PHYSICAL MODEL OF THE FLUCTUATING VACUUM AND THE PHOTON AS ITS ELEMENTARY EXCITATION

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Abstract

A physical model of the fluctuating vacuum (FlcVcm) and the photon as an elementary collective excitation in a solitary needle cylindrical form are offered. We assume that the FlcVcm is consistent by neutral dynamides, which are streamlined in a close-packed crystalline lattice. Every dynamide is a neutral pair, consistent by massless opposite point-like elementary electric charges (ElmElcChrgs): electron (-) and positron (+). In an equilibrium position two contrary Pnt-Lk ElmElcChrgs within every one dynamide are very closely installed one to another and therefore its aggregate polarization and its ElcFld also have zero values. However the absence of a mass in a rest of an electrino and positrino makes possible they to display an infinitesimal inertness of their own QntElcMgnFlds and a big mobility, what permits them to be found a bigger time in an unequilibrium distorted position. The aggregate ElcFld of dynamide reminds us that it could be considered as the QntElcFld of an electric quasi-dipole because both massless electrino and positrino have the same inertness. The aggregate ElcFld of every dynamide polarizes nearest neighbour dynamides in an account of which they interact between them-self, on account of which their photons display a wave character and behaviour. In order to obtain a clear physical evidence and true physical explanation of an emission and absorption of RPhtns, I use Fermi method for the determination of the time dependence of expansion coefficients of wave function of SchEl in a hybrid state, using the solution of the Schrodinger quadratic differential wave equation in partial derivatives with the potentials of Coulomb and of Lorentz friction force.

A physical model (PhsMdl) of the existent fluctuating vacuum (FlcVcm) and its elementary excitation photon as a solitary needle cylindrical harmonic oscillation is offered. It is common known that the physical model (PhsMdl) presents at us as an actual ingradient of every good physical theory (PhsThr). It would be used as for an obvious visual teaching the unknown occurred physical processes within the investigated phenomena. We assume that the FlcVcm is consistent by neutral dynamides, streamlined in some close-packed crystalline lattice. Every dynamide is a massless neutral pair, consistent by two massless opposite point-like (PntLk) elementary electric charges (ElmElcChrgs): electrino (-) and positrino (+). In a frozen equilibrium position both opposite PntLk ElmElcChrgs within every dynamide are very closely installed one to another and therefore the aggregate polarization of every one dynamide has zero value and its electric field (ElcFld) also has zero electric intensity (ElcInt). However the absence of a mass in a rest of the electrino and positrino makes them possible to have a big
mobility and infinitesimal dynamical inertness of its own QntElcMgnFld, what permits them to be found a bigger time in an unequilibrium distorted position. The aggregate ElcFld of the dynamide reminds us that it could be considered as the QntElcFld of an electric quasi-dipole moment \(\text{ElcQusDplMnn}\) because both opportunity massless electrino and positrino have the same inertness. For a certain that is why the FlcVcm dos not radiate real photon \((\text{RlPhtn})\) by itself, as dynamide electric dipole moment \(\text{ElcDplMmn}\) has a zero value. The aggregate ElcFld of every dynamide polarizes nearest neighbour dynamides in an account of which nearest dynamides interact between itself, and in a result of which its elementary collective excitations have a wave character and behavior. It is richly clear that the motions in the opposite direction of both opposite PntLk ElmElcChrgs of an every dynamide creates an aggregate magnetic field \((\text{MgnFld})\) of every one and the sum of which makes a magnetic part of the free QntElcMgnFld.

Although up to the present nobody of scientists distinctly knows are there some elementary micro particles \((\text{ElmMicrPrts})\) as a fundamental building stone of the micro world and what the elementary micro particle \((\text{ElmMicrPrt})\) means, there exists an essential possibility for physical clear and scientific obvious consideration of the uncommon quantum behavior and unusual dynamical relativistic parameters of all relativistic quantized MicrPrts \((\text{QntMicrPrts})\) by means of our convincing and transparent surveyed PhsMdl. We suppose that the photon is some elementary excitation of the FlcVcm in the form of a solitary needle cylindrical harmonic oscillation. The deviations of both PntLk massless opportunity ElmElcChrgs of an every dynamide from their equilibrium position in the vacuum close-packed crystalline lattice creates its own polarization, the sum of which creates total polarization of the FlcVcm as a ideal dielectric, which causes the existence of a total resultant QntElcFld. Consequently the total polarization of all dynamides creates own resultant QntElcFld, which is an electric part of the free QntElcMgnFld. Really, if the deviation of an every PntLk ElmElcChrg within every one dynamide from its own equilibrium position is described by dint of formula of collective oscillations \((\text{RlPhtns})\) of connected oscillators in a representation of second quantization:

\[
u_j(r) = \frac{1}{\sqrt{N}} \sum_q \sqrt{\frac{\hbar}{2\Theta\omega}} I_{jq} \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\} \quad (1)
\]

where \(\Theta\) is an inertial mass of the electrino and positrino and \(I_{jq}\) are vector components of the deviation \((\text{polarization})\). If we multiply the deviation \(u\) of every PntLk ElmElcChrg in every dynamide by the twofold ElmElcChrg value \(e\) and dynamide density \(W = \frac{1}{\Omega}\), then we could obtain in a result the total polarization value of the FlcVcm within a representation of the second quantization:

\[
P_j(r) = \frac{2e}{\Omega_o \sqrt{N}} \sum_q \sqrt{\frac{\hbar}{2\Theta\omega}} I_{jq} \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\} \quad (2)
\]

