7	1.0835	0.7	1.1004	0.9	1.0997	0.8	1.1027	1.1	1.0880	0.3

6. Rigid electronic structures of some other molecules

Simple calculations lead to construction of the rigid electronic structure of lithium molecule Li_2. This molecule consists of two effective nuclei with effective nuclear charge $Z_{effL} = 0.6296789e^+$ and of two electrons with charge $1e^-$. In the hydrogen molecule H_2 all four charges are equal (1e) and the rigid electronic structure of this molecule has the square symmetry D_{2h}. In the lithium molecule there are two pairs of charges, which are not equal, hence the symmetry of the respective rigid electronic structure must have symmetry $C2v$, a rhombic one. All charges must lie on one plane according to the character of the electromagnetic field. Minimalization of the total energy of this system requires that the difference in charges must be compensated by the respective distances between the electric charges, hence $\frac{Z_{effL}}{d_{Li-Li}} = \frac{1}{d_{e-e}}$, where d_{Li-Li} is the internuclear distance, or bond length, of the bond

$Li-Li$ in the Li_2 molecule and d_{e-e} is the distance between the two bonding electrons. It follows from the above relation that $Z_{effL}=\frac{d}{d_e}$ which in the case of rhombic symmetry of the rigid electronic structure of the lithium molecule (Fig. 40) is equal to $\tan\alpha$, hence $Z_{effL}=\tan\alpha$. The angle α determines the shape of the rhombic RES Li_2. Rhombic area of the RES $Li_2=A_{C2v}=\frac{d\cdot d_e}{2}$ and as $d_e=\frac{d}{Z_{effL}}$, hence $A_{C2v}=\frac{d^2}{2Z_{effL}}$. The radius of the free lithium atom in the lithium anion Li^- is twice that of the radius of the free lithium atom, due to the presence of two electrons, not one electron (Fig. 35). The dimension of force is inversely proportional to the area A, as $F=\frac{C}{r^2}$. The virial theorem is valid also for the dimension of force: total force is equal to $1/2$ force of attraction, hence $A_{tot}=2A_{attr}$, where the areas are inversely proportional to the respective forces (Fig. 39). In the case of the square $r^2_{Li^-}=A_{D2h}$ and it represents the four attraction forces between electrons and the effective charges Z_{effL} at the distance $2r_{Li^o}=r_{Li^-}$. The diagonals of this square represent the mean repulsion energies, that between the two bonding electrons and that between the two effective charges Z_{effL}. The square built on the diagonal is $(r_{Li^-}\sqrt{2})^2=2r^2{}_{Li^-}$ and its area is twice that of the square inversely proportional to the total force or to the $1/2$ the attraction force. Area does not depend on its shape and there is an area A_{C2v} equal to the area $A_{D2h}=2r^2_{Li^-}$. In this case $2r^2_{Li^-}=\frac{d^2}{2Z_{effL}}$, hence $d^2=2r^2_{Li^-}\cdot 2Z_{effL}$, consequently the internuclaer distance or bond length in the lithium molecule Li_2 is $d_{Li-Li}=2r_{Li^-}\sqrt{Z_{effL}}$ and we obtain $d_{Li-Li}=2\cdot 1.6816786\cdot\sqrt{0.6296789}=2.6689\,\text{Å}$. The spectroscopic determination gives $2.6729\,\text{Å}$, a discrepancy of 0.15%. The internuclear distance (bond length), in the lithium molecule Li_2 is thus a function of the ionization energy of free lithium atom. Simple geometry and trigonometry and a calculator suffice to obtain proper internuclear distance from the rigid electronic structures theory.

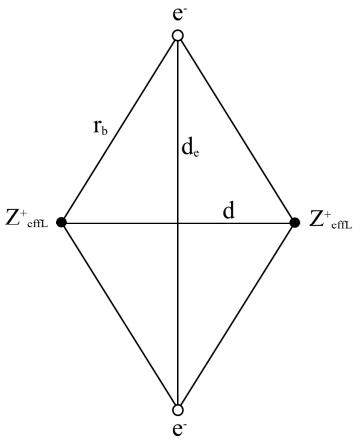


Fig. 40. The rigid electronic structure of the lithium molecule Li_2.

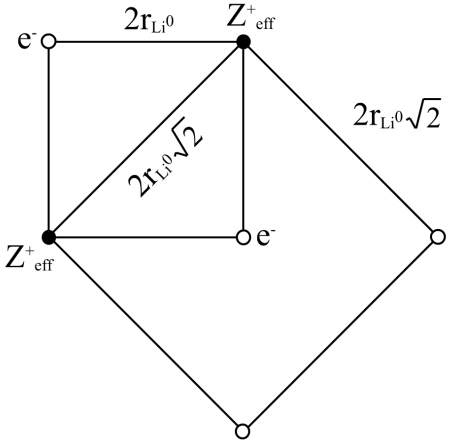


Fig. 41. Obtaining of the mean repulsion energy in the RES of the lithium molecule Li_2 by a graphic construction.

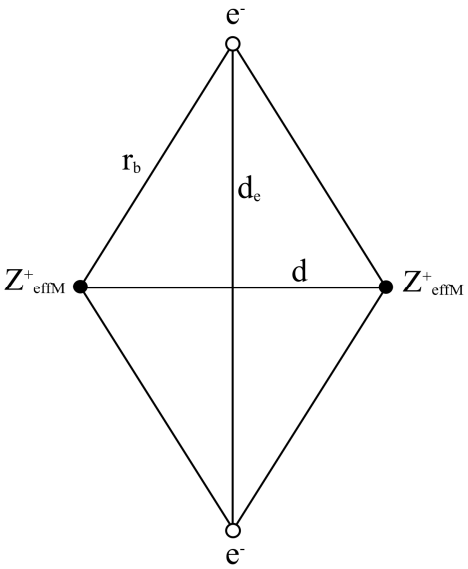


Fig. 42. The rigid electronic structure of the sodium molecule Na_2.

Sodium atom has one valency electron and RES Na_2 has the same rhombic symmetry as RES $Li_2(C_{2v})$, hence the same relation can be applied to the RES Na_2 to obtain the internuclear distance: $d_{Na-Na} = 2r_{Na^-}\sqrt{Z_{effM}} = 2 \cdot 1.9593722 \cdot 0.748059606 = 3.07252919\,\text{Å}$. Spectroscopic determination of the bond length in the sodium molecule Na_2 gives $3.0789\,\overset{o}{A}$ (UV) [6], a discrepancy of 0.207%. Correction for immobile nuclei gives the calculated bond length $d_{Na-Na} = 3.0742\,\overset{o}{A}$, a discrepancy of 0.15% (Fig. 42). The above results confirm the correctness of the rigid electronic structures theory presented in this work, as accordance with experimental results is the only possible method of confirmation of a theory.

Atoms remain in molecules as entities, bonding electrons remain in their valency shells but the atomic radius increases considerably. The bonded atom radius $r_b = \dfrac{d}{2\sin\alpha}$, from the RES Me_2^I. Hence $r_{bLi_2} = \dfrac{2.67}{1.0657} = 2.505\,\overset{o}{A}$ and $r_{bNa_2} = \dfrac{3.08}{1.0474} = 2.940\,\text{Å}$.

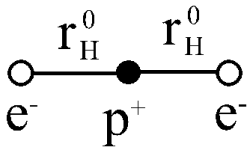


Fig. 43. The rigid electronic structure of the hydrogen anion H^-.

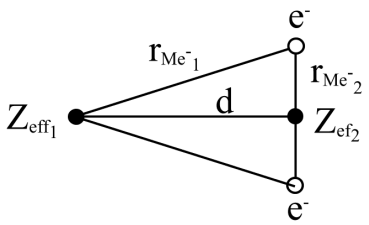


Fig. 44. The substitute triangular rigid electronic structure of the lithium hydride LiH.

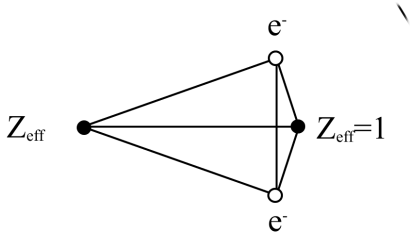


Fig. 45. The deltoidic rigid electronic structure of the lithium hydride LiH.

