

Numerical task for orbital electron in transition subatomic structure

Mikhail Ivantsov (✉ mk@mbox.vn.ua)

Research Article

Keywords: orbital electron, subatomic structure, boson classification

Posted Date: October 1st, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-952706/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Numerical task for orbital electron in transition subatomic structure

Mikhail K. Ivantsov

Abstract The present work as part of a known task of single-electron atom has been carried out, wherein one mathematical theorem is proved. Herewith an orbital electron was modeled, for which a certain parallelism exists between the highlighted ground state of the atom and special transition states in subatomic structure. Moreover, the ground state in unambiguous solution of fine-structure constant is obtained, where first transition state at the exceptional accordance with proton nucleus can be founded. For here, it is possible to relate the hyper-fine nuclear structure like the Lamb shift of hydrogen atom. In this substantiation of the task, multiply charged states were predicted for a hypothetical nucleus, as in the higher order of meson-boson transitions. The specified approach, in the terms of electric interaction, may be beyond a scope of the existing boson classification, supposedly for the carriers of electroweak interaction.

Keywords wave function · stationary Schrödinger equation · Einstein formula for electron

1 Introduction

In the famous lecture, where it is about the fine-structure constant, the Feynman confesses to the absence of a proper mathematical apparatus for a description of quantum electrodynamics: "...a bunch of words to describe the relationship between m and e - is not real mathematics!" [1].

Against the background of this problem, the same disagreement about a real nature of wave function, that started yet between the Bohr and Einstein, and which remains unresolved until now perhaps, can be noted [2].

Apparently, the probabilistic interpretation of the wave function follows only as a consequence. But that is not a reason of the mass-charge quantities.

M. Ivantsov
Vinnitsa 21000-499, Ukraine
E-mail: mk@mbox.vn.ua

It was possible to adhere to Einstein's point of view, as in the assumption of non-probabilistic interpretation ("God does not play dice...").

It may happen that for some current probabilistic event, when charged particle moves in whole space, an inexplicable situation arises, where instantaneous re-installation for electric field into infinity would be required. Whereby, an electron should be manifested before itself in own field, like if in a future.

Indeed, in the foreground is the fact that there is an initial condition for the charge singularity, since due to the limiting velocity for electromagnetic interaction, in the empty space at infinity. It is that is related to the electric charge, the field of which is defined at stationarity.

In such reasoning, there is only a transfer of electromagnetic energy in space, that can be associated with a certain diffusion rate, both in the expression of fine structure constant.

But this is not a position for mechanistic electron, ostensibly for a charged particle with mass, where an apparent paradox may meet.

For instance, relative to purely electric effect, the energy increment for orbital electron by the atom task is indicated (Note below 1.1).

Essentially, what is an electric current mean, if the electron already falls out of the closed circuit to replace an atomic "electron" through an electromagnetic field? It turns out that instead anyway electromagnetic transformation, there is a fantastic transportation for electron, as with an incommensurate rest mass $E = mc^2$

In this notion about a motion of charged particle in the central forces field, the Coulomb interaction is revealed. A forgotten Schrödinger "electromagnetic interpretation" of wave function may be mentioned: it is distribution of elementary charge as in Coulomb's field of nucleus $e \in |\psi|^2$ - that is not recognized for the quantum mechanics (in work [3]).

At the postulated Coulomb interaction $V(r) \sim e^2/r$ - the stationary Schrödinger equation is reviewed [3]

$$-\frac{\hbar^2}{2m} \nabla^2 \psi + V \psi = \mathcal{E} \psi$$

There are corresponding electronic levels $\mathcal{E} = \mathcal{E}(n)$ - in system of principal quantum numbers $n = 1, 2, \dots$

It is permissible that the indicated equation is specifically expressed at the Einstein formula for electron $E = mc^2$

From where, quantum-mechanical equation only for constant value can be redefined

$$-E r^2 \nabla^2 \psi + V \psi = E \psi \quad (1)$$

- wherein electron value is $\mathcal{E}(n) \in E$ - provided the symbolic Bohr radius $r = r_0$ (Note below 1.1).