Further we must note that the change of the spring with an elasticity \(\chi\) between the MicrPrt and its equilibrium position, oscillating with a circular frequency \(\omega\) by two springs with an elasticity \(\tilde{\chi}\) between two MicrPrts, having opportunity ElmElcChrgs and oscillating with a circular frequency \(\tilde{\omega}\) within one dynamide, is accompanied by a relation \(2\tilde{\chi} \simeq \chi\). Indeed, if the „masses” of the oscillating as unharmed dynamide is twice the „mass” of the electrino or positrino, but the elasticity of the spring between every two neighbor dynamides in crystalline
lattice is fourfold more the elasticity of the spring between two the MicrPrts, having opportu-

...larity ElmElcChrgs and oscillating one relatively other within one dynamide, while the common
...mass” of two the MicrPrts, having opportunity ElmElcChrgs and oscillating one relatively
...other within one dynamide is half of the „mass” of the electrino or positrino. Therefore the
circular frequency \( \omega \) of the collective oscillations have well known relation with the Qoulomb
potential of the electric interaction (ElcInt) between two opportunity massless PntLk ElmElc-
Chrgs electrino and positrino and their dynamical inertial „masses” which can be described by
dint of the equations :

\[
\tilde{\omega}^2 = 2 \tilde{\chi} \frac{\Theta}{\Theta} \quad \text{and} \quad \omega^2 = \frac{4\chi}{2\Theta} \quad \text{consequently} \quad \omega^2 = 2\tilde{\omega}^2
\]  

(3)

and therefore \( \Theta\omega^2 = \frac{4e^2}{4\pi\Omega_0\varepsilon_o} \) or \( \Theta C^2 = \frac{e^2}{4\pi\Omega_0 q^2\varepsilon_o} \)  

(4)

where

\[ N\Omega_o = \Omega \quad \text{and} \quad d = W e E \quad \text{or} \quad E = \frac{d}{\Omega_0 \varepsilon_o} = \frac{P}{\varepsilon_o} \]  

(5)

we could obtain an expression for the ElcInt of the QntElcMgnFld, well known from classical
electrodynamics (ClsElcDnm) in a representation of the second qua-
tization:

\[
E_j(r) = \sum_q \sqrt{\frac{2\pi\hbar}{\Omega\varepsilon_o}} I_{jq} \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\}
\]  

(6)

By dint of a common known defining equality :

\[
E_j = -\frac{\partial A_j}{\partial t}
\]  

(7)

From (6) we could obtain the expression for the vector-potential \( A \) of the QntElcMgnFld
in the vacuum in a representation of the second quantization :

\[
A_j(r) = i \sum_q \sqrt{\frac{2\pi\hbar}{\Omega\varepsilon_o}} I_{jq} \left\{ a_{jq}^+ \exp i(\omega t - qr) - a_{jq} \exp -i(\omega t - qr) \right\}
\]  

(8)

or

\[
A_j(r) = i \sum_q \sqrt{\frac{2\pi\hbar\mu_o}{\Omega\mu_o}} I_{jq} \left\{ a_{jq}^+ \exp i(\omega t - qr) - a_{jq} \exp -i(\omega t - qr) \right\}
\]  

(9)

Further by dint of the defining equality \( \mu_o H = rotA \) from (8) and (9) we could obtain an
expression for the MgnInt of QntElcMgnFld, well known from ClsElcDnm in a representation
of the second quantization:

\[
H_j(r) = \sum_q \sqrt{\frac{2\pi\hbar}{\Omega\mu_o}} [\vec{n}_q \times I_{tq}]_j \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\}
\]  

(10)

where \( \vec{n}_k \) is unit vector, determining the motion direction of the free QntElcMgnFld. By
means of presentation (10) of MgnInt \( H_j(r) \) and taking into consideration that \( \vec{n}_q \) is always
perpendicular to the vector of the polarization \( I_{jq} \) we obtain that :

\[
[\vec{v} \times [\vec{n}_q \times I_{jq}]_j] = \vec{n}_q (\vec{v} \cdot I_{jq}) - I_{jq} (\vec{v} \cdot \vec{n}_q)
\]  

(11)
From this equation (11) we could understand that if the velocity \( v \) of the interacting ElcChrg is parallel of the direction \( \vec{n}_q \) of the motion of the free QntElcMgnFld, then the first term in the equation (11) will be nullified and the second term in the equation (11) will determine the force, which will act upon this interacting ElcChrg. But when the velocity \( \vec{v} \) of the interacting ElcChrg is parallel of the direction \( \vec{l}_{jq} \) of the motion in the opposite directions of two PntLk ElmElcChrg of the electrino and positrino and one is a perpendicular to the direction \( \vec{n}_q \) of the motion of a free QntElcMgnFld, then the second term in the equation (11) will be nullified and the first term in the equation (11) will describe the force, which act s upon this interacting PntLk ElmElcChrg. It turns out that the interaction between currents of the electrino and positrino, which is parallel to the vector of a polarization \( \vec{I}_{jq} = \frac{\omega}{\pi} \vec{l}_{jq} \), with the QntMgnFld of the free QntElcMgnFld determines the motion and its velocity of same this free QntElcMgnFld. Indeed, it is well known that the change of a magnetic flow \( \Phi \) creates a ElcFld. Therefore by dint of a relation (11) we can obtain the following relation:

\[
F_j = \frac{e}{C} \left[ \vec{v} \times \vec{H} \right] = \frac{e}{mC\omega} \left[ \vec{E} \times \vec{H} \right] = \sum_q \frac{e^2}{mC} \sqrt{\frac{2\pi \hbar}{\Omega \varepsilon_0}} \sqrt{\frac{2\pi \hbar}{\Omega \mu_o}} \epsilon_{ijkl} \vec{n}_j \cdot \vec{l}_{ik} \cdot \vec{l}_{jq} \left\{ a_{kq}^+ \exp i(\omega t - qr) + a_{kq} \exp -i(\omega t - qr) \right\} \left\{ a_{kq}^+ \exp i(\omega t - qr) - a_{kq} \exp -i(\omega t - qr) \right\} \tag{12}
\]

