ESSENCE OF ELEMENTARY PARTICLES AND INTERACTION FORCES IN NATURE

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«*It is possible that one day gravitation would be explained based on the phenomena not linked with gravitation.*»
Jay Orear, Section «Problems of Future» Physics, 1979

Existence of more primitive particle, than known in physics is assumed. The hypothetical particle and its antiparticle is a priori allocated with suitable properties, main one being the radial force. More complex theoretical particles are formed from these two particles. Detailed descriptions of structure and properties are provided for each theoretical compound. Theoretical inferences are compared to empirical laws of physics.

1. INTRODUCTION

The development of concepts on the structure of the surrounding physical world and the existent laws historically proceeded from something great to something small. This paper reports considerations about a structural element and its properties and provides theoretical deduction of the structure of more complex particles.

A rotation with an angular velocity $\omega = \pm c/r$ is assumed as a basic physical property of an element; where c is velocity of light; r is radius of rotation. The matter, in the form of the force field, surrounds every physical element and is its obligatory constituent. Rotation is accompanied by displacement of an element following the rule of the right (E^+) or left (E^-) screw.

An element possesses physical properties only within the plane passing through the element perpendicularly to a screw line axis.

Mass. To materialize the concept of a force field conceptions of negative and energetic masses are introduced. The energy can be ever be recounted into the energetic mass using formula $E = |m|\cdot c^2$. The concept of the mass of an element is obtained by comparing two formulas expressing its energy: $m\cdot c^2 = h_0\nu$; where $2h_0 = h$ is the Planck's constant:

$$m = \pm h_0/2\pi rc \qquad (1)$$

Formula (1) agrees with formula $m \approx h/(2\pi r\cdot c)$ (Yukawa, 1936)

Radial force. The direction from the center of rotation is accepted as the positive direction of radial force $F = mc^2/r$ is. When moving over concave trajectory the radius acquires negative values.

II. CONCEPT ABOUT THE ELEMENT

Flat particle-field. Rotation with velocity of light causes an induction of radial (centrifugal) force: rotation takes place on the entire external part of a plane. A force field appears in the rotation plane with an induced force

$$F_{\text{ind}} = m_{\text{ind}}\, c^2/\rho. \qquad (2)$$

The force field has an energy decreasing while moving from the orbit of particle rotation (increase of ρ value). The energy enclosed within the circle of radius ρ increases. When increasing ρ by $d\rho$ the energy increment will be:

$$dE = F_{\text{ind}}\, d\rho. \qquad (3)$$

Putting equations (1) and (2) into the differentiation function (3), it is possible to calculate the potential of any circle in integrating from value ρ to infinity. Replacing ρ for *r* provides the energy of a force field and allows to define its mass:

$$E_{field} = \int_r^\infty \frac{h_0 c d\rho}{2\pi\rho^2} = \frac{hc}{4\pi r}$$

The same is gained from formula (1): **the total mass of a field implies the mass of an element**.

Elementary charge. Any element can be represented as a flat elementary charge distributed uniformly over a circumference. An electric field within a circumference does not exist. A flat electric field migrates with the velocity of light.

This presentation is not always acceptable, for the charge is provided with mutually exclusive properties: *elementary* (indivisible) and *assigned* (divisible).

III. ATTRACTION AND REPULSION OF ELEMENTS

Every element has its own flat field of force, excepting internal areas of rotation (Fig. 1).

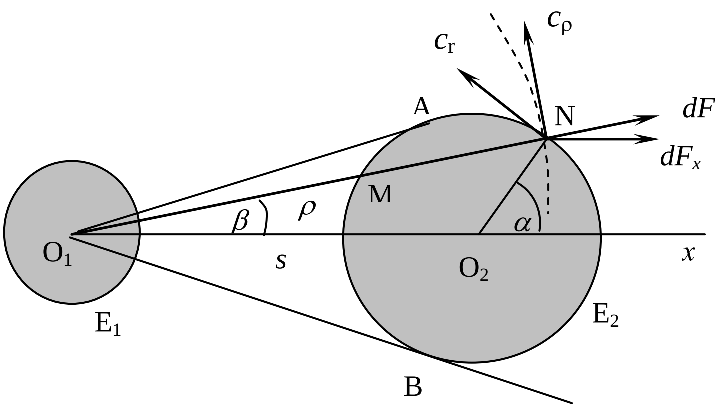

FIG.1. Action of a force field of element E_1 on element E_2. Designations: $s = O_1O_2$; $\rho = O_1N$; O_1A, O_1B and c_r are the tangents to a circle with center O_2; c_ρ is the tangent to a circle with center O_1. In N necessary constructions are made to define the force.