Then respectively, not postulated Coulomb's potential value follows (in the form $V(r) \in E$)

$$V(r) \sim n \frac{e^2}{r} \quad (2)$$

There, charge coefficient from principal quantum numbers is derived $n = 1, 2, \dots$ - as if for a multiply charged nucleus that is surrounded by an electron "shell".

Formally, what is proved here is nothing more than an equation for spherical functions (in work [4]).

Hereinafter, there is a solution of radial part from Eq. (1)

$$\psi(r) = Q_n^l(r) \cdot \exp(-\frac{1}{2} r) \quad (3)$$

- where corresponding orthogonal system is highlighted

$$Q_n^l(r) = r^l L_{n+l}^{2l+1}(r)$$

- which recorded through the generalized orthogonal Laguerre polynomials, according with the quadratically integrable expression

$$\int_0^\infty L_{n+l}^{2l+1}(t) L_{n'+l}^{2l+1}(t) t^{2l+1} \exp(-t) dt = 0 \quad (n' \neq n)$$

(the orbital numbers $l = 0, 1, \dots, n - 1$ - in system of principal numbers $n = 1, 2, \dots$).

In the same time, for the stationary Schrödinger equation, a condition of orthogonality is not performed, since an applied dependency has place $\mathcal{E}(n) \in V$. The orthogonally compatible solution should not be dependent from own numbers $\psi \neq \psi(n)$ - that only for constant value can be defined, in Eq. (1).

1.1 Note

In the fundamental constants, a relativistic ratio at achievable limit velocity $c = c_0$ - on main electronic orbit $r = r_0$ - of Bohr's radius, is symbolically designated

$$C = \frac{\dot{c}}{c} = \frac{\dot{r}}{2\pi r}$$

Here, according with the Compton wavelength $\dot{r} = \frac{2\pi\hbar}{mc}$ - there is corresponding offset for fine-structure constant, by the Sommerfeld work [5].

Is known a postulated law on "moment of momentum", in form the Planck constant

$$r m \dot{c} = \frac{1}{2\pi} \dot{r} m c = \hbar$$

- from where the rest energy for electron follows

$$E = mc^2 = \frac{2\pi\hbar c}{\dot{r}}$$

From the relative constant on electric interaction $C \sim e^2$ - there is electron increment of the ground state of atom (ionization energy)

$$\Delta E = \mathcal{E}(n = 1) = \frac{1}{2} C^2 E$$

2 Assumption about scattering function (in central symmetry system onto infinity)

The electrostatic theorem by the Gauss-Ostrogradsky formula is known

$$\oint_S \mathbf{F} \cdot dS \sim 4\pi q$$

- from which the charge proportionality under a flow of electric displacement through closed surface is applied $F(r) \sim \frac{d}{dr} V(r)$

in central forces field of Coulomb's attraction a tension spherical surface, that surrounds the charged kernel, according with

Let,

From where a function by type the distribution of probability density can be deduced (mean superficial value)

$$\chi \sim \oint_S [\psi]^2 \mathbf{F} \cdot dS \quad (4)$$

- for which, accordingly, radial dependence by the spherical functions is solved in Eq. (1)

$$\chi(r) = [\psi(r)]^2 = \int_0^\pi d\theta \int_0^{2\pi} [\psi(r, \theta, \phi)]^2 d\phi$$

Within the confines of a narrowly assigned task, for the spherical surface of charge distribution, a special position of the repulsion forces is implied. Since for this case would be an indefinite wave function at infinity, the solution of some area of complex plane is further investigated.

The Sokhotsky-Plemelj formulas are known (by work [6])

$$\left. \begin{aligned} \lim_{w \rightarrow z} \varphi_i(w) &= \frac{1}{2\pi i} \int_L \frac{\varphi(\zeta)}{\zeta - z} d\zeta + \frac{1}{2} \varphi(z) \\ \lim_{w \rightarrow z} \varphi_e(w) &= \frac{1}{2\pi i} \int_L \frac{\varphi(\zeta)}{\zeta - z} d\zeta - \frac{1}{2} \varphi(z) \end{aligned} \right\}$$

The Cauchy type integral may give values of analytic functions, where arithmetic mean of the limiting boundary integral values, respectively, inside and outside of integral counter.