Therefore by dint of (12) and defining equations (6) and (10) we can obtain:

\[
\frac{1}{\sqrt{\varepsilon_\varepsilon_0}} = \nu \sqrt{\mu \mu_o} \quad \text{or at} \quad \frac{1}{\sqrt{\varepsilon_\varepsilon_0}} = C \sqrt{\mu \mu_o} \quad \text{we have} \quad C = \nu \sqrt{\varepsilon \mu \mu_o}. \tag{13}
\]

It is naturally that when some RlPhtn is moving within the space of some substance, then supplementary polarization of atoms and molecules appears, which delay its moving and slow down its velocity. Indeed in this case the dielectric constant \( \varepsilon \) has a following form:

\[
\varepsilon = 1 + \sum_q \frac{4\pi n(q)\omega(q) - \omega_c}{m \{4(\omega(q) - \omega_c)^2 + \tau^2 \omega(q)^4\}} \tag{14}
\]

By means of the upper scientific investigation we understand that the creation of the QntMgnFld by moving opposite PntLk ElmElcChrgs of electrinos and positrinos within all dynamides together with their aggregate QntElcFld as two components of one free QntElcMgnFld one secures their motion. Therefore we should write the momentum of the free QntElcMgnFld by means of the equation of Pointing/Umov, using the definition equations (6) and (10) :

\[
P = \frac{[\vec{E} \times \vec{H}]}{4\pi C^2} = \sum_q \vec{n}_q \frac{\hbar \omega}{2\Omega \varepsilon_\varepsilon_0} (\vec{l}_{jq} \cdot \vec{l}_{jq}) \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\} \times \left\{ a_{jq}^+ \exp i(\omega t - qr) + a_{jq} \exp -i(\omega t - qr) \right\} \tag{15}
\]

or

\[
P = \sum_q \vec{n}_q \frac{\hbar \omega}{2\Omega C} \left\{ a_{jq}^+a_{jq} + a_{jq}a_{jq}^+ + a_{jq}^+a_{jq}^+ \exp 2i(\omega t - qr) + a_{jq}a_{jq} \exp -2i(\omega t - qr) \right\} \tag{16}
\]
or
\[ \bar{P} = \sum_q \bar{n}_q \frac{\hbar \omega}{\Omega C} (n_q + 1/2) \]  \hspace{1cm} (17)

It is well known that the ElmMicrPrts behavior would be studied by means of an investigation of their behaviors after their interaction by already well known ElmMicrPrts. Therefore we shall describe the properties and behavior of the real photon (RIphtn) by means of a new physical interpretation of results of its emission and absorption from atoms at their excited Schrodinger electrons (SchEls) from higher energetic state into lower energetic state or vice versa transition. In such a way we could understand the origin of some their name by dint of the physical understanding these determining processes.

In a first we begin by supposing that the RIphtn has a form of a solitary needle cylindrical harmonic soliton with a cross section \( \sigma_1 \), determined by the following equation:
\[ \sigma_1 = \pi \left( \frac{\delta x}{2} \right)^2 + \left( \frac{\delta y}{2} \right)^2 = \frac{\pi}{4} \left( \frac{C}{\omega} \right)^2 = \frac{\pi \lambda^2}{2} \]  \hspace{1cm} (18)

which is determined by Heisenberg uncertainty relations:
\[ (\delta p_x)^2 (\delta x)^2 \simeq \frac{\hbar^2}{4} ; \quad \text{and} \quad (\delta p_y)^2 (\delta y)^2 \simeq \frac{\hbar^2}{4} ; \]  \hspace{1cm} (19)

where the dispersions are:
\[ (\delta x)^2 \simeq (1/2) \left( \frac{C}{\omega} \right)^2 = \frac{\lambda}{2\pi}^2 ; \quad (\delta y)^2 \simeq (1/2) \left( \frac{C}{\omega} \right)^2 = \frac{\lambda}{2\pi}^2 ; \]  \hspace{1cm} (20)

It is well known that the probability \( P_{12} \) for a transition par second of some SchEl under ElcIntAct of extern ElcMgnFld from an eigenstate \( 1 \) into an eigenstate \( 2 \) is determined by the following formula:
\[ P_{12} = \frac{4}{3} \cdot \frac{e^2}{\hbar C^3} (\omega_{12})^3 | \langle 1 | r | 2 \rangle |^2 \]  \hspace{1cm} (21)

As the intensity of the ElcMgn emission \( I \), emitted par second is equal of the product of the probability \( P_{12} \) for a transition par second by the energy \( \hbar \omega_{12} \) of the emitted RIphtn, then for certain
\[ I = P_{12} \hbar \omega_{12} = \frac{4}{3} \frac{e^2}{C^3} \omega_{12}^4 | \langle 1 | r | 2 \rangle |^2 \]  \hspace{1cm} (22)