Relative to point O_1 element E_2 periodically changes its direction of movement. It moves on arc ANB to the field of element E_1 in the same direction as element E_1, while on arc BMA it moves in the opposite direction. In points A and B a double inversion occurs: the direction of movement is changed, and the sign with radius ρ is changed as well (movement on a concave trajectory) therefore the direction of forces for points of arcs ANB and BMA is identical (from center O_1). It is necessary to determine the sum of projections of radial forces on the axis O_1x.

Split the trajectory of element E_2 into fragments of arcs $d\alpha$, then each fragment will have mass $dm = m_2/2\pi\cdot d\alpha$. Then define projection dF_x for arbitrary fragment (in point N) using geometric constructions: $dF_x = m_2c^2\cos^2(\alpha-\beta)\cos\beta\cdot d\alpha/2\pi\rho$.

After transition to a single argument α we obtain:

$$F_{1x} = \frac{m_2c^2}{s}\int_0^\pi \frac{(r^2/s+\cos\alpha)^2(1+r_2\cos\alpha/s)\,d\alpha}{\pi(r_2^2\sin^2\alpha/s^2+(1+r_2\cos\alpha/s)^2)^2} \qquad (4)$$

Designate the value of integral as $I(r_2/s)$, then formula (4) will be expressed as: $F_{1x} = m_2c^2I(r_2/s)/s$. An analogous formula is used to show the action of element E_2 on element E_1: $F_{2x} = m_1c^2I(r_1/s)/s$. Thus,

$$F = \pm mc^2 I_{r/s}/s. \qquad (5)$$

Sign (–) is assigned to forces of attraction. The graph of function *I(r/s)* is shown in Fig. 2.

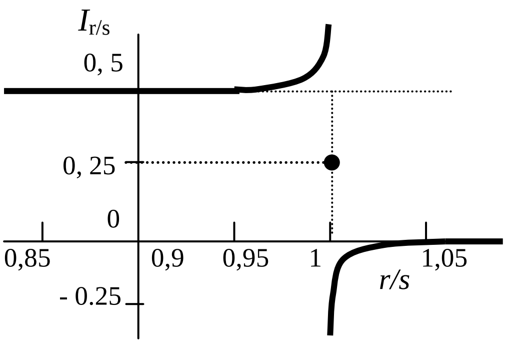

FIG.2. Change of interaction factor $I_{r/s}$ in transition through value r/s =1. With s>>r , factor $I_{r/s}$ is constant and equal to 0.5. In the transition point ($s = r$) the factor is twice less. With $s<<r$ interaction is not the case. In the field of transition (less than 5 % from r) the strong attraction is replaced by strong repulsion.

Problem 1. Find the mass of the two identical elements, being remote from each other, if the square of force of their interaction is equal to the force of interaction of two electrons.
With $r/s < 1$ the integral $I(r/s) = 1/2$ and $F^2 = 1/4 \cdot m^2 \cdot c^4/s^2$. For the two electrons $F = k_0 e^2/s^2$, and then $m = \pm 2k_0^{1/2} e/c^2 = \pm 3.4 \cdot 10^{-31}$ kg.
From experimental data the mass of electron amounts to $9.1 \cdot 10^{-31}$ kg. Thus it may suggested that **only a part of an electron mass is bound with its force field**.

IV. CONCEPT OF QUANTUM AND NEUTRINO

Formation of a quantum. Of particular concern is interaction of two different elements (Fig. 3). When they approach, the common force field will weaken, because the strain in each point of space is defined by the vector sum of combined fields. Approaching of elements is accompanied by decreasing energy of each element.