Internuclear distances (bond lengths) in the heteronuclear molecules LiH and NaH can be obtained from the RES theory as follows:

According to [6] $d^{o}_{Li-H} = 1.5949\,\text{Å}$ is the length of the single bond in the lithium hydride molecule. Chemical bond in the lithium hydride molecule is highly ionic, hence $LiH = Li^{+} - H^{-}$. In the anion H^{-} electrons are in neutral positions (Fig. 43). A triangle can be constructed with sides, the lengths of which are inversely proportional to the attraction energies and represent atomic radii in bonds. The hydrogen atom radius a_o is the same in the H^{-} anion as in the free hydrogen atom, as attractions and repulsion are here equilibrated. In the case of two electrons acting on the effective charge of the lithium cation the atomic radius of the lithium is doubled in length in the lithium anion Li^{-}: $r_{Li^{-}} = 2r^{o}_{Li} = 1.6816786\,\text{Å}$. The area of the triangle (Fig. 44) is inversely proportional to the total force acting in the RES of the LiH molecule and is equal to ½ of the respective attraction force in the state of equilibrium. Equilibrium demands that the repulsion between Z_{effL} of the lithium cation and hydrogen cation ($1e^{+}$) must be equal to projection of the attractions $Z_{eff}\ e^{+} - 1e^{-}$ on the bond direction: $2 \cdot \frac{1}{2} \cdot \frac{Z_{eff} \cdot 1}{r_{Li^{-}}} \cdot \cos\alpha = \frac{Z_{eff} \cdot 1}{d_{Li-H}}$. As $\sin\alpha = \frac{a_0}{r_{Li^{-}}} = \frac{0.52917733}{1.6816786} = 0.314672096$, hence $\alpha = 18.34101967^{o}$ and $\cos\alpha = 0.949200438$. From the equilibration of attractions and repulsion we obtain $d_{Li-H} = r_{Li^{-}} \cdot \cos\alpha = 1.6816786 \cdot 0.9492900438 = 1.596250064\,\text{Å}$, the discrepancy with the observed $1.5949\,\text{Å}$ is 0.085%. This does not require correction as a_O and not r^{o}_{H} was used. The rigid electronic structure of the heteropolar lithium hydride molecule is a deltoid, not a rhomb (Fig. 45). The area of a deltoid is a $A_{delt} = \frac{d \cdot d_e}{2}$ and as $\sqrt{d \cdot d_e} = \bar{d}$, the geometrical mean, hence $A_{delt} = \frac{\bar{d}^{2}}{2}$. Area of the square $A_{D_{2h}} = 2\bar{r}^{2}_{eff}$, where $\bar{r}_{eff} = \frac{a_0}{Z_{eff}}$ and $\bar{Z}_{eff} = \frac{\bar{I}}{I^{0}_{H}}$, where $\bar{I} = \sqrt{I_L \cdot I^{0}_{H}}$. The square area $\bar{A}_{D_{2h}} = A_{delt} = \frac{d \cdot d_e}{2}$, hence $d_e = 2\bar{r}_{eff} \cdot \frac{2}{d} = \frac{4\bar{r}^{2}_{eff}}{d}$. The same procedure can be applied to sodium hydride molecule NaH. Table VII presents comparison of RES LiH with RES NaH

Table VII. Comparison of the rigid electronic structures of the LiH and NaH molecules.

RES LiH (deltoid)	**RES NaH (deltoid)**
$d = 1.596\,\text{Å}(calc.),\ 1.5949\,\text{Å}(obs.)$	$d = 1.8865\,\text{Å}(calc),\ 1.8873\,\text{Å}(obs)$
$d_e = 0.955\,\text{Å}$	$d_e = 0.9658\,\text{Å}$
$r_b = 1.449\,\text{Å}$	$r_b = 1.7385\,\text{Å}$
$d_x = 0.228\,\text{Å}$	$d_x = 0.216\,\text{Å}$
$d - d_x = 1.368\,\text{Å}$	$d - d_x = 1.6701\,\text{Å}$
$\alpha = 19.2426^o$	$\alpha = 16.1276^o$
$\beta = 64.4679^o$	$\beta = 65.8657^o$

The atomic radii of lithium and sodium atoms in $Me^I - H$ bonds are calculated form the relation $r_b = \frac{d_e}{2\sin\alpha}$. The degree of covalency of bonds in these molecules can be calculated from the relation $\frac{d_x}{d - d_x} = C$. In the case of a homeopolar bond as in molecules Li_2 and Na_2 (with RES symmetry C_{2V}), $C = 1$, as $d_x = 0.5d$. These bonds are symmetrical, that is 100% covalent or "atomic" in character. Ionicity of the bonds is $1 - C$ and is zero in homonuclear molecules. The covalency C in lithium hydride molecule is $C = \frac{0.228}{1.368} = 0.167$, hence $i = 0.833$. In the sodium hydride molecule covalency is $C = 0.129$ and $i = 0.8707$ and this bond is more ionic in character. Ionicity means asymmetry of bonds.

In accordance with the definition: $\sqrt{\frac{I_H}{I_H}} = 1$ the effective nuclear charge $Z_{effH} = 1e,$ hence electronegativity x_G of hydrogen is 1 and this value places hydrogen in the natural state amongst the alkalogenic metals, close to the border with amphoterogenic metals which is placed at 1.02e. Then why is hydrogen a gas of molecules H_2? Simply because it cannot attract any other hydrogen atom, due to a very high overbalance of the repulsion energy between hydrogen molecule H_2 and hydrogen atom H^o. In the case of lithium the Li_2 molecule can easily join with further four lithium atoms, forming a building element for construction of the lithium metal structure.

With square D_{2h} symmetry and equal charges of the two protons, the bond H-H in the hydrogen molecule is symmetrical (atomic) and the charges on hydrogen atoms are formally neutralized $H^O - H^O$, hence a "neutral" H_2 molecule appears.

With the rhombic symmetry C_{2v} and unequal charges in the lithium hydride LiH the $Li^+ - H^-$ bond is asymmetric (ionic) and the $Li^+ - H^-$ charged elements form building units of the crystal structure [LiH].

Hydrogen atom represents the unique situation where $Z_{effv}e^+ = 1e^+$ and the single electron has charge $1e^-$ and this is the reason of its behaviour other than in the case of $Z_{effv} < 1 \ \ or \ \ > 1.$ For instance $Z_{effv}e^+{}_{Ca^{2+}} = 0.934e$ and $Z_{effv}e^+{}_{Mg^{2+}} 1.051e$ and both these elements are forming metallic structures, but in the case of hydrogen it is impossible. Hydrogen does not form metals, only molecules, due to inability to join together more than two atoms and two molecules of hydrogen H_2 also repel each other with energy 31.358 eV (Fig. 46). In this respect the hydrogen molecule (RES D_{2h}) is "inactive" but Mg_2 and Ca_2 molecules (RES C_{2v}) are "active".

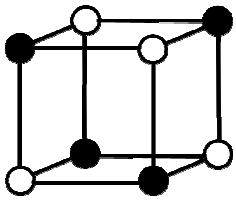


Fig. 46. The nonexistence of the hydrogen molecule H_4.

The "atomic" bonds with bonding electrons in the plane cross-secting the internuclear distance in the middle (symmetrical bonds) are not quite appropriately called "covalent" as all kinds of chemical bonds are really "covalent" with bonding electrons placed equally in the valency shells of both joined atoms, even in the case of the asymmetric "ionic" bond type, bonding electrons are always shared by both bonding atoms.

The methane molecule CH_4 presents a simple example of molecules with many chemical bonds.

Due to repulsion between the bonding electrons in the C-H bond, this bond cannot be formed by an electron pair and the Lewis symbol C:H should be replaced by the symbol $C{\cdot}H{\cdot}$ (Fig. 47). Also symmetry requirements exclude a 4:2 arrangement resulting from the sp^3 hybridization, as there exists no respective subgroup of symmetry.

The four "arms" in the RES CH_4 repel each other because the sum of the repulsion energies prevails over the sum of attraction energies. Chemical bonds can be formed only along the "arms" in linear arrangement on which the equilibrium can be reached in accordance with the virial theorem. Between the "arms" only Coulomb attractions and repulsions are possible, as the distances between electric charges are

not fulfilling the condition of synchronization of rotation of electric charges and these rotations proceed not in the same plane in adjacent “arms”, like those in the “arms”. Rotations of the positive charges in the atomic nuclei must fulfill also these conditions and this must lead to ordered positions of protons in atomic nuclei producing quasi-crystalline structures.

The equilibrium internuclear distance C-H in the CH_4 molecule can be calculated in the frame of the rigid electronic structures theory. A hydrogen atom H^0 (RES Fig. 14) approaches with the positive H^+ and one of the four L-shell electrons of the carbon atom and joins with it at the distance r_H, forming the H^- anion (RES Fig.43) in which charges of the electrons are equilibrated by the H^+ charge.