Really the matrix element \( \langle 1|r|2 \rangle \) of the SchEl position is determined by the product of the probability for the spontaneous transition of a SchEl from an higher energetic level into a lower energetic level and the number \( (n + 1) \) for the emission or the number \( n \) for the absorption of a RIphtn, where n is the number of the RIphtns within the external QntElcMgnFld, which polarizes atom. In our view here we need to note obvious supposition that the spreading quantum trajectory of the SchEl is a result of the participating of its well spread (WllSpr) ElmElcChrg in isotropic three dimensional (IstThrDmn) nonrelativistic quantized (NrlQnt) Furthian stochastic (FrthStch) circular harmonic oscillations motion (CrcHrmOscsMtn), which is a forced result of the electric interaction (ElcIntAct) of the SchEl’s WllSpr ElmElcChrg by the electric intensity (ElcInt) of the resultant resonance QntElcMgnFld of all stochastic virtual photons (StchVrtPhtns), existing in this moment of time within the area, where it is moving.
In order to understand this uncommon stochastic motion we must remember the IstThrDmn nonrelativistic classical (NrlCls) Brownian stochastic (BrnStch) trembling harmonic oscillation motion (TrmHrmOscMtn) (\([2]\)), (\([3]\)), (\([4]\)), (\([5]\)), (\([6]\)), (\([7]\)).

Therefore there is no possibility for a classical Lorentz' electron (LrEl) to be in a hybrid state, as it must go along one smooth classical trajectory and therefore it has no possibility to tunneling between two different quantized orbits. But in a natural result of its quantized stochastic motion it is turn out that the SchEl repeatedly \((\approx 10^6\text{times})\) goes (tunnels) through the potential barrier between both stationary states by dint of the ElcIntAct of the SchEl’s WllSpr ElmElcChrg by the ElcInt of the resultant resonance QntElcMgnFld of all StchVrtPhtns existing in this moment of the time within the barrier area. Really at these periodic tunnelling of the SchEl it has a possibility to go from one stationary orbit to another stationary orbit and back again for the time of the emission or the absorption of a RlPhtn by a purpose to ensure the periodic alteration of the atomic ElcDplMmn, constituent by SchEl’s WllSpr ElmElcChrg and the ion ElcChrg. It is quite plainly that it needs the optical resonance to be observed in a case of a coincidence of the proper circular frequency of these transitions between both energetic state with the radiation frequency \((\omega_c = \omega_2 - \omega_1)\).

It is necessary here to remember that the light radiation of a solitary moving WllSpr ElmElcChrg of the SchEl with acceleration between two stationar states within Qoulomb potential of atomis nuclear charge is caused by Lorentz’ friction. Therefore Fermi (\([\text{I}]\)) thought that at the description of the forced flate oscillating FnSpr ElmElcChrg it is necessary to take into an account the term of Lorentz’ friction because of radiation. Although such consideration, which is developed by Fermi seventy three years ago permits us to consider as an alternate transition of the SchEl between both energy levels so and dumping and increasing of the expansion coefficients of the orbital wave function of both energy levels (OrbWvFncs) \(\phi_j\), connecting them in the hybrid state, in a time during its radiation, I think that we must compare the value of different forces although they have different result and could be considered in different mathematical ways. In such a way we could understand not only why RlPhtn has a solitary needle fashion but and why one is radiated in a single form one after another, We will also to discuss what is a physical cause for separation of different processes.

In the first we wish to display our physical understanding all process within the emission and absorption phenomena. In this purpose Fermi begin with the determination of the Lorentz’ friction force with the MgnIntAct force. As it is well known from classical electrodynamic (ClsElcDnm) the value of the Lorentz’ friction force is described by a following equality:

\[
F_{jr}^{fr} = -e \cdot E_j = (\frac{e}{C}) \frac{\partial A_j^{fr}}{\partial t} = \frac{2}{3} \cdot \frac{e^2}{C^3} \ddot{r}_j
\] (23)

After the substitution of \(\ddot{r}_j\) by means of Newton equality \(m \ddot{r}_j = -eE_j\) the value of Lorentz’ friction force takes a following useful form:

\[
F_{jr}^{fr} = -\frac{2}{3} \frac{e^2}{C^3} \frac{\partial E_j}{\partial t} = \frac{2 \omega e^2}{3 C^3} eE_j
\] (24)

It is easy to understand that par unit of time the Lorentz’ friction force produces a work, determined by following equation:

\[
W_{jr}^{fr} = v_j \cdot F_{jr}^{fr} = \frac{2 e^2}{3 C^3} (\dot{r}_j \cdot \ddot{r}_j) = \frac{2 e^2}{3 C^3} \frac{d}{dt} (\dot{r}_j \cdot \ddot{r}_j) - \frac{2 e^2}{3 C^3} (\dddot{r}_j \cdot \dddot{r}_j)
\] (25)
As after an averaging over time the first term \( \frac{2e^2}{3mc^2} \frac{d}{dt} (\vec{r}_j \cdot \vec{r}_j) \) is canceled and therefore the work of Lorentz’ friction force coincidences with the averaged emission energy:

\[
\bar{E} = \frac{2}{3} \frac{e^2}{\omega C^3} (\vec{r}_j \cdot \vec{r}_j)
\]  

(26)

After substitution of \( \vec{r}_j \) by its value, determined by means of Newton’s equation \( \vec{r}_j = \frac{e}{m} E_j \) we can obtain a following:

\[
W_{fr} = -\frac{2}{3} \left( \frac{e^2}{mc^2} \right)^2 C (E_j \cdot E_j) = -\frac{8\pi}{3} \left( \frac{e^2}{mc^2} \right)^2 C \left( \frac{E_j \cdot E_j}{4\pi} \right)
\]  

(27)

The equation (27) shows us that work, produced by Lorentz’ friction force per unit time is equal of the product of Thompson total cross section \( \sigma = \frac{8\pi}{3} \left( \frac{e^2}{mc^2} \right)^2 \) of the dispersed light (RlPhtns) by the FnSpr ElmElecChrg of some free DrEl and its Pointing/Umov’s vector \( S = \frac{C}{4\pi} (E_j \cdot E_j) \). In my point of view I need to make note that if you wish to understand what is a physical cause for obtaining so big Thompson total cross section of dispersion of RlPhts from FnSpr ElmElecChrg of DrEl, instead from its PntLk ElmElecChrg, then you need to read about the participation of its PntLk ElmElecChrg in own inner self-consistent Zitterbewegung ([4], [5]).