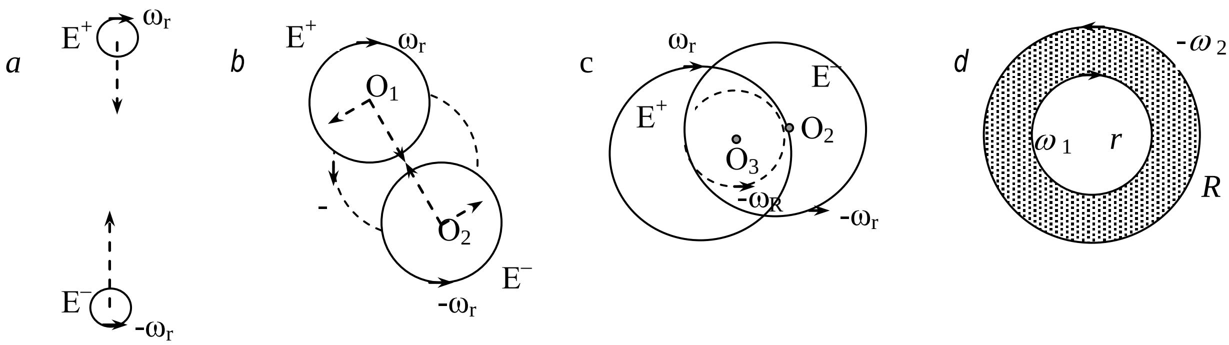

FIG. 3. The scheme of quantum formation and neutrino structure; (*a*) Attraction of elements E^+ and E^-; (*b*) Left-hand rotation; (*c*) Interaction results in formation of quantum structure ($O_1O_2 = s = r = 2R$); (*d*) The force field of element E^+ exists only within element E^-, further it is compensated (neutralized) by a force field of element E^-.

When elements are being attracted, their radii increase, and the orbits of rotation stretch. The orbit stretching (Fig. 3*b*) is thought to cause a new rotation, which raises the energy to the former level. Eventually a new particle of quanta appears.

Interaction of flat elementary particles implying redistribution of energy as the change of radii and emergence of new orbits.

Structure. Two different elements rotate in the same plane (Fig. 3*c*). The centers of circles move one after the other over a circumference with a radius $r/2$ at a velocity u; $u < c$. There arise quantum$^+$ and quantum$^-$ depending on the direction of rotation.

The value u is defined by an equality of centrifugal force and force of attraction: $mu^2/R = mc^2I_{r/s}/s$; $I_{r/s} = 1/4$ (see Fig. 2). $\nu_R = c/(2^{3/2}\pi r)$. This very frequency is used in the equation: $E = h\nu$. There are 2 elements in a quantum. Therefore in formula (1) $h_0 = h/2$.

The straight line passing through the centers of elements of quantum (O_1 and O_2 in Fig. 3*c*) repeats its position in space after a period $T = 1/\nu$. The plane produced by these positions is referred to as the plane of quantum polarization; and the straight line itself as the line of polarization. The planes of polarization allow the phase shift of the two quanta to be compared. These two quanta have identical frequency, however they occur in different planes.

Another representation of quantum is a rotation of two flat elementary charges with frequency ω_R and movement of this dipole at velocity of light.

Neutrino. Two elements E^+ and E^- form a neutrino, if they have the common center (Fig. 3*d*). Besides this, force fields of elements E^+ and E^- overlap outside a circle of radius R. The force field will be preserved over the range between r and R. It equilibrates centrifugal forces of element rotation. The energy of a neutrino is composed of: energy of rotation E^-, energy of rotation E^+ and energy of a field.

$$E = hc/4\pi r + hc/4\pi R + hc\,(1/r - 1/R)/4\pi = hc/2\pi r = h\nu_r.$$

The central symmetry of circles R and r is not determined, therefore a neutrino is steady only in absence of external interaction, which would result in the transfer of an internal element outside to produce quantum. The antineutrino has the same structure: elements E^+ and E^- are mutually replaced.

The presence of a right-screw and a left-screw rotation in a particle determines the relative stability of a neutrino. An absence of an external force field provides high penetrating ability.

V. INTERACTION OF QUANTUM AND ELEMENT

When being in the same plane the quantum and the element interact. Let element E^+ move like a quantum along the axis O*y*, as shown in Fig. 4. It causes the forces acting on E^+. Angle α is defined by direction of quantum (E^+) on the element relative to axis O*x*.