This Sokhotsky-Plemelj theorem may be written in compact form of the Kramers-Kronig relations, as on open contour in infinity (by work [7])

$$\phi(w) = \frac{1}{\pi i} \mathcal{P} \int_{-\infty}^{+\infty} \frac{\varphi(w')}{w' - w} dw'$$

For the boundary values of analytic function, there is the identical transformation with a real positive parameter (by work [8])

$$f(x) \equiv \frac{1}{\pi i} \int_0^\infty \frac{f(\zeta)}{\zeta - x} d\zeta$$

These principal limited value of the Cauchy integral are shown in form of the Sokhotski-Plemelj theorem (by work [9] - else [4])

$$i \lim_{\epsilon \rightarrow 0^+} \int_{-\infty}^{+\infty} \frac{f(t)}{t - i\epsilon} dt = -\pi f(0) + i\mathcal{P} \int_{-\infty}^{+\infty} \frac{f(t)}{t} dt$$

There, by the exponential expression of wave function, the integral Hankel representation is noted (bypass by a loop)

$$\frac{1}{\Gamma(1-\alpha)} = \frac{1}{2\pi i} \oint_{-\infty}^{\infty} t^\alpha \frac{\exp(t)}{t} dt$$

Supposition about reflected branch of function Let be permissible identical transformation for negative limit as if outside of integral contour

$$\chi(z) + \chi(-\bar{z}) = \frac{1}{\pi i} \int_{-\infty}^{+\infty} \frac{\chi|t|}{t-z} dt \quad (5a)$$

The given position from base integral expression can be continued

$$X = \frac{1}{2\pi i} \oint_{-\infty}^{\infty} \frac{\chi(t)}{t} dt \quad (5b)$$

In fact, there is possible solving for Eq. (5a) - only from the parametric line on complex plane

$$\left. \begin{aligned} z(x) &= x + iy(x) \\ \bar{z}(x) &= x - iy(x) \end{aligned} \right\}$$

- where, accordingly, the mapping of real parts is performed

$$\left. \begin{aligned} \mathcal{I}(x) \\ \bar{\mathcal{I}}(x) \end{aligned} \right\} = \text{Re} \left\{ \begin{aligned} \chi(z(x)) \\ \chi(-\bar{z}(x)) \end{aligned} \right\} \quad (6)$$

Supposition about weighted characteristic on complex-conjugate plane As far as is argued, there is highlighted solution of the ground state in condition of the wave function (4)

$$\chi(r) = [\psi(r)]^2 = [Q(r)]^2 \cdot \exp(-r)$$

So that, for specified mapping (6) - the transition states from separated orthogonal system, only on the complex plane, can be formulated

$$\left. \begin{aligned} \mathcal{I}(x) \\ \bar{\mathcal{I}}(x) \end{aligned} \right\} = \text{Re} \left\{ \begin{aligned} \chi(z(x)) \\ \chi(-\bar{z}(x)) \end{aligned} \right\} = \text{Re} \left\{ Q^2(z) \cdot \begin{cases} \exp(-z) \\ \exp(\bar{z}) \end{cases} \right\} \quad (6')$$

This is, in generally, imagination of steadiness point about the charge singularity, which can be illustrated in Fig. 1.



Fig. 1 Bypass of initial point on complex plane from infinity as in discontinuity point, accordingly for Eq. (5b) - and Eq. (5a).

2.1 Note

There is a functional expression for Eq. (6') - provided the condition in initial point $\mathcal{I}(0) + \bar{\mathcal{I}}(0) = 0$

When passing through the initial point, then orthogonal system remains always on principal half-plane, where a replacement to opposite sign on complex-conjugate plane is required.