The same result can be obtained from (22) if we substitute kinetic energy of forced oscillating SchEl \( m (\omega)^2 (1 \mid r \mid 2 )^2 \) by potential energy of its ElcIntAct \( \epsilon \epsilon_o E^2 \), which follows from Newton relation and the energy equality. From this physical clear and mathematical correct investigation we could understand that the friction of such a free ScrEl is determined by dispersion of the light, which its FnSpr ElmElecChrg can diffract.

In the second we can obtain that the force of the MgnIntAct between the electric current \( j = ev \) of the SchEl’s ElmElecChrg and the MgnInt of the free QntElecMgnFld, emitted or absorbed by it, is the \( \frac{\hbar \omega}{mc^2} \) times smaller than the force of the ElcIntAct between the SchEl’s ElmElecChrg and the ElcInt of same free QntElecMgnFld, emitted or absorbed by it. Although we begin with the calculation of the value of the work, produced by the MgnIntAct force for unit of time, determined by following equation:

\[
W^m = \frac{e}{C} \{ \vec{v} \cdot [\vec{v} \times H] \} = \frac{e}{C} \{ [\vec{v} \times \vec{v}] \cdot H \} = 0
\]  

(28)

From the equation (28) we can see that the Lorentz’ MgnIntAct force cannot participates in the emission and absorption of RlPhtns. Although many physicists think so writing : \( H_{in} = (j \cdot A) = -e(v_j A_j) \), than this term describe magnetic interaction, but in reality it is wrong. Really it is easy to understand that :

\[
H_{in} = -e(v_j A_j) = -e \frac{d}{dt} (r_j A_j) + e(r_j \frac{dA_j}{dt}) = -e(r_j E_j)
\]  

(29)

Hence in a reality the Hamiltonian \( H_{in} \) describes the ElcIntAct between the ElcChrg of the particle and the ElcInt of the QntElecFld. Therefore in a purpose to describe the emission and absorption of RlPhtn we can use two type of interaction in two different role. The first, ElcIntAct as the cause, creating the alternate ElcDplMmn by means of which the RlPhtn is created or absorbed. The second, Lorentz’ friction force as the cause, which restricts the value
of the forcing influence of the ElcIntAct at creating the ElcDplMmn. This physical clear way can be written in a following mathematical form:

\[ m \ddot{r}_j - m \tau \dot{r}_j + m\omega_c^2 r_j = -eE_j \]  

(30)

where the first term describes the inertial force, the second term describes the friction force and the third term describes the elastic force, forcing the emitting or absorbing SchEl to move between two energetic levels \( E_n \) and \( E_s \). The fourth term describes the electric force of ElcIntAct of the ElcInt of the external QntElcMgnFld by WllSpr ElmElcChrg of the emitting or absorbing SchEl. In this way I shall take into consideration most of an acting interactions by dint of compensation of acting forces at a determination of radius deviation and only the Lorentz’ friction force and ElcInt by Qoulomb potential. Therefore I shall find a solution of the inhomogeneous equation (31) in order to determine the time dependence of the radius deviation \( r \) as a result of ElcInt of WllSpr ElmElcChrg of the emitting or absorbing SchEl with ElcInt of the existent StchVrtPhtn. In this connection I shall also write into quadratic differential wave equation in partial deviations of Schrodinger only the Fermi’s potential of the Lorentz’ friction force and the Qoulomb potential in same method as the method of Fermi.

With a purpose for easily understanding the way of the mathematical solution of equation (31) we must note that Fermi has ignored three forces: the inertial force, the elastic force and the electric force, as he thought that only the Lorentz’ friction force transforms emitting SchEl’s kinetic energy to energy of emitted RlPht. Therefore only the Lorentz’ friction force affects over time dependence of expansion coefficients of total wave function of the emitting SchEl’s into a hybrid state during the time of emission. Therefore for a curtain he has not written and used the solution of a following inhomogeneous equation:

\[ \ddot{r}_j = -\frac{e}{m} E_j \]  

(31)

For this purpose Fermi have used the Fermi potential \( V^{fr} = -\frac{2}{3} \frac{e^2}{C}(r_j \ \ddot{r}_j) \) of the Lorentz’ friction force of the free moving SchEl instead the electric field potential \( V^{ef} = e(r_j E_j) \) of the oscillating moving SchEl within the QntElcMgnFld of RlPhtn or VrtPhtn. For a description of the emission and absorption of photons (RlPhtn and VrtPhtn) we can use the OrbWvFnc \( \phi_n(r) \), which are eigenfunction of the time dependent quadratic differential wave equation within partial derivatives (QdrDfrWvEqtPrtDrv) of Schrodinger, having a following form:

\[ i\hbar \frac{\partial \Psi(r, t)}{\partial t} = -\frac{\hbar^2 \Delta}{2m} \Psi(r, t) + V_c(r)\Psi(r, t) + V_{fr}(r)\Psi(r, t) + V_{ef}(r)\Psi(r, t) \]  