With turning elements of quantum by $\pi/2$, force F turned by the same angle. Thus inducing force F rotates with the same frequency, as the elements of quantum inducing free element E^+ to rotate with frequency ν.

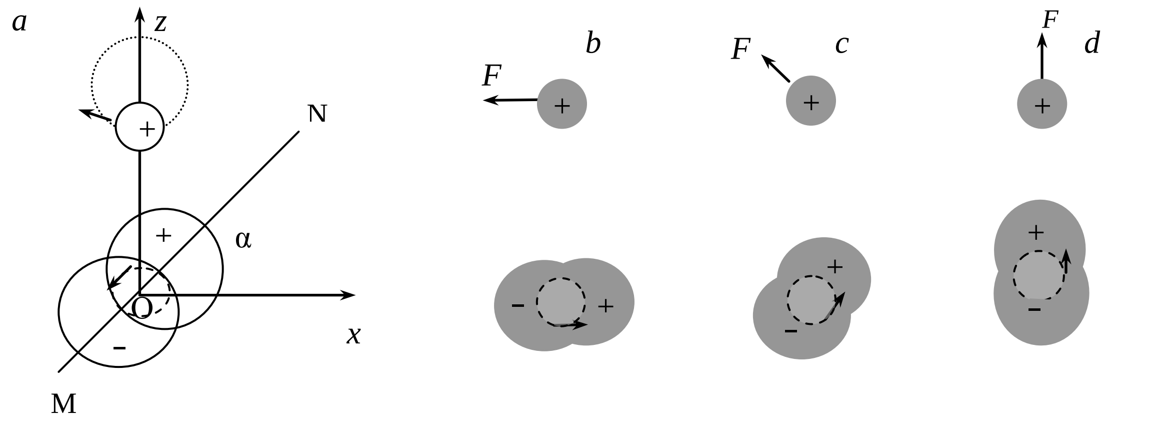

FIG. 4. The scheme of quantum and element interaction. (*a*) Elements are put in the system of coordinates. A dotted line shows a trajectory of their centers. MN is a line of polarization. The angle α is defined by a line MN and an axis *x*. (*b*) $\alpha = 0$; elements form isosceles triangle; force F represents a magnetic component of interaction. (*c*) $\pi/2 > \alpha > 0$. (d) $\alpha = \pi/2$; all elements are located on a straight line; force F is directed perpendicular to the line connecting the centers of quantum and element. It represents an electric component of interaction.

The flux of quanta near to an environment containing free elements is polarized (quanta with identical frequency will have the same plane of polarization). The elements of the environment, occurring in the same plane with quantum hν, acquire rotation with frequency ν.

Package of quanta. Several quanta might occur within the same plane. Interaction will cause equalization of frequencies. Such a flat formation is a package of quanta. Interaction of quanta packages is expressed in a turning the plane of a package to a certain angle. The packages following each other form a beam, in which packages do not interact as they belong to different planes. Each package has its own direction.

VI. SPATIAL ELEMENTARY PARTICLES

The following refers to stable elementary particles only.

Transformation of element into an elementary particle. Let element E^+, rotating with radius r with the speed of light, to move inside a circle with velocity u ($u < c$). After a certain number of turns the element can appear as in the start point (L in Fig. 5), or before or after the start line. If the element does not appear on the start line, it needs additional rotation increasing or reducing the speed of its motion to make the points of start and finish overlap (L and K or L and N). Additional rotation occurs in the plane perpendicular to the plane of a drawing.

The construction obtained will correspond to a hypothetical particle. To convert it into an elementary particle it is necessary to reduce the number of turns up to $n = 1$ (Fig. 5*b*). Thus the energy of an element would increase.