This solving explicitly is shown (in Fig. 2)

$$\begin{aligned} \mathcal{I}(x) + \bar{\mathcal{I}}(x) &= (\operatorname{Re} [Q^2(z)] \cdot \cos(y) + \operatorname{Im} [Q^2(z)] \cdot \sin(y)) \cdot (\exp(-x) + \exp(x)) = \\ &= \frac{4}{\pi} xy \int_0^\infty \frac{Q^2(t) \exp(-t) t dt}{t^4 + 2t^2 (y^2 - x^2) + (y^2 + x^2)^2} \end{aligned}$$

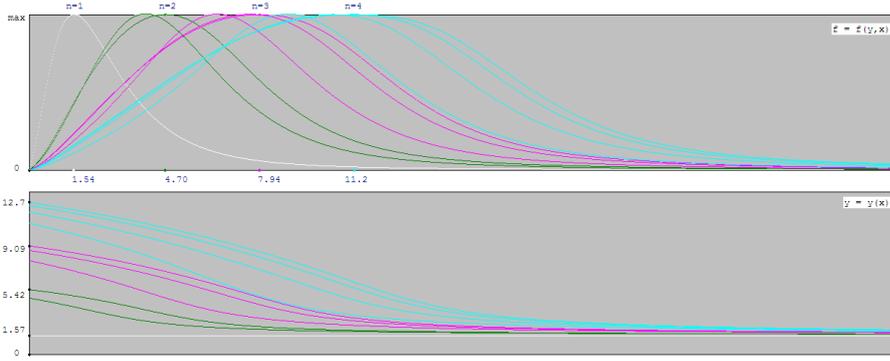


Fig. 2 The reduced curves of reflected branches in maximum $f(y, x) \sim \bar{\mathcal{I}}(x)$ - where approximate equality for points of maximum $x(n) \approx \frac{2n-1}{2} \pi$ (by principal numbers). In solution of complex plane $y = y(x)$ - for ground state, nearly straight line along the asymptote runs $y_{(n=1)}(\infty) \rightarrow y_{(n=1)}(0) = \frac{\pi}{2}$ (marked in white)

3 Energy representation (application in extremum)

The aforesaid proposition of the real parts (6) - can be completely resolved in the existence of an extremum (as per Note 2.1)

$$\mathcal{I}_i \in \bar{\mathcal{I}}_i \quad (\bar{\mathcal{I}}_i = \bar{\mathcal{I}}(x_i) \rightarrow \max)$$

- where, in point of maximum $x \rightarrow x_i$ - the offset order of principal numbers is designated $i = n - 1 = 0, 1, \dots$

Let be the extreme position for some spherical system, which normalized at the above basis expression (5b)

$$\left. \begin{matrix} \dot{r}_i \\ \bar{r}_i \end{matrix} \right\} \rightarrow \frac{4\pi r_i}{X_i} \left\{ \begin{matrix} \mathcal{I}_i \\ \bar{\mathcal{I}}_i \end{matrix} \right.$$

Moreover, the proportionality as for offset system of relative radial moment is founded (provided the maximum $\mathcal{M} \in \bar{\mathcal{I}}$):

$$\left\{ \begin{matrix} \mathcal{C}_i = \dot{c}_i / c_i = \dot{r}_i / (2\pi r_i) \\ \mathcal{M}_i = \dot{m}_i / m_i = r_i / \bar{r}_i \end{matrix} \right. \quad (7)$$

Here, at rationale of the highlighted ground state, a law on moment of momentum conservation can follow, directly (as per Note 1.1)

$$m_i c_i^2 = m_0 c_0^2 \equiv \mathbf{E} \quad (i = 0, 1, \dots)$$

Hence, provided that there is a degenerate electronic value

$$r_i \dot{m}_i \dot{c}_i = r_0 \dot{m}_0 \dot{c}_0$$

- a ratio of momentum is derived

$$\frac{m_i}{m_0} = \frac{c_0^2}{c_i^2} = \frac{r_i^2}{r_0^2} = \frac{\mathcal{M}_0 \mathcal{C}_0}{\mathcal{M}_i \mathcal{C}_i} \quad (8)$$

It is corresponding ratio from the above supposition about weighted characteristic

$$\frac{\mathcal{M}_0 \mathcal{C}_0}{\mathcal{M}_i \mathcal{C}_i} = \frac{\mathcal{I}_0 \bar{\mathcal{I}}_i}{\bar{\mathcal{I}}_0 \mathcal{I}_i} = \exp^2(x_i - x_0)$$