(32)

where \( V_c \) is a Coulomb potential, \( V_{fr} \) is Lorentz friction potential and \( V_{ef} \) is a potential of the SchEl within the QntElcFld. I think that it is very interesting that Fermi didn’t use known expression for emission of the electric dipole moment of the emitting atom. Therefore in a real case the energy of interaction may be presented as potential in a following form:

\[ V_{ef} = -\frac{e}{C}(v_j.A_j) = -e(r_j E_j) \]  

(33)

We are use the Newton first motion equation (31) \( m\ddot{r}_j = -eE_j \) in order to determine \( r_j \) as a function of \( E_j \) by its equal product \( -\frac{e}{m\omega_c^2}E_j \). In this fashion the Fermi’potential of the
Lorentz’ friction force accepts a following form:

\[ V_1(r) = -\frac{2e^2}{3mc^3}(r_j \dot{E}_j) \] (34)

But in a reality we shall use Fermi potential of the Lorentz’ friction force only for its restrictive influence. But time dependence of emitting SchEl’s radius vector \( r_j \) for description of Lorentz friction force at resonance case we shall describe by the equation (31) at determination of emitting SchEl’s radius vector \( r_j \) as a function of the ElcInt of the external QntElcMgnFld. I must remember you, that \( E_j \) is the electric intensity (ElcInt) of the external QntElcFld, within which is found polarized atom, composed by ion and the charge of the stimulated SchEl. As I carry out over the potential \( V_1 \) same operation integrating by part, then we can obtain its other presentation:

\[ V_1(r) = -\frac{2}{3} \frac{e^2}{mc^3} \frac{d}{dt}(er_jE_j) + \frac{2}{3} \frac{e^2}{mc^3}(er_jE_j) = \frac{2}{3} \frac{e^2}{mc^3}(J.E) \] (35)

The expression (35) show us that the potential \( V_1(r) \) is equal of the product of the factor of the electric power \( W_1 = (JE) \), which loses a free SchEl, creating electric current \( J \) under the QntElcFld ElcIntAct, multiplied by the emission time \( \tau = \frac{2}{3} \frac{e^2}{mc^3} \) of one real photon (RlPhtn). May be therefore Fermi didn’tused the potential \( V_1 \) for describing the spontaneous emission of a RlPhtn. Indeed, Fermi had used the first potential form, from which we could directly obtain Lorentz friction force \( F_{fr j} \):

\[ V_{fr}(r) = -\frac{2}{3} \frac{e^2}{c^3}(r_j \ddot{r}_j) \] (36)

In the beginning we determine the orbital wave eigenfunction (OrbEgnWvFnc) \( \Psi_n(r) \) of SchEl within Qoulomb potential of the nuclear electric charge (NclElcChrg). In its first work (1927) although both potentials \( V_c(r) \) and \( V_{fr}(r) \) have no time dependence Fermi had found the solution of the time depending QdrDfrWvEqtPrtDrv of Schrodinger, having a following form:

\[ -\frac{\hbar^2}{2m} \Delta \phi_n(r,t) + V_c(r)\phi_n(r,t) = E_n\phi_n(r,t); \] (37)

In order to obtain the total OrbWvFnc \( \Psi_{ns}(r,t) \), which is an eigenfunction of emitting SchEl, moving within Qoulomb potential of the NclElcChrg:

\[ -\frac{\hbar^2}{2m} \Psi_{ns}(r,t) + V_c(r)\Psi_{ns}(r,t) + V_{fr}(r)\Psi_{ns}(r,t) = E_n\Psi_{ns}(r,t); \] (38)

we shall expand the total OrbWvFnc \( \Psi_{ns}(r,t) \) in series of the eigen OrbWvFncs \( \phi_n(r,t) \):

\[ \Psi_{ns}(r,t) = \sum_s \lambda_s \phi_s \exp(-i\omega_st) \] (39)

It is very interesting that Fermi had well known, that the electric dipole moment (ElcD-plMmn) \( d_j = -er_j \) of the atom must be time dependent, as we could see from expression (35). Therefore although he didn’t took into consideration the existence of the time dependent ElcInt \( E_j \) of the external QntElcFld, one had artificially put in an use a time dependence of
radius-vector matrix elements. In such an artificial way Fermi written potential of the Lorentz
friction potential \( V_{fr} \) in a following fashion:

\[ \langle V_{fr} \rangle = i \frac{2e^2}{3C^3} \sum_{n,s} \lambda_n^* \lambda_s (\langle r \rangle \cdot \langle r \rangle) \cdot (\omega_n - \omega_s)^3 \exp i(\omega_n - \omega_s)t \] (40)

For calculation of the radius-vector matrix elements \( \langle r \rangle \) Fermi had used \( \Psi(r) \) expanded in a power of eigen functions \( \phi_n \) of a SchEl, moving within Coulomb potential of the Nuclear Charge \( V_q \) with eigen energy \( E_n = \hbar \omega_n \):

\[ \Psi(r, t) = \sum_n \lambda_n \phi_n |n_n \rangle \exp -i\omega_n t \] (41)

Therefore Fermi had used \( \Psi(r) \) of the calculation of the radius-vector matrix elements \( \langle r \rangle \) in a following fashion:

\[ \langle r \rangle = \int \Psi^*(r, t) r \Psi(r, t) d^3 r = \sum_{n,s} \lambda_n^* \lambda_s r_{n,s} \exp i(\omega_n - \omega_s)t \] (42)