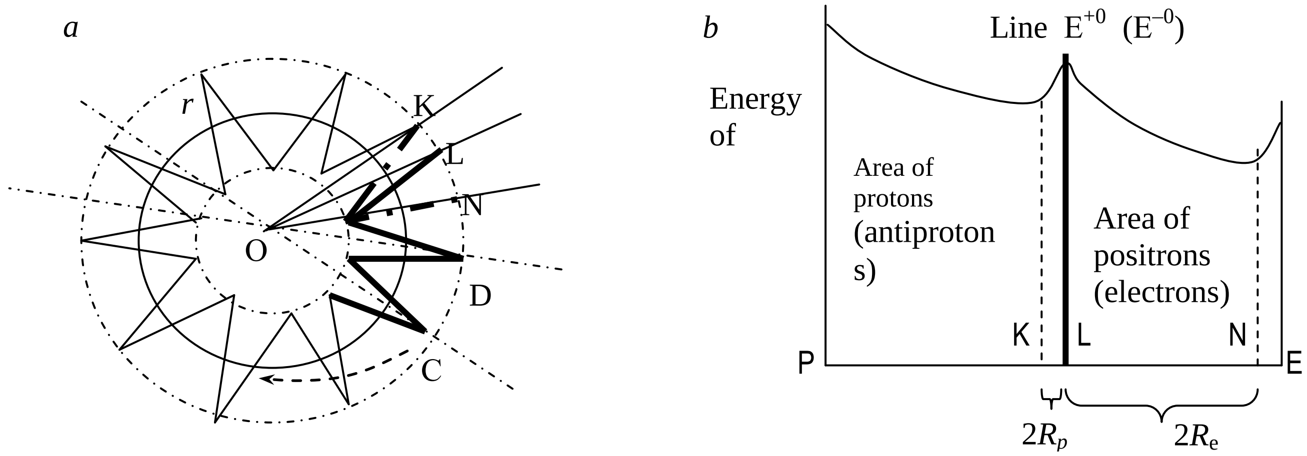

FIG. 5. The scheme of theoretical transformation of an element. (*a*) Element E^+ rotates perpendicularly to the plane of a sheet. The element covers the track $20\pi r$ (10 full turns) from OL (start line), and reaches beam OK; it appears on beam ON. To get on start it should either additionally turn directly by1/10 of ∠LOK or in the opposite direction by 1/10 of ∠LON.
(*b*) Energy of elementary particles. Point L is start; the P and E are the finishes. The curve over site PK is $hc/4\pi r n_r + hc/4\pi R n_R$, where n_r and n_R designate a share of one turn ($n_r + n_R = 1$). The minimum of energy will be at $r/R = (1/n_r - 1)^2$.

In the electron the element does one left screw turn of radius r and simultaneously it does one right screw turn of radius R ($R < r$) in the other plane. If this scheme is applied for a quantum a positron will also be formed along with an electron. The proton has both right-screw rotations.

Elementary particle structure. Displacement of an element on a circle causes rotation in two planes around the stationary point. Any rotation can be either right- or left-screw. One rotation occurs with the velocity of light and has a force field, while another one proceeds at a smaller velocity and has no force field. The force field of elementary particle surrounds it on all sides.

An elementary particle can be represented as a hollow-core sphere of radius P, on its surface E^+ or E^- is rotating on a circle of radius r (Fig. 6). In the other plane (a circle of radius R) the element is rotating either over the right or left screw, that can lead to an additional rotation of sphere of radius P around point O so, that the element always lies at distance ρ from the center of an elementary particle. When additional rotation is not the case, $\rho = P = r$.

The designation of an elementary particle E^{ij} includes two rotations (i – rotation giving force field): E^{-+}, E^{+-} is electron and positron; E^{++}, E^{--} is proton and antiproton; E^{-0}, E^{+0}.
We write separately masses for E^{+0}, electron (e), and proton (p):

$$m(E^{+0}) = {}^0m_r \;; \qquad m_e = {}^em_r + {}^em_R,\ \ {}^em_r < 0; \qquad m_p = {}^pm_r + {}^pm_R\,.$$