The L-shell electrons in the carbon atom are at the distance $\frac{1.952435}{\sqrt{64.493762}} = 0.2431183\,\text{Å}$ from the effective nuclear charge $Z_{effC^{4+}}$, hence from effective nucleus C^{4+}, due to the presence of the two $1s^2$ K-shell electrons. The effective nuclear charge $Z_{effC^{4+}} = 2.1777816e$, but in the case of the RES CH_4 (Fig. 47) the two $1s^2$ electrons cannot be located on the “arm” in linear arrangement due to repulsion by the carbon atom L-shell electrons but are repelled to outside positions on a line parallel to the side of the tetrahedron formed by the outet electrons in the RES of the CH_4 molecule (Fig. 47) what allows to keep the tetrahedral symmetry undistorted. But such a position of the two $1s^2$ electrons outside the “arms” exposes the C^{6+} nucleus of the carbon atom which repels the hydrogen cation H^+ from the initial distance 0.5194587+0.2431183A. The energy of repulsion is $\frac{1\cdot 6}{0.772577}\cdot 14.399625 = 111.8306eV$. The respective L-shell electron is thus attracted with energy 64.493762eV but hydrogen cation H^+ is repelled from its original position by energy 111.83059eV. The difference of these energies is 47.336824eV. This amount of energy lengthens the distance between the nucleus C^{6+} and the respective L-shell electron by $\frac{1.952435}{\sqrt{47.336824}} = 0.2837769\,\text{Å}$, hence the total radius of the L-shell becomes 0.2431183+0.2837769=0.5268952A and the internuclear distance C-H would be 0.5268952+0.5294587=1.056353A. This distance must be however enlarged by the contribution from the K-shell $1s^2$ electrons. Ionization energy of the $1s^2$ electrons in the carbon atom is 352.17eV and the respective radius of the K-shell is $r_{effK} = \frac{1.952435}{\sqrt{352.17}} = 0.0985915\,\text{Å}$. The projection of this radius on the C-H distance is *cos* 70.53^o = 0.333313 and with more precise value of the tetrahedral angle: 180^o-109.47122^o=70.52878^o it is 1/3, hence 0.0985915:3=0.0328638 Å is the contribution of the K-shell electrons to the internuclear distance $d_{C\text{-}H}$=0.5268952+0.5294587+0.0328638=1.0892177 Å (at 0 K).

Thus the discrepancy with the experimental value 1.091 $\overset{o}{A}$ (probably measured at room temperature) is 0.16%, whereas the most refined quantum-mechanical computations show discrepancy of 0.27% (Table VI). Thus the RES theory opens way to an alternative type of calculations of the chemical structures.

The sum of radii of hydrogen and carbon atoms is 0.5294587+0.2431183=0.772577 $\overset{o}{A}$ and the internuclear distance d_{C-H} in the CH_4 molecule is 1.091 $\overset{o}{A}$ (experimental data), hence the difference is 0.318423A. The respective energy -37.596231eV is the bonding energy of hydrogen atom and carbon atom in the methane CH_4 molecule. From the calculated value it would be -38.02066379eV.

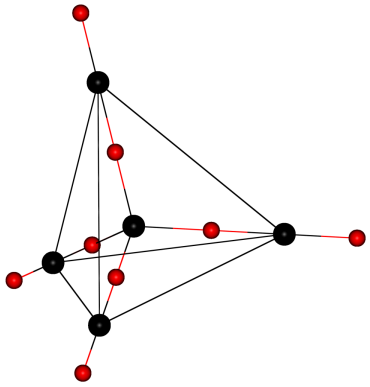


Fig. 47. The rigid electronic structure of the methane molecule CH_4.

$[SiO_4]^{4-}$

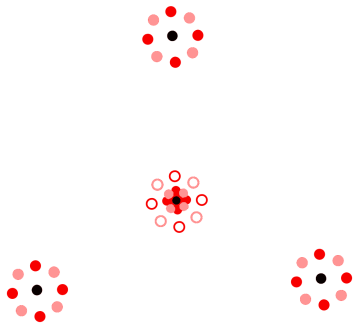


Fig. 49. Rigid distribution of the electrons in the monosilicate anion SiO_4^{4-}.

The example of the monosilicate (orthosilicate) anion $[SiO_4]^{4-}$ (Fig. 49) illustrates the fact that only “invisible” exchange of semiphotons, as carriers of the electromagnetic field, connects the particles, and not any “strings”, as is usually depicted. It is really a state of electromagnetic levitation.

Equilibrium between the negative and positive electric charges, hence fulfillment of the virial theorem, can be achieved if two conditions are fulfilled:

1. Both charges must rotate in the same plane;
2. The distance between the two charges must suit synchronization of the phases of rotations.

Othervise only Coulombic repulsions and "attractions" occour between the charges, as semiphotons, the carriers of the electromagnetic field, are emitted (and absorbed) by the semielectrons in (of from) all directions with the same probability.

The presented theory of the rigid electronic structures is based on the nature of the electron and its charge and on the energy minimalization principle, hence it connects mechanics with phenomenology. The experimental basis is supplied by ionization energies of free atoms, which in accordance with the virial theorem represent the total energies of respective electrons in atoms. Rigid electronic structures are related to the ground state equilibrium at 0 K or to $298.18K(25^{o}C)$. In the case of crystals the Madelung constant must be taken into account, otherwise this theory applies directly to all types of closed atomic systems: atoms, ions and molecules. As there is only one state of equilibrium possible at constant conditions, the rigid electronic structure theory is deterministic in its nature. A system in the state of thermodynamic equilibrium cannot change this state spontaneously and this condition is timeless, hence abstract, at 0 K.

7. Dissociation enthalpy and bond energy of some molecules

Rigid electronic structure of the hydrogen molecule (Fig. 37) has the square D_{2h} symmetry; the electrons and protons are in fixed positions. The radius of hydrogen atom is $a_o = 0.52917733\text{Å}$ and the respective energy is $1Ry = 13.605698eV$. The four sides of the RES H_2 square represent together $4Ry$ total energy. Dissociation of the hydrogen molecule proceeds by two steps. In the first stage one of the four equivalent sides is broken if energy $13.605698eV$ is introduced into this system (Fig. 50). Then, due to the repulsion energy, the molecule is immediately stretched into a linear configuration (Fig. 51). Such a configuration is completely unstable and undergoes at once autodissociation, releasing energy $\frac{1}{2}E_{attr} = -\frac{1}{2}\frac{1\cdot 1}{a_o}\cdot f_1 - \frac{1}{2}\frac{1\cdot 1}{3a_o} f_1 = -1\frac{1}{3}Ry$ and as $E_{rep} = 2\cdot\frac{1\cdot 1}{a_0}\cdot f_1 = 2Ry$, hence the sum is $\frac{2}{3}Ry$. The sum of the repulsion energies acting on the middle bond (Fig. 51) is $+27.211396eV$ and the sum of the attraction energies is $-18.140931eV$, hence energy $+9.070465$ (or $2/3Ry$) is released into the surroundings. As $13.605698eV$ was used to sever one half of one bond, the resulting input of energy is $13.605698 - 9.070465eV = 4.535233eV$ (or $1/3Ry$). Hence dissociation of the hydrogen molecule is a chemical reaction involv-

ing autodissociation of an “active complex”. Reaction proceed between two end states, that of the hydrogen molecule H_2 and that of two free hydrogen atoms. The process of synthesis proceeds in the reversed direction to the dissociation process from two free hydrogen atoms to the hydrogen molecule: $H_2 \underset{-4.535234eV}{\overset{4.535234eV}{\rightleftarrows}} 2H$.

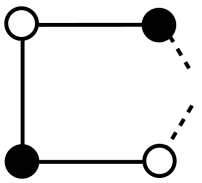


Fig. 50. Breaking of a single side in the D_{2h} rigid electronic structure of the hydrogen molecule.

The amount of energy consumed by the system in the process of dissociation is the same as the amount of energy released in the process of synthesis. Synthesis of the hydrogen molecules starts with formation of a single half- bond, releasing $13.605698eV$ energy, but from it the amount of energy $9.070465eV$ is consumed to oppose the repulsion energy, what enables formation of the second half-bond in the hydrogen molecule H_2. The difference is $4.535233eV$. Bond energy of the hydrogen molecule presents the difference between total energy of two free hydrogen atoms and the total energy of hydrogen molecule. The total energy of the hydrogen molecule at 25°C (298K) is 15.8578 eV and from RES D_{2h} it is – 15.8824 eV. The internuclear distance D_{H-H}^{298} from thermochemical experiments is 0.751A, hence $r_H^{298} = \frac{0,751}{\sqrt{2}} = 0.5310372A.$ From this the ionization energy at 298K is $\frac{1}{2} \cdot \frac{1 \cdot 1}{0.5310372} \cdot 14.3999652 = -13.558eV$ hence total energy of two free hydrogen atoms at 298K is –27.116eV, and the bond energy of the hydrogen molecule is –27.116+15.882=-11.234eV from RES D_{2h}, or -11.258eV from –15.8578eV (discrepancy 0.21%).