Taking into consideration the expression (39), we can put the expansion (41) into QdrDfr-WvEqtPrtDrv of Schrodinger (35) and obtain the equation for expansion coefficients \( \lambda_n \):

\[ \sum_n \dot{\lambda}_n \phi_n (r) \exp i\omega_n t = \frac{i}{\hbar} \sum_k \lambda_n V_{fr} (r) \phi_k (r) \exp -i\omega_k t \] (43)

In order to obtain the algebraic number equation, depending only from time in first we must multiply the both sides of the equation (35) by the SchEl’s complex conjugate \( \phi_n^* (r) \), multiplied by \( d^3 r \), and in second to integrate over the whole space around. Taking into consideration the orthonormality of the system from the orthogonal and unitary \( \phi_n (r) \), we can obtain a following system of equations for the expansion coefficients \( \lambda_n \):

\[ \dot{\lambda}_n = \frac{i}{\hbar} \sum_s \lambda_s \int \phi_n^* (r) V_{fr} (r) \phi_s (r) d^3 r \exp i(\omega_s - \omega_n)t \] (44)

Substituting the matrix element \( \langle V_1 \rangle \) by its expression (42) into equations (44) we could obtain more simple equations:

\[ \dot{\lambda}_n = -\frac{2}{3hC^3} \sum_{l,k,s} \lambda_l \lambda_k^* \lambda_s \cdot (\omega_l - \omega_k)^3 \cdot \{ \langle l | r_j | k \rangle \cdot \langle s | r_j | n \rangle \} \cdot \exp i(\omega_k - \omega_l + \omega_n - \omega_s)t \] (45)

Secular indignation of the expansion coefficients \( \lambda_k \) values are determined by the parts of second power, for which the exponential factors are came to constants. For obtaining this purpose it is need one to satisfy a following equality: \( \omega_l - \omega_k + \omega_s - \omega_n = 0 \). If we assume that the rational relations have no between frequencies \( \omega_k \), then this equality is equivalent of other two equalities: \( l = n \) and \( k = s \). Then taking into consideration only the secular indignation we could obtain very simply equations:

\[ \dot{\lambda}_n = -\frac{2}{3hC^3} \sum_s \lambda_n \lambda_s^* (\omega_n - \omega_s)^3 \cdot \{ \langle n | r_j | s \rangle \} \cdot \{ \langle s | r_j | n \rangle \} \] (46)
In further we will investigate a case of emission only of one spectral line, when all expanding coefficients \( \lambda_j \) have zero values with the exception for an instance of \( n = 1 \) and \( s = 2 \). In this case after accept of a need used designations:

\[
A = \frac{2}{3} \frac{e^2}{\hbar C^3} \times (\omega_2 - \omega_1)^3 \cdot \{ \langle 1|r_j|2 \rangle \cdot \langle 2|r_j|1 \rangle \} = \frac{4}{3} \frac{e^2}{\hbar C} \cdot \frac{m(\omega_2 - \omega_1)^2}{2} \cdot \{ \langle 1|r_j|2 \rangle \cdot \langle 2|r_j|1 \rangle \} \cdot (\omega_2 - \omega_1) \cdot mC^2
\]

As it follows from determination (47) the constant \( A \) is determined by the product of the fine structure constant \( \alpha = \frac{e^2}{\hbar C} \) with the circular frequency \( \omega_c = (\omega_2 - \omega_1) \) and with the product of the ratio of the quadrate of the circular frequency \( (\omega_2 - \omega_1) = \omega_c \) to the quadrate of the light velocity \( C \) (which is an equal of the quadrate of wave number \( q_c = (q_2 - q_1) \)) with the \( \frac{2}{3} \) of the module quadrate of the matrix element \( |\langle n|r_j|s \rangle|^2 \) of the radius vector \( r_j \) of SchEl. In such a way we could understand that constant \( A \) has a inverse of time dimension.

In second presentation we should see that constant \( A \) is a product of the fine structure constant \( \alpha = \frac{e^2}{\hbar C} \), the ratio of the twofold kinetical energy \( \frac{4}{3} \frac{e^2}{\hbar C} \cdot \frac{m(\omega_2 - \omega_1)^2}{2} \cdot \{ \langle 1|r_j|2 \rangle \cdot \langle 2|r_j|1 \rangle \} \) of oscillating SchEl to its total energy \( mC^2 \) and the circular velocity \( (\omega_2 - \omega_1) \). In such a way we could understand that constant \( A \) has a inverse of time dimension.

In further we can obtain from the equations (10) a following simple equations by dint of substitution of constant \( A \):

\[
\dot{\lambda}_1 = A\lambda_1\lambda_2\lambda^* \quad \dot{\lambda}_1^* = A\lambda_1^*\lambda_2\lambda^* \quad \text{(48)}
\]

and

\[
\dot{\lambda}_2 = -A\lambda_2\lambda_1\lambda^* \quad \dot{\lambda}_2^* = -A\lambda_1^*\lambda_2\lambda^* \quad \text{(49)}
\]

It is easy for us to see that by multiplying each equation by its complex conjugated factor and after this by summing of all such obtained new equations we can obtain their first integral: \( \lambda_1\lambda^* \cdot \lambda_2\lambda^* = 1 \); This result is obvious and very easy for physical understanding. It shows us that the probability for finding the emitting SchEl in both energetic levels is preserved during the emission time.