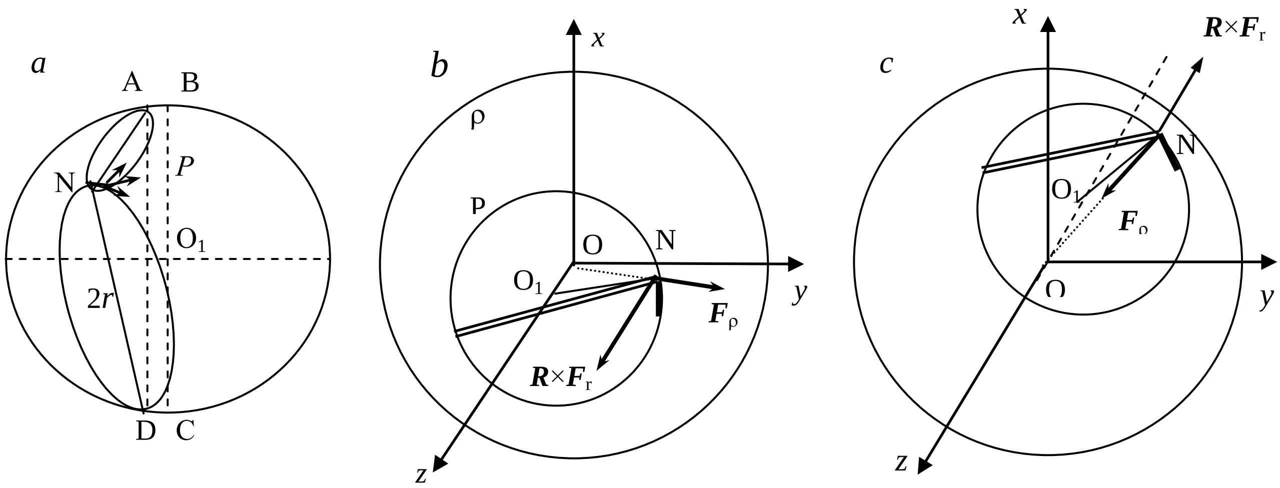

FIG. 6. (*a*). Fragment of elementary particle (electron) structure. Element N rotates on the circles with radii r and R simultaneously. Arrows show the direction of rotations and the resulting direction. Both rotations provide surface of sphere with radius P with the center in point O_1. $\angle AND = \alpha$; $P^2 = (r^2 + R^2 - 2r R\cos\alpha)/\sin^2\alpha$. (*b*) and (*c*), Structural differences of electron and proton. The element is in point N. Double and solid lines represent diameters (ND and AN in Fig. 6*a*). The moment of force $R\times F_r$ is parallel to an axis *z*, but it has a different direction. Radial force F_ρ is directed to point O for proton and from point O for electron.

VII. BALANCE OF DIRECTIONS AND FORCES

The surface of a force field rotates uniformly in two mutually perpendicular directions and passes for a period $T = 2\,\pi/\omega$ through all possible positions in space. If these positions are equally probable, the field around a single elementary particle will be homogeneous (identical in all directions). In this case the balance of directions is observed:

$$\omega_\rho = \omega_R = \omega_r = c/r.$$

When the balance of direction is disturbed, the value of *r* will depend on direction, that may be the cause of symmetry law disturbance.

The expression of a stable rotation is expressed as the equality of the force moments: $\boldsymbol{R}\times\boldsymbol{F}_r = \boldsymbol{\rho}\times(\cos\alpha\cdot\boldsymbol{F}_r)$, where $\cos\alpha\cdot\boldsymbol{F}_r$ is the tangential component of a force field. Therefore , from the equation it follows: $\cos\alpha = R/\rho$.

The other balance of forces is a compensation of the element force field by the two radial forces. The resultant force is defined by the vector product (Fig. 6*b*). Then

$$\boldsymbol{F}_R \times \boldsymbol{F}_r = \cos\beta\cdot\boldsymbol{F}_r, \qquad (6)$$

where $\boldsymbol{F}_r$ is the radial force of rotation at a velocity $\boldsymbol{c}$; and $\boldsymbol{F}_R$ is the radial forces of rotations at a velocity *u*;
Cos $\beta\cdot\boldsymbol{F}_r$ is the normal component of a force field. In particles E^{+0} and E^{-0} $R = 0$, and
$\cos\alpha = \cos\beta = 1$.