In concrete solution of the above system (7) - the highlighted ground state is obtained

$$\mathcal{M}_0 < 1 < \mathcal{M}_i \quad (\mathcal{M} \in \max)$$

- as if for relative *center-of-mass system* (as per Table 1)

$$\mathcal{M}_0 \rightarrow \frac{\mu}{\mu + m} \quad (\mu \gg m)$$

As it turned out, there is a reduced value to the ground state of atom

$$\Delta E_0 = \frac{1}{2} \mathcal{M}_0 \mathcal{C}_0^2 \mathbf{E} \rightarrow \mathcal{M}_0 \Delta \mathbf{E} \quad (9)$$

- namely, in approximation of the fine-structure constant $\mathcal{C}_0 \rightarrow \mathcal{C}$ (as per Note 1.1).

It possible that among the transition states, there are the effective levels of kinetic energy by a dissipation type

$$\Delta E_i = \frac{1}{2} \mathcal{M}_i \mathcal{C}_i^2 \mathbf{E} \quad (10)$$

There is possible first level as in accordance with the quantum state

$$\Delta S(n=2) \rightarrow \frac{\Delta E_1}{\Delta E_0} \Delta E$$

- that may belong of leading line of fine structure $S(n=2)$ - like for the Lamb shift of hydrogen atom (in work [10]).

In such case, there is a moment of electron scattering at extremum (Table 1)

$$\frac{S(n=2)}{\Delta S(n=2)} \rightarrow \mathcal{M}_1$$

Table 1 Solution of principal numbers in system $\mathcal{C}_i \in \mathcal{M}_i$ - in extremum $\mathcal{M}_i \in \max$ - according to Eq. (7)

$i = n - 1$	0	1	2	3
\mathcal{M}_i	$\approx 1 - 1/207$	10.38	37.40	91.25
\mathcal{C}_i	7.297×10^{-3}	1.281×10^{-6}	5.361×10^{-10}	3.163×10^{-13}

Probably, this position like from fine-structure constant, to the Compton Effect of scattering can be referred (by work [4]).

Let for given transition states, the energy nuclear values are supposed

$$K_i = \frac{E}{\pi \bar{\mathcal{C}}_i} \quad (11)$$

- where a root mean square, from Eq. (10)

$$\bar{\mathcal{C}}_i^2 = \sqrt{\mathcal{M}_i \mathcal{C}_i^2 \cdot \mathcal{M}_0 \mathcal{C}_0^2}$$

As it turned out, there is first transition level in accordance with proton value (as per Table 2).

Presumably, from the above electron moment Eq. (8) - the special energy levels of electromagnetic energy can be characterized

$$T_i = m_i c^2 \quad (12)$$

- where electron value $T_0 = E$ - at achievable velocity $c_0 = c$ - as per Note 1.1.

Table 2 Comparative solution from the Eq. (11) - and Eq. (12) (in relative units of proton)

$i = n - 1$	1	2	3
K_i	≈ 1.0	35.48	1169
T_i	0.14889	98.62	68521

If the first level in accordance to charged π -meson there is, then the second level may be assigned to particle by boson type (as per Table 2).

For the testing of Eq. (12) - the extended expression has been composed

$$\frac{\bar{T}_i^l}{T_i} = \begin{cases} 1 & (l = 0) \\ \sqrt{\frac{T_i^2}{T_i^2 + T_i^2}} & (l \geq 1) \end{cases} \quad (12')$$

- as from projection of orbital numbers $l = 1, 2, \dots, (n-1)$ - in shifted system of principal numbers $i = n-1$

There is possible a general order of the quantized charge $n-l-1 = 0, 1, \dots$ - both for the charged and neutral states.

Together with the π -mesons, the family of intermediate bosons can be identified, where a sequence to the spin momentum of particle occurs (as per Table 3).

Table 3 Regular diagonal series from the orbital projection in Eq. (12') - at comparison with experimental data (in electron units)

$(n-1) \setminus l$	0	1	2
0	E	π^0	Z^0
1	π^\pm	W^\pm	
2	?		