Dissociation enthalpy of this molecule represents something quite different and is not a measure of its bond energy, but is the result of a chemical reaction in which an autodissociating intermediate state is included as “active complex”.

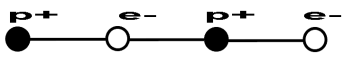


Fig. 51. The unstable linear form of the hydrogen molecule H_2.

Protons and electrons remain in fixed positions only at 0 K at higher temperature they acquire vibrational energy due to thermal collisions and this is causing some dilatation of the molecule. The internuclear distance (bond length) $d_{H\text{-}H}$ at O K is

$0.7483697\,\mathring{A}$ and at $298.18K(25^o)$ it is $0.7510845\,\mathring{A}$. At this temperature the observed dissociation enthalpy is $4.5187eV$ [8], corresponding to bond length $0.7510845\,\mathring{A}$. Spectroscopic determination [7] at OK: $D^o_{H_2} = 36118.11(8)cm^{-1}$ or $4.477765eV$ and $D^{298}_{H_2} = D^o_{H_2} + \frac{3}{2}$ RT where $3/2RT = 0.0385425eV$, hence $D^{298}_{H_2} = 4.5163075eV$. Spectroscopic determinations concern proton following the circular motion of the electron and $I^o_H = 13.598439eV$. With immobile proton $Ry = 13.605698eV$. The ratio $\frac{13.605698}{13.598439} = 1.0005338$, hence $D^{298}_{H_2} = 4.5163075 \cdot 1.0005338 = 4.5187184eV$ and the observed energy of dissociation at $298.18K(25^o)$ by thermochemical method is $4.5187194eV$.

The observed dissociation energy (enthalpy) of the lithium molecule Li_2 is $110.21(4)kJ \cdot mole^{-1}$ at $298.18K(25^o)$ $D^{298}_{Li_2} = D^o_{Li_2} + 3/2RT$. As $D^o_{Li_2} = 1.1422465eV$, hence $D^{298}_{Li_2} = 1.1422465 + 0.0385425eV = 1.180789eV$. Dissociation energy of lithium molecule Li_2 can be calculated from the rigid electronic structure of this molecule (Fig. 40). The radii of lithium atoms in lithium molecule are obtained from following relations: $\tan\alpha = Z_{effL} = \frac{\sqrt{5.39172}}{13.598439} = 0.6296789\,\mathring{A}$, hence $\alpha = 32.197756^o$ and $\sin\alpha = 0.5328431$. As $\sin\alpha = \frac{0.5}{r_b}$, hence $r_b = \frac{1.33645}{0.5328431} = r_b = 2.50815\,\mathring{A}$, from the observed interatomic distance and $2.5044\,\mathring{A}$ from the bond length calculated from the RES of Li_2 molecule. Bond energy is defined as the difference between total energies of two free lithium atoms and total energy of bonded lithium atoms in this molecule: $2I_L = 10.78344eV$ and $E_b = 2\frac{1}{2}\frac{Z_{effL} \cdot 2}{r_b} = \frac{0.6296789 \cdot 2}{2.50815} \cdot 14.3996251773 = 7.230141848eV$. Hence $E_b = 10.78344 - 7.230142 = 3.553298\text{eV}$.

Assuming the same mechanism as in the case of the hydrogen molecule D^o $Li_2 = 1/3E_b = 1.18443267eV$ at OK. As here only the difference between ionization energy I^o and I^{298} is involved in computations hence to obtain $D^{298}_{Li_2}$ from $D^o_{Li_2}$ we have to use a conversion factor from temperature O K to $298.18K$, this factor fol-

lows from the ratio $\frac{13.55652}{13.598439} = 0.9969174$. Then $1.844274 \cdot 0.9969174 = 1.1807815eV$ and the observed energy at 25^0C is $1.180789eV$, discrepancy 0.0006%. Such an agreement confirms the rigid electronic structures theory, based on minimalization of internal energy of systems consisting of electric point charges, negative and positive.

Edward Görlich

IX. Entropy and ektropy of energy

There is much fascination with entropy and there are also some misunderstandings.

En-tropos means in Greek an outward tendency (into surroundings). A Polish biologist Emil Godlewski (1927) proposed for the reversed tendency, usually described as antientropy or negentropy, a more positive term of ektropy. Ek – tropos in Greek means the inward tendency (from the surroundings).

According to Max Planck entropy is uniquely a function of probability. The Boltzmann – Planck relation is $S = k \ln W$, where W is the so called "thermodynamic probability" representing the number n of possibilities. But this is really not a definition of entropy but a relation between entropy and the gas constant R, as $k = \frac{R}{N}$, hence $\frac{NS}{R} = \ln W$. In this relation entropy is an intensive property, like temperature or density. It is not an extensive property like energy, hence entropy values are not additive. Gas constant R has the dimension of entropy and applies to ideal gas at standard conditions of temperature ($0^o C$), pressure (1 atm.) and to one mole of particles (N), hence also to the constant volume V, thus R represents entropy of the ideal gas at standard conditions. Entropy of real gases differs from R by $\ln W$, for a single particle. Then what is entropy? A quantity of energy in a given volume represents the density of energy: ρ_E, an intensive property of a system. Ektropy is connected with an inward tendency, hence growth of ektropy means concentration of energy and an increase of entropy means attenuation of energy (and of density, as $E = mc^2$). Entropy and ektropy depend on the volume in the logarithmic way. Using for ektropy the symbol э, for entropy we have $S = -$ э. Ektropy becomes a logarithmic measure of density of energy э$= ld\rho_E$, if $\log_2 = ld$ base is used like in the theory of information. Entropy is then $S = -ld\rho_E$, with negative sign. The same amount of energy in larger volume has higher entropy and lower ektropy. Entropy, like temperature and density describes the state of a system, ektropy represents "potential" of energy in the system, hence it is rational to give entropy a negative sign.

There is no sense whatever in expressions like “source of entropy” or “production of entropy”.

Internal energy of a system is defined as $E = F + Q$, where F is described as “free energy”, whereas it represents the energy stored in the system, the cohesion energy. Matter is connected with imprisoned energy. The heat energy $Q = nTS$, where T and S are intensive properties and only n, the number of particles in the system is an extensive property. In analogy to $T = \frac{E_{kin}}{n}$ we may introduce the concept of ligature $L = \frac{E_{coh}}{n}$, the mean potential energy of cohesion or attraction on one particle in the system. Consequently as $Q = nTS$, free energy $F = nL$ э and internal energy is $E_{\text{int}} = nTS - nL$ э, as $E_{pot} = -E_{attr}$. Applied to density, instead to energy $S = -ld\rho$, hence for instance the definition of $p_H = -\log\ [H^+]$ represents entropy of the hydrogen ions in solution.

Proceeding along the lines proposed by Arrhenius (1811) we can define the logarithm of the reaction rate constant as $ldk = \frac{L_m ld\rho_m}{Tld\rho} = \frac{L_m\ э}{TS} = \frac{F_m}{Q}$, where L_m is the ligature of the strongest chemical bond in the substrates of reaction, which must be broken to enable the initiation of reaction. It must not be the strongest bond absolutely, as some groups of atoms may remain unchanged in this reaction. Probability of initiation of a reaction is related to the density of bonds with ligature L_m, that is to ρ_m. In Arrhenius equation $\ln k = -\frac{E_a}{RT} + \ln A$, where E_a is the energy of an “active complex”, whatever this means. This concept is replaced by L_m. The logarithmic dependence remains, but the “extralogarithmic” constant vanishes. At $V = \text{constant}$ and $N = \text{constant}$ $\rho = \frac{V}{N}$ is constant. With $V =$ constant an increase of temperature increases the number of collisions in the system and the kinetic energy content increases, hence ektropy (potential) of the system increases and accordingly entropy decreases. Energy content nL grows and L_m decreases with the temperature increase, hence reaction can proceed more rapidly. Equilibrium condition is $\Delta S = \Delta$ э.