Mass of elementary particle. Equality (6) allows to go from the vectors to their modules and to calculate the mass of electron and proton: $m_R u^2 \sin\gamma/R = \cos\beta$; where γ is the angle between radii *r* and *R*.. Replacing r for m using formula (1) allows to define a mass m_r:

$$m_r^{\ 2} = h/(2\pi c^3)\cos\beta\,/\sin\gamma \qquad (7)$$

Masses of particles E^{-0} and E^{+0} are determined by the simplified equation $m_r^{\ 2} = h/(2\pi c^3)$. Numerically it is expressed as $m_0 = 1{,}978386\cdot10^{-30}$ kg. Then $r_0 = c^{1/2}h^{1/2}/(2\pi)^{1/2}$ and $S_0 = 2hc$ (sphere). Masses m_0, m_e and m_p are related by the ratio:

$$m_e/\mathrm{arctg}\,(m_e/m_p) = m_p\mathrm{arctg}\,(m_e/m_p) = 2\pi^2 m_0; \qquad m_e\cdot m_p = 2\pi^3 h/c^3. \qquad (8)$$

IV. INTERACTION OF ELEMENTARY PARTICLES

The necessary condition of interaction is positioning a single elementary particle in a force plane of the other one. Though the force field of the elementary particle represents a twisted surface, it is feasible to replace a portion of this surface, covering the other particle, with a segment of a plane. The cases of interaction and its absence are shown in Fig. 7.

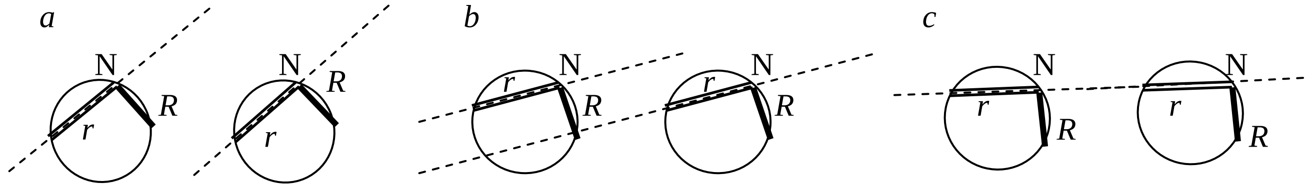

FIG. 7. Interaction and absence of interaction between two elementary particles. The drawing displays the plane perpendicular to the force fields. (*a*) and (*b*), no interaction; (*c*), elementary particles interact.

Let us distinguish strong (electric forces) and weak interaction. The first case considers interaction in the same plane m_{r1} and m_{r2}, and the second one represents the sum of two forces: action of field m_{r1} on mass $m_{R2,}$ and action of field m_{r2} on mass m_{R1}.

Forces of the two types of interaction are determined by the equations

$$F_q = p(r)F_r\,; \qquad\qquad F_M = p(r)(F_1 + F_2); \qquad\qquad (9)$$

where F_r is the force determined by the equation (5); $p(r)$ is the probability of circles of radii r_1 and r_2 being in the same plane; F_1 and F_2 are forces acting between m_{r1} and m_{R2} and between m_{r2} and m_{R1}.

Thus it can be suggested that doing a short time both strong and weak interaction between remote elements is existing.

Strong interaction. If two independent elementary particles have a most possible probability of interaction, then this pair will be referred to as coordinated. The systems, in which all independent elementary particles, with a rare exception, are forming pairs, are referred as coordinated systems.

To deduce the equation of a strong interaction for two independent elementary particles, we present p(r) in the equation (9) as geometrical probability.

At a sufficient distance of a diameter $2R$ (Fig. 7) will be seen under angle $2R/s$. At a full turn in the coordinated system a favorable event will take place twice – strong interaction. Then based on the definition of a casual event probability there will be: $p(r) = 2R/\pi s$. As for elementary particles the relation $R/r = \mathrm{tg}\,\gamma$ is a constant, $p(r) = 2r\,\mathrm{tg}\,\gamma/\pi s$. This expression and equation (5) are inserted into equation (9):

$$F_q = p(r)F_r = hc\,\mathrm{tg}\,\gamma\,/2\pi^2 s^2\,. \qquad (10)$$

Angle γ for an electron and proton is different. We receive from equation (6):

$\sin\gamma_e = -h/2\pi c^3 \cos\beta_e/{}^e m_r^2$; $\sin\gamma_p = h/2\pi c^3 \cos\beta_p/{}^p m_r^2$. The electron and proton interact identically regarding the absolute value, therefore $\gamma_e = \pi/2 + \gamma_p$; $\mathrm{ctg}\,\gamma_e = \mathrm{tg}\,\gamma_p$.