$n-1$	l	$\frac{1}{2}\bar{T}_{n-1}^l$	experiment
1	0	273.38	273.13
	1	264.82	264.13
2	0	181081	-
	1	160886	158000
	2	180811	187000

4 Electron-nuclear correction

It is clear that in the description of wave equation, some amendment on electronic self-perturbation should be taken into account (by a relativistic type). Let the identical variants of equation (1) - both for the electronic value and potential value, are transformed

$$-\mathbf{E} \mathbf{r}^2 \nabla^2 \psi + V \psi = \check{\mathbf{E}} \psi \quad (1a)$$

$$-\mathbf{E} \mathbf{r}^2 \nabla^2 \psi + \check{V} \psi = \mathbf{E} \psi \quad (1b)$$

- where radial variable replacement from Eq. (2).

These variants can be appropriately rewritten at relative λ -parameter

$$\begin{aligned} \frac{d^2\psi}{dt^2} + \frac{2}{t} \frac{d\psi}{dt} + \left[-\frac{1}{4} \frac{\check{E}}{E} + \frac{n}{t} - \frac{\lambda(\lambda+1)}{t^2} \right] \psi &= 0 \\ \frac{d^2\psi}{dt^2} + \frac{2}{t} \frac{d\psi}{dt} + \left[-\frac{1}{4} + \frac{n}{t} \sqrt{\frac{E}{\check{E}}} - \frac{\lambda(\lambda+1)}{t^2} \right] \psi &= 0 \end{aligned}$$

- where perturbed electronic value is redefined (in order of principal numbers $n = \iota + 1 = 1, 2, \dots$)

$$\frac{\check{E}}{E} = \left[\frac{n}{n+\lambda} \right]^2, \quad \lambda = n \left[\sqrt{\frac{E}{\check{E}}} - 1 \right]$$

Moreover, such an electronic perturbation is based under the above increment of energy (by Note 1.1)

$$\check{E} = E + \kappa^2 \Delta E \quad (13)$$

So that a small variation of electronic value is realized, for which corresponding relative charge coefficient given (some charge-factor).

As it turned out, there is a fractional charge-factor $\kappa = \pm \frac{1}{3}$ - where, for the highlighted ground state, an exceptional matching with the experimental muonium atom can be obtained (as per Table 4).

More accurate approximation, however, for potential variation is solved in Eq. (1b) - than in Eq. (1a).

Such a dissimilarity in the solutions may indicate for incomplete task (within the sixth sign of relative error).

Supposedly, the given charge-factor in Eq. (13) - toward the transition states can be continued (as per Table 5).

In this correspondence, with the Lamb shift of hydrogen atom, there is electron value as if from difference between the correlated and uncorrelated solutions for proton nucleus $K_1 - \check{K}_1 \rightarrow E$

There is a small variation of charge-factor for weak quantized dependence

$$\kappa_\iota = \kappa_{(n-1)}$$

- from where a correlation between the experimental data is simultaneously improved (as per Table 5).

In this case, perhaps, a slight correction with respect to electron in the transition nuclear structure can be introduced, as for upper limit of electronic neutrino (here, it would be within $\check{E}(\kappa_1) - \check{E}(\kappa_0) \approx 0.15 \text{ eV}$).

Such an imagination with the fractional electric charge, does not contradict the existing Quark Model of nucleus which is confirmed experimentally (in Fig. 3).

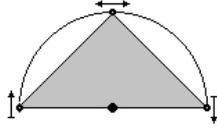


Fig. 3 Quasi-planar model for electron that is inscribed into nuclear "orbit", where elementary charge on three parts is disintegrated, as under a bound charge-pair. This can be shown from a property of the geometric plane which drawn only through three points.

