ENTANGLED ELECTRON FOR NEW QUANTUM MECHANICS PART 2

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ABSTRACT

This work integrates and completes the previous studies (viXra 2411.0050 and 2412.0092 - Quantum Physics) . The attractive and repulsive potentials are defined, where the magnetic moment and spin play an essential role in ensuring the stationarity of the electron and the orbitals that constitute it .

A hypothesis is proposed regarding a source of the electrostatic field , determined by the extreme polarization of the quantum vacuum , which exists at very short distances corresponding to very high energy densities . The effect of such polarization creates a void , induced by the surrounding charges of opposite sign , whose attractive effects are balanced by spin , which generates a local centrifugal force . The application of this concept provides an innovative solution to the unresolved problem of the "Poincaré stress" .

Following the framework of traditional quantum mechanics , the Hamiltonians and Schrödinger equations are defined for each orbital . The resulting wave functions , which are entangled like the orbitals they refer to , are combined with appropriate normalized coefficients to form the global electron wave function .

1) INTRODUCTION

The characterization of s-type orbitals requires the definition of some points to establish the fundamental requirement of stationarity .

A)- definition of the central potential and its source as a function of attraction .

B)- definition of a repulsive force suitable for balancing the attractive force, realizing the

stationarity of the s orbitals .

C)-definition of the Hamiltonian for every s orbital .

D)- definition of the wave function for each s orbital .

the International System (SI) is adopted and for the values of the constants reference is made to CODATA 2022 .[3]

2) STATIONARITY OF THE ELECTRON

In the Compton zone , electric charges are generally indicated by : q_J and wavelengths by : λq_J . Outside the Compton zone , electric charges are indicated by : q_i and lengths wave with : λ_{mi}, the masses with: m_i .

The first two points mentioned presuppose new conceptual contents , so it is necessary to approach them with analogies and subsequent assumptions , initially using simplified models useful for subsequently reaching the definitive model .

A) The analogy used for the definition of the central field source and that of the polaritonIn crystalline structures and under particular conditions , the presence of free electric charges on the lattice deform it , constituting a hole , which turns out to be to all intents and purposes , a charge of opposite sign and source of the electric field on the basis of which the pair of opposite charges in sign called polariton is formed .[4][5]

Using this analogy , because of the energy densities of the electrostatic field at extremely short distances , I assume that the negative charges distributed homogeneously and isotropically on a spherical surface , with the center coinciding with the center of gravity of the charges , produce in it , an opposite electric charge hole , thus constituting the charge source with the potential of which interact .

Due to the II running α_e of the constant at high energies (and short distances) the visible charge q_J in these conditions is higher than the classical .[6]

The electron is subject not only to the electromagnetic interaction but also to the weak one , which at low energies, for distances $\geq \lambda_e$, assumes values of about: 10^{-5} compared[a] to the first , so it is generally neglected , even if it is a characteristic of the electron .

As a result of the running of constants , at very high energy $> 10^{13}$ Gev and very short distances $< 10^{-29}$ m , is assume a unification of all constants $\alpha_e, \alpha_w, \alpha_s$.

Such unification may take place jointly or separately (before α_e with α_w and then α_s)

Assuming, in the context of the SUSY-GUT unification models , variants with intermediate breaks (such as the Pati-Salam or similar ones) we have values of $\alpha_{ew} = 0{,}03 \div 0{,}04$, before this constant is also unified at α_s .[7][8]

Considering that the electron is not subject to the strong interaction , this value can be taken as a reference to determine the source charge q_{s_g} .[b]

The energy density relative to the sphere of radius r_c , considered conservatively homogeneous is :

1) $W_c = \frac{3e^2}{16\pi^2 \varepsilon_0 r_c^4} \simeq 2{,}92 \cdot 10^{58}$ [J/m³]

Much higher than the typical density calculated for an average black hole .[c]

In such conditions it is reasonable to think that , in the vicinity of the source area , there is an extreme polarization , which in appropriate conditions can cause a consistent "polariton effect" even in the absence of the support of a crystal lattice .

In such a zone there would be a consistent Schwinger effect with the creation of particle-antiparticle pairs with an unstable situation , similar to a "quantum fluid" of a polarized vacuum .[10]

The central attractive potential $q_{s_g} = n_q \cdot e$ at the distance r , we can calculate :

2) $V_{s_g} = \frac{q_{s_g}}{4\pi\varepsilon_0 r}$ from which the relative electrostatic force can be derived .

n_q is the source parameter .

B) To obtain the stationarity of the system , sustaining the permanence of charges and holes , an isotropic repulsive force is needed , which balances the electrostatic attractive force .