X. The nature of the Universe

Physics ends on gravitons, we don’t know, and would never know what is inside them. If gravitons are ideally spherical in shape they really present mathematical entities, but as they have rest mass they are also physical, material entities. Gravitons in the constant number N_{gr} are moving with their intrinsic speed c, hence the energy of

the Universe is $E_u = \frac{1}{2} m_{gr} c^2$. N_{gr} = constant. Planck units d, m_{gr} and the velocity c (Einstein velocity) describe this ultimate particle. Gravitons in the number N_{gr} emerged at time zero from the Void, which is limitless, immovable and is present everywhere, anytime. The Void may be considered as dimensionless and timeless, like a mathematical point, only with here and now. The graviton represents a quantum of 3D space contained in a perfect, mathematical sphere with area $d^2\pi$, "cut" out from the Void and moving with the constant speed c. Einstein velocity c produces the dimension of time and with Planck length d the ultimate quantum of time t_{PL}=d/c. Collision of two gravitons coming from random directions results in their rotation around each other, that is in the formation of a materion, to which the minimum value of the Heisenberg uncertainty principle applies, stating that the position of the gravitons on the circle 2pi cannot be established, but that the energy of collision, changed into their bonding energy, is determined. The graviton represents also the ultimate quantum of matter with mass m_{gr}, as inherent resistance to any change of velocity characterizes matter. Hence the Protouniverse issued from limitations of mass, dimension and speed within the Void. Production of the Universe escapes physical interpretation, hence is metaphysical. At time zero transcendency touched with science. Protouniverse with its extreme density of mass and energy possibly presented the initial „black hole" with enormous rotational energy content and with nothing in the surroundings to oppose the outward tendency of escape of matter. Matter in the Protouniverse must have presented a superplasma of the carriers of the fields: subparticles $1m_{gr}$, $2m_{gr}$, $3m_{gr}$ maybe even more. It was a kind of a superheated fluid. If the state of the Protouniverse is accepted as a kind of "fluid", consisting of carriers of the three kinds of fields (gravitons, semiphotons and subneutrinos) in chaotic motions, than the expansion, due to the excess kinetic energy from the Big Bang, would lead at a "boiling" point to the change of phase from "fluid" to "gaseous", with a violent increase of volume, that is to "inflation". At this point the Protouniverse became the Universe.

The bonding forces in the fluid phase, weakening with expansion and finally overpowered by the kinetic energy, are due to absorption, emission and recoil ("attraction") of particles, the carriers of fields. The axes of rotation of the local concentrations of subparticles in the Protouniverse must had all possible and changing directions.

The rotational motions in the Protouniverse mean imprisoned energy (an ektropic process).

The "escape" radial velocity c of the carriers of fields is the same in all directions in the 3D space, with the rotational momentum preserved.

According to the gravitonic theory $d^2\pi$, $m_{gr}c$ and N_{gr} are the ultimate deterministic constants in the Universe and together with the free, indeterministic distribution of

the initial directions of motions of carriers of the three kinds of fields, present the initial conditions which govern the Universe and its evolution.

This means that the gravitonic Universe began from rotating chaos and that this chaos of motions of identical gravitons produced forces of attraction, which tend to create order, but randomness prevails on order at any time, othervise the Universe would be a dead one. Graviton is a perfect, ideal entity, it is the randomness of motions which makes the Universe imperfect and capable to evolve to higher qualities. On the other hand, there is no sense in maintaining that the Universe is totally probabilistic, as in this Universe some laws are reigning, and that means necessity. Ratios $d:c:m_{gr}:N_{gr}$ which define our Universe must be maintained with absolute precision to enable its existence and function.

Were gravitons ideally elastic, the Universe would represent an ideal gas. Only due to the absolute undeformability of gravitons they can condense into matter and the effects of attraction forces can appear.

Carriers of the fields are moving with the speed of light which in vacuum becomes constant Einstein velocity c. Inside the Universe particles of matter, especially in a dense medium of cosmic dust, are moving with lesser velocities and the rotating matter tends to form discs, as slowing down means in accordance with the principle of conservation of momentum, tendency to gather further from the axis of rotation.

The “black holes”, like the Protouniverse, present the hottest and densest possible concentrations of the heat energy. They are really condensed fields, consisting of the carriers of these fields in partly chaotic motions. No structures, such as elementary particles, can exist at this temperature. It is at present a matter of conjecture whether in the process of the “Hawking emission” the black holes can produce elementary particles at falling temperature and density, as it occurred on an incomparably bigger scale in the expansion of the Protouniverse.

A “black hole” consist of carriers of fields and does not contain any structured matter. Rotation in a plane around an axis introduces some kind of order, but carriers inside are moving chaotically with their inherent speed c, making a “black hole” a “fluid” which is “evaporating” from the surface. Small “black holes” due to low ratio volume/ surface would vanish rapidly. What is “evaporating” is a “mixed” field consisting of carriers of three kinds. This “field” collides with the surrounding gas and dust. No “memory” of any structure is present in a “black hole”, hence no such information can leave the “black hole” and of course cannot be retrieved, just as the general relativity predicts, in spite of the “quantum” character of the mixed field.

Information can be regarded as reduction of uncertainty. In this case an increase of ektropy means also an increase of information. Growth of ektropy results from concentration of mass and energy and represents storage of information. But information manifests itself only then, when it is retrieved by a receiver, othervise it remains an abstract concept. Information can be received only in an ordered form. Ideal gas does not contain retrievable information. Order results in nature from the actions of

"attractions" leading to an increase of ektropy. Information may be retrieved if contained in the form of accustic, electromagnetic or chemical (molecular) carriers. Ordering is in the form of frequencies in the case of accustic and electoromagnetic stimuli, or is presented by the structure of the molecules. Hence retrievable information requires existence of atoms, or at least of the atomic nuclei. In the indirect way we can obtain information only by reasoning, what means presence of intelligence.

The Universe is evolving as a whole in a way which cosmology tries to explain. The Universe evolves also locally in galaxies, stars, planets and as life on them, if any exists. On Earth we observe also evolution of science and technology. Evolution seems to constitute the fundamental characteristics and function of our Universe. Evolution seems to be decided on by the initial conditions characterizing the Protouniverse which were responsible for the future fate of the Universe. It may be supposed, that the initial random orientations of turbulences consisting of gravitons, semiphotons and subneutrinos with outward directed resultant vectors of motions, produced the Universe as it is observed now. Hence the Protouniverse can be regarded as the "genom", which contained full information about the future development of the Universe, but this information cannot be discovered by humans. Nothing can change this design, but this does not mean predestination, because it will remain unknown to the human mind forever, hence it does not take the responsibility from man for his decisions, nor excludes choices. Evolution is the result of cooperation between freedom and necessity. Freedom resulted from the initial conditions, as no constraints were imposed on the directions of the first vectors of motions of particles, all must have been equally probable. Necessity results from the presence of attractions such as gravitation or electromagnetism. Attraction between particles means determination of directions of motions. What is observed as attraction really issues from recoil, which is always connected with emission, and absorption equals emission. Equilibria of attractions and repulsions create structures, hence order. But as in the Universe $\sum E_{kin} > \sum E_{coh}$ any equilibrium cannot last for ever. Chance and necessity, Fatum and Fortuna create evolution, but evolution does not proceed at the same rate throughout the system. Some changes advance more rapidly than others and some regions remain unchanged for a relatively long time. Evolution proceeds through partial destruction and partial new constructions which enable better coexistence with changed external conditions. There is no evolution without preserving something from the past. That is why evolution creates historical time, marked by special situations for each period and leaves "archives" of the past, making possible, for instance, geohistorical studies. History of mankind, of geological and cosmological processes is based on "archives"- remnants of the past. Not everything disappears without traces. The electromagnetic background radiation contains information about the Universe at it was about 300000 years after the Big Bang, and may be that something is preserved about the Big Bang itself in the gravitational field, but this probably will remain unobserwable. Evolution of the Universe seems to proceed according to in-

born principles, including the effects of chance, as well as of necessity, as humans see them. Beginnings of our Universe cannot be explained by the laws of physics as those themselves resulted from the initial conditions at the birth of the Universe and not from any previous state. After the inexplicable Big Bang, the reasons of which are not contained in the frame of physical laws, next in importance after the appearance of gravitons is the phase of formation of electrons, which are sources of the electromagnetic field. This can be and certainly will be, explained in the frame of physical laws. Next problem is the confinement of quarks in the electrons and formation of hadrons and among them of barions, such as proton and neutron. Why the "black holes" consisting of semiphotons rotating with the speed c and with total mass of the semielectron, were stabilized by joining in pairs and forming electrons, appeared at certain density of the Universe, should be possible to explain in the future. Evolution means also the recycling of structures, with some changes, which are due to the pressure of the environment, eliminating "weak" structures, unadapted to the respective conditions. A demanding environment, but not a completely destructive one, accelerates the evolution. Otherwise, as in the case of parasites, devolution results. The price of evolution up to the level of the intelligent life is exorbitant, as the amount of matter attaining this stage is quantitatively negligible on the scale of the Universe. That evolution, with only one kind of particles, the gravitons as basic constituents, can produce such effects as our brains is an unbelievable event. A Protouniverse consisting of "black holes" rotating with the speed c of various sizes and various mutual orientations, can explain many problems.

At the beginning the Protouniverse was characterized by the highest possible density of energy and mass ($E = mc^2$), hence its potential (ektropy) was the highest possible and as the surrounding Void was at potential zero, the highest possible tension between them resulted in the expansion of the Universe which is due to the tendency to reduce this tension, so this process must continue infinitely.