Table 4 Solution of ground state from Eq. (9) - at comparison with experimental data of muonium atom, where relative expression of the center-of-mass system according to muon mass $\mu_0 = \frac{\mathcal{M}_0}{1-\mathcal{M}_0} \rightarrow m_\mu$ - and fine-structure constant $\mathcal{C}_0 \rightarrow \alpha$ (relative error)

$\mathcal{M}_0 - \frac{m_\mu}{m_\mu + m_e}$	$\frac{\mu_0 - m_\mu}{m_\mu}$	$\frac{\mathcal{C}_0 - \alpha}{\alpha}$	(variant)
-8.5×10^{-6}	1.8×10^{-3}	-4.9×10^{-5}	(1)
-1.0×10^{-8}	2.1×10^{-6}	5.1×10^{-6}	(1a)
-1.0×10^{-8}	2.1×10^{-6}	7.3×10^{-7}	(1b)

Table 5 Solution of transition state from the Eq. (12), Eq. (11) and Eq. (10) - in comparison with experimental data for charged π -meson, proton, also for the Lamb shift (relative error)

κ	0	$\frac{1}{3}$	$\frac{1.05}{3}$
$\frac{T_1 - 2m_\pi c^2}{2m_\pi c^2}$	9.0×10^{-4}	1.1×10^{-4}	3.0×10^{-5}
$\frac{K_1 - m_p c^2}{m_p c^2}$	5.2×10^{-4}	7.0×10^{-5}	2.6×10^{-5}
$1 - \frac{\Delta E_1}{\Delta E_0} \frac{\Delta E}{\Delta S(n=2)}$	2×10^{-3}	2×10^{-4}	1×10^{-5}

5 Conclusion and discussion

Within the framework of this problem, a characteristic feature of the mass for a charged particle can be established. It would be interesting to know what do means the hypothetical multiply-charged states in the nuclear structure.

Unlike the muon particle with charged kernel $n = 1$ - the complex structure of stable proton must have twice-charged kernel $n = 2$ - like surrounded by an electron "shell" in Eq. (2).

There, opposite the meson state of proton $K_1 > T_1$ - other boson states would have the anomalous nuclear nature in form $K_i < T_i$ (as per Table 2).

How does it correspond to reality, there are transient threshold state $K_2 + T_2 \sim 125.8 \text{ GeV}$ - as in experimental confirmation for the Higgs boson (in the account of proton units, as per Table 2).

For the purpose of a circumstantial evidence, is possible to point to known experiment by the W-boson or Z-boson production, with a subsequent decay to quark pair (in work [11]).

After all, there can be a production of quark jets as with participation of intermediate "core", where one would observe to distinct splash (in Fig. 4).

As well, in this collision process of interacting nuclei, the resulting (double) value of electromagnetic energy can be demonstrated in form $2 K_2 \rightarrow 15+52 \sim 67 \text{ GeV}$ (in Fig. 5).

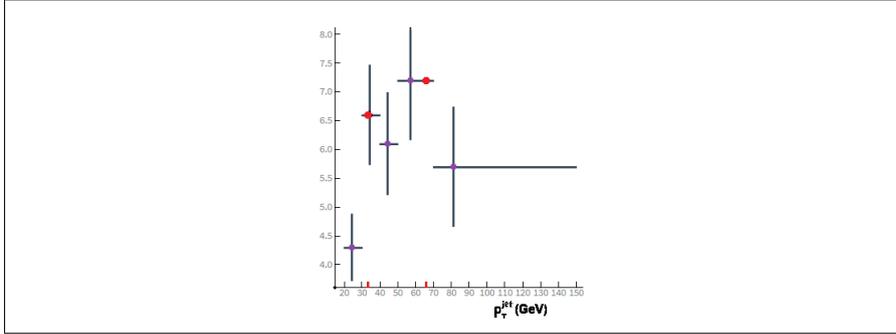


Fig. 4 The ratio of the W + c-jet to W + b-jet production cross sections for data, where the obtained values are marked $K_2 \sim 33 \text{ GeV}$ - and $2 K_2 \sim 67 \text{ GeV}$ (in red marks). Taken from FIG. 8, by the FERMILAB-PUB-14-525-E