As a preliminary , let us consider the following general expressions :

3) $\hbar = m\, c\, r_c$ or similarly : $\hbar/2 = m c r_c/2$

Let's put the ratio : $e/m = \rho \simeq 1{,}75882 \cdot 10^{11} \cdot \gamma$ [Coulomb/Kgm]

where γ It is a unitary constant, whose dimensions are : [Coulomb/Kgm]

We can then write :

4) $e\,c\,\lambda_c = s\,m\,c\,\lambda_e$

and with : $\lambda_c/s = \lambda_e \rightarrow \frac{e}{m} \simeq s = \tilde{\gamma} \cdot \frac{\lambda_c\,[m]}{\lambda_e\,[m]}$

5) $\hbar/2 = mc\lambda_c/2 = s\,mc\,\lambda_c/2s = ec\lambda_e/2$

Where we don't write γ why unitary .

(5) written in the usual form outside the Compton area, assumes a similar meaning inside .

The spin $\hbar/2$ (written in scalar form) assumes, both within the Compton zone (where the present model does not admit mass elements) and outside , a centrifugal force function , which in the proposed model , allows to balance the mentioned attractive force , in both zones , constituting an inverse Poincare' belt .

The traditional Poincare' belt with centripetal effect did not allow a solution to the problem of the stationarity of the electron . (11)

(5) can also be written :

6) $\hbar = n_q\,e\,c\lambda_e/n_q \qquad (\lambda_e << \lambda_c)$

(6) can be interpreted in analogy with Bohr's H atom ,with $\hbar$ which represents the moment of momentum that balances the system , where the charges replace the masses (and can move at speed c without affecting the R.R.) and λ_e/n_q the distance from the source , at which they orbit $n_q \cdot e$ electric charges , in a symmetrical position with respect to it .

This distance is relative to each of the maximum circumferences contained in the spherical surface mentioned in (A) .

The analogy with the Bohr atom, extended to the negative ion of H , allows us to have a system , seen from a distance , overall with a unitary negative electric charge and to prepare the way for a subsequent quantum mechanical treatment .

Using Gauss' electrostatics theorem , one can approximate the charge seen from a sphere of radius $r \geq \lambda_e/n_q$ as a single charge concentrated in the center where the source is located , adding algebraically to it , so that we have :

7) $q_{tot} = +q_{sq} + (-2q_{sq}) = -q_{sq}$

Similarly to (6) valid in the regime of high energies and short distances , which is located inside the Compton zone , outside on the orbitals spatially determined by the expression Z an analogous expression is valid .

Let's consider preliminarily :

8) $\hbar = m_i c \lambda_{m_i}$ with $m_i = \hbar c K_i$ and $\lambda_{m_i} = 1/(K_i \cdot c^2)$ In addition :

9) $\mu = q_i c \lambda_{m_i}$ with $q_i = s \hbar c \cdot K_i$

(8) , (9) are relative to the i-th orbital where the respective charges are associated with the masses present .

If we take into account the balance of charges with the source , applying Gauss's theorem , we gets :

10) $-q_i = +e + \left(-2 \cdot s \cdot \hbar c \sum_{l=1}^{i} K_l\right) = +e - 2 \sum_{l=1}^{i} q_l$

where , outside the Compton area and therefore $d = d_e$, the source seen is : e .

The (10) extended to all orbitals is :

11) $q_{tot} = +e + \left(-2 \cdot s \hbar c \sum_{i=1}^{n} K_i\right) \simeq -e$ with : ($n >> 1$)

Outside the Compton zone, the magnetic moment assumes an intrinsic character as well as the spin related to the latter, being $m_i \lambda_{m_i} = \hbar / c$ constant .

Within the Compton area : q_J and λ_{q_J} they are not constant because , due to the running of d_e against a λ_{q_J} can be calculated q_J which grows much slower than decreases .

It is therefore possible to determine , outside the Compton zone , the centrifugal force as deriving from the spin which , despite being a statistically zero vector , until its measurement (through the magnetic moment) , maintains the moment property of the intrinsic momentum and in this case of the orbital momentum imposed on the electron .

C) We can then write the relations that impose the stationary equilibrium between the attractive force due to the charges of opposite sign and the centrifugal force , moving on to the definition of the individual terms that constitute the Hamiltonian for each i-th orbital , introducing a quantum approach .