This fact determines the so called „arrow of time" and the irreversibility, which is also connected with the infinite growth of entropy S. But in the Universe are also active forces of attraction, such as gravitation and electromagnetism. These tend to increase locally the density of mass and energy, hence the ektropy $\ni$, and such increase means local reversal of "time arrow", a "retardation of entropy". In the case of the "black holes" this reversal is near to the primary conditions in the Protouniverse. Increase of ektropy means thus a local "rejuvenation" effect.

Between the Past and the Future lies the Present. In the physical sense it cannot last longer than the Planck quantum of time $\frac{d}{c} = 3.8 \cdot 10^{-44} s$. What happens during this time cannot be ever observed. The past is fixed, is determined and nothing can change it. But the Future is in its nature indeterministic, despite our knowledge of physical laws, which are deterministic, because we would never know precisely the

initial states, due to the Planck time $\frac{d}{c}$ gap at the beginning of the Protouniverse. Hence we never can foresee future events precisely and uncertainty grows exponentially with the "time arrow". The Past is determined between the first Planck unit of time in the Protouniverse and the Present. The future as such is nonexistent at any present time.

In the expanding Universe entropy is not growing like that of the ideal gas, in which only ideally elastic collisions occur, but is lesser: $\sum S_{real} = \sum S_{ideal} - \sum э_{real}$ and this means a summary growth of entropy in the Universe and not just increase of entropy, creating complete disorder.

There are two sources of energy making the Earth alive, the internal heat which is driving the continental plates and the solar radiation which is partially consumed in formation of complex organic structures. But as a whole solar radiation is degraded on the Earth surface from higher frequencies to low infra-red thermal frequencies. Hence ektropy of solar radiation decreases and entropy increases in the process. Summary growth of entropy and dissipation of energy characterizes the Universe, Earth and our own body.

The driving force of all processes in the Universe is the tendency towards equilibration of potentials. A higher local potential, that is higher concentration of energy, higher ektropy, is the source of changes. The greatest possible difference of potentials between the Protouniverse and the surrounding Void undergoes relaxation through the expansion of the Universe, a process which cannot be reversed on the Universal scale by any physical means, in accordance with the second Law of thermodynamics. Hence a collapse of the Universe is impossible. Spontaneous increases of potentials are possible on a local scale, due to attractions, but not on the Universal scale, hence the Universe must be an "open" one and it represents a one-way transient event. Even with part of the total energy stored in semiphotons and subneutrinos, the sum of all potential energies (attraction energies) is in the Universe much smaller than the sum of kinetic energies with centrifugal tendencies.

First Law of the Uniwerse: The conservation of gravitons	First Law of Thermodynamics: The conservation of energy
Second Law of the Universe: Attenuation of the mean density of gravitons with time	Second Law of Thermodynamics: Summary growth of entropy with time

1. $E_{tot} = \frac{1}{2} N_{gr} \times m_{gr} c^2 = \text{constans}$ represents the First law of nature.

2. $E_{tot} = E_{kin} + E_{coh}$, where $E_{kin} > E_{coh}$ represents the Second law of nature.

The First Law of the Universe means conservation of the gravitons and corresponds with The First Law of Thermodynamics, that is conservation of energy.

The Second Law of the Universe means attenuation of the mean density of the gravitons and corresponds with The Second Law of Thermodynamics, that is with summary growth of entropy with time.

This part of the total kinetic energy which is not engaged in bonding gravitons together, drives gravitons, semiphotons and subneutrinos with the speed c in vacuum, forming respective fields and this energy leads to expansion of the volume in which the mass and energy of the Universe is contained, that is to expansion of the Universe and to summary growth of entropy. Our Universe is an extremely unequilibrated system.

Evolution of the Universe started at time zero, but it cannot proceed infinitely because the Universe is expanding, hence its potential (density and temperature) is falling along, thus the constructive, ektropic, processes must at some time attain a state of maximum development. Production of the highest, intelligent states of local evolution must reach highest probability at some point of the Universe size and age. This point would be the turning point of evolution, at which probability of devolution begins to exceed the evolutionary processes. Hence at this point the function of the Universe imposed by the "genom" contained in the Protouniverse would reach its fulfillment. Functionality characterizes organisms, each part of an organism has a function needed to preserve the life of this organism. Also every organism as a whole has its function, which is to secure the survival of the respective species. In such sense the Universe may be described as an organism with the function of maintaining the possibility of evolution. Organism, after fulfilling the demands of their function, die and Universe after surpassing limits of its function would undergo extinction of its matter into state which may be called "Nirvana". Evolution as we know it, ends at attaining the level of intelligent life, able to investigate the Universe. Intelligent beings (we know only Man), have intelligent kind of function: the search for comprehension. Through speech, writing and internet this function becomes a common product of human species, a spiritual one. Species become extinct to open a way for evolution of other species. We cannot as yet answer the question whether extinction of human species would open the way for further evolution, may be that of sexless electronic beings? But would they acquire any motivating interest?

At any rate man is putting an end to spontaneous evolution on Earth. The incubation period before intelligence emerges in the Universe was tremendously long and intelligences seem to be scattered over immense distances, probably making any contacts between them impossible. Mankind has indeed right to regard itself as the "crown" of evolution and to be proud of this fact, because of the enormous expense of time and energy engaged in this process and due to our exceptionality in the Universe. What is more, every one of us is unique and our chances to be born at all were infinitesimal in view of all the menaces our lineage, beginning with the first cell, had to escape successfully. The Good and the Bad are among the instruments of evolution. There are many good things, like appetite and sex, and some bad things, such as suf-

fering and death, but death may also mean deliverance. We cannot however be sure that our organic life and intellectual capabilities present the ultimate apex of evolution. Up to now we don't know whether we are not only steps towards creating inorganic "artificial" higher intelligences and functions.

The birth of the Universe means birth of gravitons in the number N_{gr} moving with the speed c, produced by the timeless and limitless Void through some process of selflimitation. What is surprising is that the Universe is an evolutionary one, due to fundamental characteristics of gravitons: m_{gr}, d, c and N_{gr} and the right amount of freedom of movements. The laws of physics are consequences of the properties obtained at the birth of the Universe from the Void. This fact cannot be explained by the laws of physics, as these are secondary to this fact, hence the birth of the Universe is in this sense meta-physical. A Void creating such an Universe is something that eludes human understanding.

The function of the human brain is to produce thoughts which are weightless, hence not material, but energy is needed to activate its function, and energy means mass. Thus matter can produce results which are not material, at least in our awareness. But human thought can produce, using mass and energy, very elaborate material constructions.

The Thought which was necessary to produce the plan of formation of our Universe was nonmaterial, hence represents "pure thought" sensu stricto.

Collisions between photons (rather semiphotons) of the electromagnetic radiations and gravitons in the gravitational field can be "elastic" if their relative velocities are less than c. These collisions change the paths of the photons, curving them in the direction from the higher density of the gravitational field towards lesser density of this field. The gravitational field shows thus optical density, acting on the photons. The concept of the "curvature of space " in the Einstein theory of general relativity can be replaced by changes of velocity of photons due to the optical density of the gravitation. The same idea suggested Pharabod and Pire [8]. Hence there are relations between the index of refraction and the "curvature" of space. Also the fine structure constant α shows connections with the index of refraction, $n = \frac{c}{\mathrm{v}}$ and $\alpha = \frac{\mathrm{v}_e}{c}$. Both are describing changes in directions of the motions, the constant α rotational, circular motions of semielectrons and electrons in the hydrogen atom. In crystals a surface of the indices of refraction, called indicatrix, describes changes of velocity of light connected with the symmetry of the crystal structure. Photons traversing a crystal are constantly deviated by optical density of the crystal, curving their path as arcs of circles. Curvature of space, replaced by changes in the velocity of photons, shows some resemblance to the surface of indicatrix, changing with evolution.

Light could emerge only after hydrogen and helium atoms were present in the Universe and began to oscillate. Light was "liberated" about 300000 years after time

zero and then it has to travel through extremely dense gravitational (and possibly subneutrinic) field, being coerced to take a path along the rewinding spiral on the Universal scale. Hence at first the velocity of light $\mathrm{v} = \frac{c}{n}$ in the optical density of the gravitation field must have been less than c. This means also that the Universe is somewhat older than it follows from the Hubble constant.

The universal time is given by the ratio $\frac{R}{c} = t_u$, where R is the actual radius of the Universe. This radius is meant here as the distance of the outermost gravitons, at the border with endless Void, from the Protouniverse at time zero. The path of light from this point was not linear but runs along a revolving spiral.