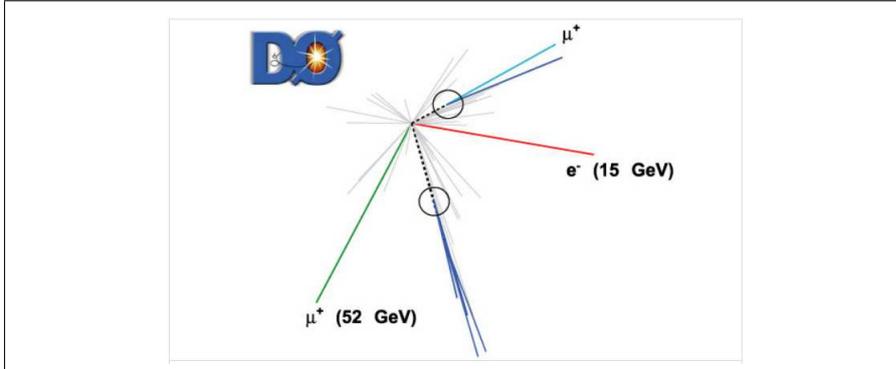


Fig. 5 Result of a restored event with two b-jets in experiment DZero at the Tevatron collider with the D0 detector. The picture is taken from site: www.fnal.gov

A badly interpretable observation of the photoabsorption for actinides nuclei in region of Δ -resonance is noted here, for which a total cross-section does not substantially match the so-called "universal curve" (in work [12]).

The special Higgs effect with a resonant process of intermediate "core", as inside the compound atomic nucleus, can be detected, where some critical atomic number from the above result $K_2 \approx 238 \cdot \pi^\mp$

It possible charge exchange for some interconnected meson ensemble, the number of which is equal number of the nucleon number of heavy nucleus.

Thus, an idea about versatility of the Higgs mechanism in high-energy nuclear reactions may be submitted for consideration.

In this conjuncture, there is a last stage for heavy nuclei, in which the Higgs boson among the similar high-energy multiply-charged states is manifested themselves (as per Table 2).

It is necessary to note the known Rubbia hypothesis about solar neutrinos, where a slow reaction of nuclear fusion proceeds with participation of the heavy boson quanta (in work [13]).

The fact is evident that observed (thermonuclear) reaction of nuclear fusion, always occurs as avalanche due to excessive presence of actinides, that would be perhaps ineffective only with the light nuclei.

References

1. R. Feynman *QED - The Strange Theory of Light and Matter*, Alix G.Mautner Memorial Lectures Princeton University Press, Princeton, New Jersey, 1985
2. A. Einstein, B. Podolsky, N. Rosen, *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?*, Phys.Rev., / G.D.Sprouse — American Physical Society, **47**, (1935)
3. E. Schrodinger, *Quantisierung als Eigenwertproblem (vierte Mitteilung)*, Annalen der Physik, **81**, (1926)
4. J. Jackson, *Classical Electrodynamics*, 2nd ed. (New York: John Wiley, 1985)
5. A. Sommerfeld, *Zur Quantentheorie der Spektrallinien*, Annalen der Physik, 356 **51**, (1916)
6. Y. Sokhotsky, *On definite integrals and functions used series expansions*, Doctor thesis, Saint Petersburg, (1873)
7. P. Blanchard, E. Bruening, *Mathematical Methods in Physics* (Birkhauser 2003), Example 3.3.14
8. I. Privalov, *Introduction to the Theory of Functions of Complex Variables*, Nauka, Moscow, 1984.
9. H. Bremermann, *Distributions, Complex Variables, and Fourier Transforms*, Addison-Wesley, 1965 (Section II)
10. S. Lundeen, and F. Pipkin, *Measurement of the Lamb Shift in Hydrogen, n=2*, Phys. Rev. Lett. **46**, (1981)
11. V. Abazov et al., (D0 Collaboration), Phys.Lett.B **743** (2015), e-Print: 1412.5315 [hep-ex], DOI: 10.1016/j.physletb.2015.02.012
12. J. Sanabria, et al., *Photofission of actinide nuclei in the quasideuteron and lower part of the Delta energy region*, Phys. Rev. C **61**, 034604, (2000)
13. C. Rubbia, *Experimental Observation of the Intermediate Vector Bosons*, Nobel Lecture (1984)