From (10) we can write the expression of the electrostatic potential energy :

12) $U_{q_i} = +q_{s_g}\left(+e - 2\sum_{l=1}^{l=i} q_l\right)/4\pi\varepsilon_0 r_i$ where we used the potential defined in (2)

for $i >> 1$ and $r_i = \lambda_{m_i}/n_q$ we have :

13) $U_{q_i} \simeq q_{s_g} \cdot e \dfrac{n_q \cdot K_i c^2}{4\pi\varepsilon_0} \simeq \dfrac{-2e^2 \cdot 2 K_i \hbar^2}{4\pi\varepsilon_0} \simeq -q_i 2 \cdot 10^{-11} \cdot K_i \longrightarrow 0$

Let us consider a local centrifugal force , for each orbital , determined by the spin : (d)

14) $F_{c_i} = \hbar^2/(m_i r^3)$

The local force is responsible for the equilibrium , for each orbital , with the electrostatic

force :

15) $\frac{\hbar^2}{m_i \cdot r^3} + \frac{dU_i}{dr} = 0$ from which , for $i >> 1 \rightarrow q_i \rightarrow e$ and $r' = r \cdot d_e$ we have :

16) $r'_{(eq.)} = \frac{4\pi\varepsilon_0 \hbar^2}{m_i \, e^2 \cdot n_q} = \lambda_{w_i} / n_q$

The centrifugal force that is responsible for the local equilibrium of each orbital , replaces in an inverse way , the" Poincaré belt", which should have contributed to the global equilibrium of the electron in an old conception of centripetal force .

The statistically zero nature of the spin is reflected on the orbital angular momentum .

Considering the sum of the contributions on an entire orbital , which cancel each other out as a whole for reasons of symmetry , the relative energy term representing the quantized orbital angular momentum , does not appear in the Hamiltonian of the orbital under consideration .

The Hamiltonian therefore turns out to be relative to 1s-type orbitals (with zero orbital part) :

17) $H_i = -\frac{\hbar^2}{2m_i} \cdot \nabla^2 + U_i = -\frac{\hbar^2}{2m_i} \cdot \frac{1}{r^2} \frac{d}{dr}\left(r^2 \frac{d}{dr}\right) + U_i$

The Scroedinger equation for a 1s orbital is dependent on the radius alone .

18) $\left[-\frac{\hbar^2}{2m_i} \cdot \frac{1}{r^2} \cdot \frac{d}{dr}\left(r^2 \frac{d}{dr}\right) + U_i\right] \cdot R_i(r) = E_i \cdot R_i(r)$

With $R_i(r)$ radial wave functions and E_i energies of the i-th orbital .

We introduce a variant to the 1st ith orbital , introducing the electrostatic energy calculated in (12) .

We can then write the modified Scroedinger equation for a generic i-th orbital modified (named $1S^*$) , by placing for ease of calculation : $\phi_i(r) = r \cdot R_i(r)$

19) $\left[-\frac{\hbar^2}{2m_i} \cdot \frac{d^2}{dr^2} + \frac{q_{sg} \cdot q_i^*}{4\pi\varepsilon_0 r}\right] \cdot \phi_i(r) = E_i \cdot \phi_i(r)$

with : $q_i^* = +e - 2\sum_{l=1}^{i} q_l$

D) We can obtain the wave function for the generic i-th orbital , by suitably integrating (19) :

20) $\phi_i(r) = \frac{e^{-r'/a'}}{\sqrt{\pi a_i'^3}}$ let's say : $r' = r\,d_e$ and : $a' = a\,d_e$ get :

21) $a_i' = \frac{4\pi\varepsilon_0 \hbar^2}{m_i \, q_i^* \, q_{sg}}$ (e)

Where to $i >> 1 : q_i^* \rightarrow e$ and therefore we find an expression analogous to : $a_0 = \frac{4\pi\varepsilon_0 \hbar^2}{m e^2}$

we therefore have that the coordinate where the maximum probability density is needed ,

of the i-th orbital , turns out to be : λ_{m_i} / m_q

The $\phi_i(r)$ represent the i-th orbital and therefore are entangled as are the orbitals themselves.

For this reason, to obtain the total wave function it is necessary to make this entanglement explicit through the calculation of the normalization coefficients .

We can therefore write :

22)

Where the they take into account the entanglement that exists between the :

23) $\phi_T(r) = c_1 \phi_1(r) + c_2 \phi_2(r) + c_3 \phi_3(r) + \dots$

Therefore , since c_i , which turns out to be a given value , the variation of any value of a λ_{m_i} produces a change in the value of others .