Any local increase of potential, hence ektropy, means a local journey in time, into the past in relation to the universal "time arrow". Time travel into the past is possible in part by various means: memory, photography, video and such, but we cannot travel personally into the past, not only because of the impossible energy cost but at all, due to the probabilistic character of situations in the past, due to the included indeterministic element. Any voyage into the future is impossible as velocity c cannot be surpassed. The historical time cannot be reversed as the chaotic, random, indeterministic elements were involved in its formation, which cannot be recreated. As there exist deterministic physical laws, some non- material pre- constructions of the future are possible, but only to some extend, as we could not know the complete set of initial states. If these are sufficiently well known, we can for instance obtain ammonia at will, but it is not possible to foresee the weather with the same precision, because many initial states are not exactly known. Too many outside circumstances exclude the possibility of foreseeing ones own future.

The expansion of the Universe is infered from the changes of the wave-lengths of light emitted by atoms in the most distant galaxies interpreted as Doppler effect. Light was "liberated" about 300000 years after the Big Bang event. And at this time it must have traveled through a very dense gravitional field, hence its trajectory must have been bend into a logarithmic spiral. In the initial stages of expansion the velocity of light, if looked as along a straight line from the Protouniverse as the starting "point", must have been very much lower than the Einstein velocity c. The acceptance of this velocity produced a false conclusion of the acceleration of the expansion of the Universe, indicated by the "cosmic constant", as light from the not so far off galaxies follows a nearly straight path. The expansion of the Universe from a small volume of the Protouniverse outwards, must have left the "core" of the spherical Universe depleted of matter, leading to a shell-like Universe.

The observed Universe is a gravitonic one, everything consists of gravitons, laws of nature deciding on the make- up of the Universe are determined by the properties of gravitons. Gravitons are carriers of the gravitational field, they are constituents of semiphotons and of hypothetical subneutrinos. All these particles are moving in va-

cuum with the Einstein speed c, producing respective fields. Hence at time zero not only gravitons but also semiphotons and subneutrinos must have appeared together and a driving force has moved them all with the velocity c, giving them respective kinetic energies. The impulses acting on them must have been individualized, constituting their inherent properties. These impulses of injected energy must have been distributed randomly and these particles were dispersed throughout the entire Protouniverse, what resulted in general outward tendency of motions, but also in forming locally rotating "black holes" with random orientations and distribution, producing the elements of randomness, incorporated into the Protouniverse and consequently into the Universe. Matter in the Protouniverse must have presented a superplasma of the carriers of the fields, that is subparticles $1m_{gr}$, $2m_{gr}$, $3m_{gr}$ and may be also more. It was a kind of superheated fluid, not a solid, hence Protouniverse as a whole had no rotational momentum, which the Universe would preserve. The axes of rotation of local groups of subparticles in the Protouniverse must would preserve and changing directions.

Separation of the three types of fields must have occurred at a later phase of expansion of the Universe. Along with formation of the Protouniverse from the Void, appeared distinction between the kinetic energy and the potential energy, as well as between the deterministic and the indeterministic behaviors. One kind of particles, their energy and elements of chaos make up our Universe, but an infinite number of different Universes based on the same principles is possible.

If gravitons were existing outside our Universe in infinite numbers, then our Universe would be supplied from the outer infinite Space by infinite numbers of gravitons and this would create a kind of the Olbers paradox, that is an infinite growth of the Universe in mass and size.

Other Universes may exist, but at infinite distances, perhaps even in other Infinities, or gravitons which once emerged from the Void at the time of Big Bang, can at another time be re-dissolved into this Void. In both cases any contact between possible other Universes is excluded forever.

The function of the Void itself seems to be creation of new Universes and removing of the old ones after their function has ended and they reached what may be regarded as their "Telos". This Void, producing life, has created emotions which motivate actions like forage, saving life and procreation and in the case of Man religion: Faith, Hope and Love are emotions.

Creation of matter and motion means relaxation of energy and information contained in the Void. The motion of inert masses, generated by energy, creates time and space (in reality different times and spaces). Velocity relates space and time.

Evolution leads, by trials and errors, to complex structures and highly organized processes up to the apperance of the intelligent life. The trial and error methods in their haphazard way aim howewer to achieve a purpose. This purpose may not be achieved, or only partly achieved or even missed altogether, but a purpose is in-

tended. But what is the purpose? The natural selection removes the unsuccessful attempts, what makes this the purpose. Solutions of the problems connected with achieving this purpose are rather similar in the case of the organic life on Earth. On the isolated Australia the evolution of the marsupials produced the same types of animals as in the case of placentalia on other continents, as the purpose is the same. So we may assume that on the other planets, at similar conditions as on the Earth, natural selection would produce similar results and, if time allows, similar kinds of the intelligent life. But why intelligent? On Earth the natural selection produced intelligent life in accordance with the needs of the catching hands, to enable a refinement of its uses. Animals with catching abilities, like elephants, are more intelligent than for instance rhinoceros, and a parrot more than a sparrow.

The abstract thinking becomes necessary at the highest level of evolution, and the natural

selection acts also in this case, eliminating the ineffective ideas. This is not possible at the extremely high temperatures. Thus evolution requires falling of the initial temperature of the Protouniverse down to the optimal temperatures, such as observed on Earth.

The primary function of the Universe seems to be creation of conditions sustaining evolution. The natural selection, eliminating the “unfitted” (or unlucky) elements, drives evolution.

Growing complexity of structures and functions is achieved step by step through joining more structural units built by atoms to form structural systems, able to withstand the existing outside conditions. The ultimate driving force of evolution is thus the electromagnetic attraction, powered by the dark energy. Feeble forces of gravitation acting on the cosmic scale produce galaxies, stars and planets, some of which may support evolution of life. The electromagnetic waves, produced by atoms, enable a long range communication and information.

The appearance of sex (and desire), in its most elementary form, is also reduced to the electromagnetic forces of attraction between the oppositely charged structural units. In the case of complex molecules, such as the DNA strands, it requires also their proper spatial conformation. Sex doubles the chances of survival of the structures.

Viruses, with no sex and no metabolism, are not alive, as there is no life without cells, creating internal conditions, separate from the outside ones. Viruses reproduce by “eating”.

Reproduction saves organisms and life, hence sustains evolution. The development of nervous systems produced internal integration of the organisms and the appearance of emotions, which include hunger and desire, further promoting survival.

With expanding Universe first the growth of entropy on the Universal scale, that is attenuation of energy favored evolution from elementary particles to atoms and molecules. In the Universe nearing the “Nirvana” temperatures and the mean density

of energy will be to low to sustain evolution. Somewhere between “Nirvana” and Protouniverse Stages must exist a point in time when the state of the Universe would enable formation of places with proper energy concentrations on the greatest scale, places at which occurance of intelligent life would be at highest probability. This point in history of the Universe may represent the “Telos” of the Universe. This point will be nearer “Nirvana” than the Protouniverse stage. Dark energy has the special function of supporting the existence of the observable Universe.

Motion produces time, hence corpuscular semiphotons and subneutrinos present quanta of space-time in the Universe. Two or more gravitons in rotational motion represent a closed space-time system and their translational motion with velocity c produces space-time expansion of the Universe. Gravitons produce only linear space-time expansion.

Inertia is the immanent property of matter, hence moving it, or changing its motion, requires an impulse giving it a momentum p=mv. As motion produces time, then time began at the Big Bang due to impulses given to gravitons, semiphotons and subneutrinos by the Void.

Presented analyses lead to a corpuscular (mechanics) and based on the minimalisation of potential energy (phenomenology) description of the material reality. Only formation of the primary structures, semiphotons (materions) and subneutrinos is not connected with minimalisation of energy which remains constant in the process, as no field exists between the gravitons.

The analysis of the basic scientific data supplies solid arguments for accepting a corpuscular nature of the carriers of fields and of the electron. Corpuscular theory leads to the uniform and coherent structure of science and does not require any additional interpretations.

“Great Unification” as a physical process means “condensation” of the semielectrons from gravitons of the gravitational field, occurring at the proper density, that is at the right ektropy of energy which represents the potential of the Universe at this stage of its expansion. Rotational motions of matter must have been involved in this process, because two semielectrons are rotating around each other with velocity v_e, forming an electron. The problem of connecting (not unifying!) the electromagnetic field with the gravitational field can be reduced to connecting the electron as the electromagnetic charge with gravitons as carriers of the gravitational field.

X. Supplementary Remarks

1. Time results from motion, without motion there is no time, there are as many real times as there are different speeds of motions. The dimension of time, like the dimension of length, applies to various concrete cases. In the Protouniverse, at the beginning, there was only one speed, the Einstein speed c, hence only one real time. The dimension of time and the real times should not be confused.

Time connected with a graviton linear motion is $t_{gr} = d/c$, but the direction of this motion is free In the 3D space. A hydrogen atom with a single electron circling the proton on the orbit $2\pi a_0$ in one plane represents a flat face of a watch. The hydrogen atom time is $2\pi a_0 / v_e$.