Let us express tg γ through physical constants: $\mathrm{tg}\,\gamma = r_e/R_e = R_p/r_p$ and $\mathrm{tg}\,\gamma \cong (m_e/m_p)^{1/2}$.

Finally we receive $F_q \cong \pm hc\,(m_e/m_p)^{1/2}/2\pi^2 s^2$. This equation can be generalized for the case of a strong interaction of one group of elementary particles with another one in the coordinated system:

$$F_q = \frac{hc\sqrt{m_e/m_p}\,N_1 N_2}{2\pi^2 s^2} \qquad (11)$$

where N_1 and N_2 are the algebraic sums of signs plus and minus in two groups of particles.

Problem 2. Whitt hat force two electrons repel one from another at a distance 1*m* ? Compare with the empirical equation $F_q = k_0 e^2/s^2$.
Substitution of physical constants into the theoretical equation (11) gives $F_q = 2.348 \cdot 10^{-28}$ newton. The Coulomb's law gives $F_q = 2.307 \cdot 10^{-28}$ newton, that is less than the expected value. Conclusions:

- Dielectric permeability of vacuum $\varepsilon_o = \pi\,(m_p/m_e)^{1/2} e^2/2hc$.
- The nature our surrounding is highly coordinated.

Weak interaction. During the period of strong interaction both masses (m_R and m_r) of the other element are in the force surface of elementary particle. Mass m_R moves at velosity $u < c$. This factor suppresses the inequality $m_R > m_r$ and permits a weakness of interaction to be to stated.
Using formula $F = \rho(R) \cdot F_R$ we get equation:

$$F_M = \theta\,(\pm{}^1m_r\,{}^2m_R \pm {}^2m_r\,{}^1m_R)/s^2. \qquad (12)$$

The mode of weak interaction for the basic pairs of elementary particles:

(1) *e-e*: $F_M = \theta\,(-{}^em_r\,{}^em_R - {}^em_r\,{}^em_R)/s^2 = -2\theta\,{}^em_r\,{}^em_R/s^2$ (attraction);

(2) *p-p*: $F_M = 2\,\theta\,{}^pm_r\,{}^pm_R/s^2$ (repulsion);

(3) *p-e*: $F_M = \theta\,(-{}^em_r\,{}^pm_R + {}^pm_r\,{}^em_R)/s^2$ (attraction).

In the case of opposite signs, the more significant sign is put on the first place.

Universal gravitation (Newtonian attraction). Now we consider the interaction between two pairs p-e at a distance *s*. The electric forces are balanced, so only a weak interaction remains. We shall deduce the factor determining the sign of the weak interaction: $-2{}^pm_r{}^pm_R + (-2{}^pm_r{}^em_R + 2{}^em_r{}^pm_R) + 2{}^em_r{}^em_R \cong -2\,{}^pm_R\,{}^pm_r$. Considering this factor and equation (11) interaction N_1 of pairs p-e with N_2 will become $F_M = -2\theta N_1 N_2\,{}^pm_R\,{}^pm_r/s^2$.

The mass of any neutral (in terms of balance of number p^+ and e^-) is produced by pairs *p-e*. Masses ${}^pm_R$ and ${}^pm_r$ are proportional to m_p, and also mass ($m_p + m_e$). Then the equation of gravitation will acquire common expression: $F_M = -\gamma m_1 m_2/s^2$.

Absence of interaction. In some cases a close distance interaction may or may not take place (Fig. 7). Moreover, the mechanism preventing from interaction between electron and proton and between protons (nuclei of chemical elements) does exist. If interaction begins in the nucleus between at least two protons, then the forces of repulsion defined by formula (11) will cause removal from a nucleus of one or several fragments (nuclear decay). Thus, there is no need in specific nuclear forces to account for the stability of nuclei.

VIII. CONCLUSIONS

The mechanical models have long been ignored in fundamental physics. The elementary particles, electromagnetic field and mechanical model? Yes. And the model considered above is fairly simple. The material proposed seems primitive and sometimes absurd. But the results acquired merely from theoretical considerations showed unexpected (for the authors as well) coincidence with empirical laws and physical constants.

The mechanical model provides not only the visual representation but also claims to be the universal theoretical method of learning physical phenomena. In 1968 experiments were conducted in terms of mechanical representation of energy of crystalline structure. However their publication was postponed to uncertain time.