We propose the following method of normalization :

1) Let's calculate the squares of the individual terms : $1/\lambda_{m_i}$ getting : $p_i = (1/\lambda_{m_i})^2$

2) Let's calculate the sum of the results obtained : $P_T = \sum_{i=1}^{n} p_i$

3) We obtain the normalized coefficients : $c_i = p_i / P_T$

Considering the value of $1/\lambda_{m_1}$ with respect to $1/\lambda_{m_i}$, for $i > 1$, defined $\varepsilon = 1 - c_1$, we have that : $\varepsilon < 1$ or $\varepsilon << 1$ depending on the normalization method chosen for which we have , with a good or excellent approximation :

24) $\phi_T(r) \simeq \phi_1(r)$

Summarizing the results of the present study and the previous ones , closely related , we have :

In the outermost orbitals : $m_i \to 0 \; ; \; q_i \to 0 \; ; \; \lambda_{m_i} >> 1 \; ; \; c_i \to 0$

Overall (seen from the outside) : $m_{tot} \simeq m_{sg} \; ; \; q_{tot} \simeq e \; ; \; \lambda_{m_T} \simeq \lambda_c \; ; \; c_{tot} = 1$

An approximate size of the internal source can also be defined : $\lambda_{q_{sg}} \leq 10^{-29} [m]$

and also an external operational dimension that depends on the precision with which we are able to determine the mass , in fact the actual error is about $m^* \simeq 10^{-40} [Kg\, m]$ which corresponds to :

25) $\lambda \simeq \hbar / (c \cdot 10^{-12}) \simeq 10^{-3}$ [m] under standard environmental conditions .

a) The relationship may be derived from the expression : $G_F \cdot E^2 / e^2$, where G_F is Fermi's constant , which is considered at the usual energy : $E \simeq 1$ Mev

b) The parameter n_q can be derived from : $n_q = \sqrt{4\pi\varepsilon_0 \hbar c \, \alpha_{ew}} / e = 2{,}02758 \div 2{,}34125$ respectively for : $\alpha_{ew} = 0{,}03 \div 0{,}04$

c) Let's adopt the hypothesis of uniformly distributing energy within a sphere with radius equal to that of the event horizon .

Although the average density is a theoretical concept that does not take into account the complexity of the structure of a black hole , it is possible to calculate it . (9)

The average energy density is : $d = (3c^2) / (32 \pi G^3 M^2)$

For an average black hole, assuming a mass : $M \simeq 2 \cdot 10^{33}$ [Kg m] get : $d \simeq 1{,}7 \cdot 10^{30}$ [J/m^3]

d) Consider the specific angular momentum : $L / 2\pi = m \lambda v = m r^2 \omega$

In the sense of spin considered , we can put in a heuristic way : $\omega = \hbar / (m r^2)$

The centrifugal force results : $F_c = m\omega^2 r = \hbar^2 / (m r^3)$

Since statistically the spin vector is zero , until it is measured , therefore also the sum of the calculated local centrifugal forces , which are effective because have centrifugal effects , it cancels out.

Note that in the final expression of F_c , no form of velocity appears.

e) In the expression of the wave function the parameter a_1 represents the coordinate where the maximum value of the probability density is needed and is defined as the Bohr radius : $a_0 = \dfrac{4\pi\varepsilon_0 \hbar^2}{m_e c^2}$

The reduced Compton length is : $\lambda_c = \hbar / (m_e \cdot c)$

their relationship is : $\dfrac{\lambda_c}{a_0} = e^2 / (4\pi\varepsilon_0 \hbar c) = \alpha$, from which : $a_0 = \lambda_c / \alpha$,

so what : $\alpha_i' = k \cdot u_i'$

3) CONCLUSIONS

The entangled electron model, developed as part of an extended dBB interpretation—referred to as dBBZ—has been completed, following the two previously cited works .

The stationarity of the electron system , achieved through a dynamic equilibrium between the electrostatic force and the local centrifugal force , resolves a longstanding unresolved issue related to the "Poincaré stress" , which had historically prevented the consideration of the electron as a complex and spatially defined structure.

By determining the Hamiltonians defined for each modified 1s-type orbital and solving the corresponding Schrödinger equations , the associated wave functions have been established .

The composition of these wave functions , through a weighted sum with coefficients derived from the entanglement consideration , has led to the determination of the global wave function of the electron .

Explicit knowledge of the electron's structure , and by extension , other similar particles , may pave the way for further studies aimed at evaluating their intrinsic properties and external interactions .

In particular , the ongoing study of the magnetic anomalies of the electron and muon may be fully derived from the structural definition of these particles .

A crucial aspect for this purpose will be the choice of the source value and the method of normalizing the constants used to impose the entanglement of the structures under examination .

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