2. The minimum value of the Heisenberg uncertainty principle has a deterministic value: $H = \frac{1}{2} h/2\pi$. The Planck constant $h = 2m_{gr}c^2$, hence $H = m_{gr}c^2/2\pi$ and $2 \cdot 1/2 \cdot m_{gr}c^2$ is the kinetic energy of two gravitons circling around each other in one plane (2π), forming a materion with a spin. Positions of the gravitons on the circle 2π are unknown, but their kinetic energies are determined. A materion is like the flat face of a watch, showing the flow of time $t_{Pl} = 2\pi d/c$. Time connected with linear motion of a graviton is $t_{gr} = d/c$, but the direction of this motion can be any in the 3D space. A hydrogen atom with a single electron circling the proton on the orbit $2\pi a_0$, represents a flat face of a watch showing the flow of time $t_H = 2\pi\alpha_0 / v_e$. Time of the Universe moves with the growth of its spherical surface, $t_U = d^2\pi / c$, hence is not flowing linerly along 1D, like "normal" time, but is "swelling" in 2D.

3. The Newton constant of gravitation for one graviton $G_N = d^2\pi c$, hence $d^2\pi/c$ is the time of expansion of the spherical surface of the Universe. This expansion concerns the three kinds of fields, with carriers consisting of one, two and three gravitons, moving with the speed c (the gravitational, electromagnetic and "dark energy fields). These three kinds of fields are unificated by the gravitons, which are forming their carriers. Hence the gravitonic hypothesis is equivalent to the Theory of Everything in our Universe.

XI. The gravitonic theory and quarks – discussion of some problems

Looking for an answer to the question whether the quantum mechanics (wave mechanics) is reliably founded, and if not, what can replace it properly?

We can arrive at these answers in three steps:

1. By showing that the foundations of the quantum mechanics (wave mechanics) are unreliable
2. By establishing the correctness of the classical mechanics at the atomic scale
3. By showing that a corpuscular theory presents an alternative to the quantum mechanical outlook

Ad 1.a. The ungrounded replacement of a discontinuous function by a continuous one.

Ad 1.b. By showing that the accepted interpretation of the double slit experiment is false.

Ad 2. The Franck – Hertz experiment can be used to corroborate the applicability of the classical mechanics to atoms.

Ad 3. A corpuscular theory can be inferred from the fact that the classical electron radius and its mass have the same value if expressed in the respective Planck units.

The gravitonic theory – problems discussed

1. Graviton as the "divine particle".
2. The Universe like a soap bubble.
3. Quarks and the asymmetry matter – antimatter.
4. Classical physics at the atomic scale.
5. The Large Hadron Collider and the gravitonic theory.

Graviton as the "divine particle"

The gravitonic hypothesis assumes, regarding the origins of gravitons, that they were created spontaneously by the omnipresent, timeless and nonmaterial Void, and such assumption comes near to the St. Augustine conclusion, that God is a nonmaterial Spirit, completely different from matter, which He had created from nothing, hence the term "divine particle" is here quite appropriate.

Some extremists among the theorists connect God with mathematics, but mathematics has been created by people, as a requisite tool (hardly needed by God), and then developed into an intellectual challenge. Mathematicians themselves are built from material gravitons, like everything in our Universe, matter as well as fields, like the gravitonic theory assumes (what makes it a Theory of Everything). Physics deals with matter and fields, which also consist of material gravitons or their groups, but mathematics deals with abstract concepts, nonmaterial ones. Hence mathematics and physics should not be treated like equivalents.

The Universe like a "soap bubble"

The Newton gravitation constant expressed in the gravitonic form is $G = d^2\pi.c/m_{gr}$, where d is the diameter of the graviton, describing the Universe as a sphere expanding in time with the Einstein velocity c.

Within the Planck time unit $t_{Pl} = d/c$ the Universe is a static 3D sphere. Physics is the same throughout the Universe, but in the case of a non-spherical Universe the observed effects would be dependent on the direction. Starting from the extremely condensed Protouniverse, a centrifugal dispersion of matter and fields from this center must have brought about a nearly complete depletion of them in the inner parts of the spherical Universe and lead to a hollow, bubble-like shape of the Universe. The appearance of "common matter", and with it of the gravitational forces, has introduced something like a "surface tension", acting in the expanding spherical Universe. With time the density of matter and energy is decreasing, so these forces are also decreasing, what can be the reason of the observed acceleration of expansion of the Universe. The light from distant galaxies arrives on Earth not along a straight route, as is assumed, but along a much longer, logarithmic spiral - like trajectory, because of

the dependence of the velocity of propagation of light on the optical density of the fields, which is lowered along the route due to the decrease of this density with time. That can be the reason for the real and the apparent acceleration of the expansion of the Universe.

Gravitation issues from matter and the velocity of propagation of light depends on the density of the gravitational field, hence on the density of matter, thus the observed expansion concerns the material Universe. The fields of the primary "dark energy" carriers, as well as gravitons, expand independently from matter, with the constant Einstein velocity c, like foreseen by the Newton gravitation constant G.

Quarks and the asymmetry matter – antimatter

The problem why our Universe contains matter and not antimatter may be reduced to the problem of the existence of protons and not antiprotons.

According to the gravitonic hypothesis proton consists of three quarks and one positron and quarks are considered as electromagnetically neutral particles with quite complex structure and mass equal to the mass of 612 electrons. The problem of protons and antiprotons must be connected with the relations between the three quarks and the positron or the electron. The idea is that the difference in these relations is due to the chiral character of the arrangement of three quarks inside positrons and electrons, with analogy in the bioenantiomers. As in that case, selection of privileged direction of the turn (right or left) depends not on the differences in the potential energy of the two enantiomers (which is nil) but from an external influence. In the case of the bioenantiomers the selection was due presumably to the direction of rotation of the Earth magnetic field at this time, and in the case of the three quarks within the positron it may be the direction of rotation of the Universe as a whole, with matter and the fields within, which lowers the potential energy of protons in relation to antiprotons. In mesons there are two quarks in an achiral arrangement (which includes the center of symmetry, lacking in the chiral arrangement). Hence there are positive, negative and neutral mesons possible.

Most probably electrons and positrons were formed early in the chaotic motions of the carriers of fields, highly independent on the rotation of the Universe, like the Brown motions are independent on the rotation of the Earth. Quarks with their rather complex structure and their size, must have appeared much later and have been more strongly influenced by the rotation of the Universe. Quarks, if they represent particles of the "dark matter", are much more numerous then electrons and protons. In their chaotic motions they may have entered by accident the positrons to form stable protons or enter electrons to form unstable antiprotons. Quarks inside the positron are squeezed by its inner electric field, like in the case of the radiation pressure, and rotate with the same velocity as the positron rotates, due to the inner magnetic field. The squeezing grows when quarks are nearing the semielectrons, hence it seems that the interactions between quarks are growing with distance between them.

Classical physics on the atomic scale

Measuring of the ionization energies of atoms by applying the Franck - Hertz thermal electrons method is expected to provide us with an experimental verification of the assumption that energy may be absorbed by atoms in a continuous way and not only in quantum portions.

Ionization energies of atoms can be used to construct a periodic system of chemical elements with double periodicity, that of free atoms of the elements and that of the elements as homonuclear compounds in their natural state on Earth.

Ionization energies are determined by their attraction to the nucleus and by the repulsions from other electrons in the electronic shell, coming from different directions, within the frame of classical physics.

The number of protons in the nucleus of an atom is equal to the number of electrons in its electronic shells, if these are fully occupied. The electromagnetic interaction between the proton in the nucleus and the electron in the shell, bonded to this proton, are subject to the symmetry law U(I) stating that the electromagnetic field expands in one plane. The distances between the protons and the electrons bonded with them are fixed by the classical physical laws. Hence the distribution of protons in the nucleus must follow the distribution of the electrons in the electronic shell. Thus protons in the atomic nuclei are forming a rigid framework and the nuclei of atoms cannot represent “drops of a liquid” or such.

The periodicity chart based on the ionization energies reveals the “onion-like” character of the atomic shells. The quantum mechanical “orbitals” (like: s,p,d,f and their combinations) are presenting artificial constructions, without any semblance of reality.

The Large Hadron Collider and the gravitonic theory

One of the main objects of the experiments planned for LHC is the finding of Higgs particles, with mass foreseen by the present theories. If such particle will not be found, then the assumption, that the suppliers of mass (and energy) to the elementary particles consist of the carriers of the “dark energy” field (the subneutrinos), would gain credibility.

Next, if protons are formed by quarks and positrons then those last, at the collision of the protons, must reject each other in the opposite directions, what can be observed. In such a case the quarks would be found electromagnetically neutral and the participation of positrons in the structure of the protons would be confirmed.

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