It is easy for us to see also that by multiplying of each equation by a its complex conjugated factor, after summing of both such obtained new pair equations and after using by substitution obtained first integral we can obtain following two equations:

\[
\frac{d}{dt} |\lambda_1|^2 = 2A|\lambda_1|^2(1 - |\lambda_1|^2) \quad \frac{d}{dt} |\lambda_1|^2 = -2A|\lambda_2|^2(1 - |\lambda_2|^2) \quad \text{(50)}
\]

After integrating of equations (50) we can obtain following two solutions:

\[
2At = \ln\{|\lambda_1|^2/(1 - |\lambda_1|^2)\} + const_1 \quad \text{and} \quad 2At = \ln\{|\lambda_2|^2/(1 - |\lambda_2|^2)\} + const_2 \quad \text{(51)}
\]

If we suppose that \( \lambda_2 = 1 \) and \( \lambda_1 = 0 \) at \( t = -\infty \) and \( \lambda_2 = 0 \) and \( \Lambda_1 = 1 \) at \( t = +\infty \), then we can determine both constant and obtain following definition equations:

\[
|\lambda_1|^2 = \exp(2At)\{\exp 2At + 1\}^{-1} \quad \text{and} \quad |\lambda_2|^2 = \exp(-2At)\{\exp -2At + 1\}^{-1} \quad \text{(52)}
\]

In order to obtain their product \( |\lambda^*_1\lambda_2| \) we must in first multiply their values from equation (52) and in second take square from this factor. In such an elementary easy way we can obtain a simple useful results:

\[
|\lambda^*_1\lambda_2| = 2cosh^{-1}(At) \quad \text{(53)}
\]
The obtained result (53) shows that the real photon (RlPhtn) has a solitary needle package form of a length \( l = \{C/A \} \) of cylindrical harmonic oscillations, who is emitted for a limited from \( A^{-1} \) time. This result gives very obvious fashion of the RlPhtn, which explain the physical cause, ensuring the existence of Plank’s rule for emission and absorption of every RlPhtns singly in a solitary needle form. It is a very clear way for correct obtaining of such physically clear result, but in a reality it don’t contain a very important product of the resonance term. Indeed, as we could see Fermi has used the Lorentz friction potential \( V^{fr} = -\frac{2}{3} \epsilon \frac{e^2}{C^3} (r_j \dot{r}_j) \) of the free moving SchEl instead the electric field potential \( V^{ef} = e(r_j E_j) \) of the oscillating moving SchEl within the QntElcMgnFld of the existent RlPhtn or VrtPhtn. It is true as only the friction term would turn the kinetic energy of excited SchEl in energy of RePhtn.

Although the obtained results by Fermi is physically clear and mathematically correctly nobody turn necessity attention and therefore after the publication of the work ([9]) by Heisenberg and Pauli, Fermi himself used their method in works ([10]). As I think that Fermi method is physicaly clear and mathematically correctly and gives more obvious picturial description, I shall thry to use its and determining the radius vector value of SchEl by means of equation of motion of forced oscillator with Lorentz friction as in ([11]) and ([12]). In order to obtain better and more mathematically correct and physically clear solution in the first we shall use the Lorentz’ friction force using the determination of the deviation radius value \( r_j \), created by the influence of the ElcIntAct, using not only inertial force within the left hand-side of Newton first motion equation (31) and after that we shall use another presentation of same Lorentz frictional potential. Really it will be better to use the Newton first motion equation (30) instead simplified equation (31) for determination the radius vector \( r_j \) value. In the first we shall take into account in first the term describing the inertial force, and in second the term describing the friction force and in third the term describing the elastic force, which forces the emitting or absorbing SchEl to move between two energetic levels \( E_n \) and \( E_s \). In second, we shall take into consideration the fourth term, describing the electric force of ElcIntAct of the ElcInt of the external QntElcMgnFld by WllSpr ElmElcCrgh of the emitting or absorbing SchEl, which secures being of the emitting SchEl in a hybrid state of two energetic levels, ensures the existence of the deviation value \( r_j \), which determines the electric dipole moment value of the emitting atom. I reaped, with a purpose for easily and obvious understanding the way of the mathematical solution of the quadratic differential wave equation of Schrodinger Fermi has ignored the inertial force, the elastic force and the electric force, as he thought that only Lorentz’ friction force transforms the kinetic energy of emitting SchEl’s to energy of emitted RIpht. In order to obtain our purpose we shall use the most correctly equation of motion (30). In this way we shall take into consideration all terms of interactions and of physical cause, ensuring the existence of the electric dipole moment (ElcDlpMnn), which ensures the emission and absorption by atom of some real photons. I think that I am need to note here that Fermi method is founded aggregate of well considered expressions. Therefore we must take into account in first the electric frictional potential of SchEl within external QntElcMgnFld and in second all terms in the motion equation (30), determining the radius vector \( r_j \) as a function of the ElcInt \( E_j \). Therefore we shall use the presentation of the friction potential \( V^{fr} \) of SchEl moving within external QntElcMgnFld:

\[
i\hbar \frac{\partial \tilde{\Psi}(r,t)}{\partial t} = -\frac{\hbar^2 \Delta}{2m} \tilde{\Psi}(r,t) + V_e(r) \tilde{\Psi}(r,t) + V^{fr}(r) \tilde{\Psi}(r,t) + V^{ef}(r) \tilde{\Psi}(r,t) \tag{54}\]

I need to point here, that the influence of the potential $V_{ef}(r)$ within eqt. (54) will be taken into account by dint of the motion eqt. (30). Therefore the influence of Lorentz friction force will be taken into account by me in same way that Fermi took into account the same Lorentz’ friction force in an approach, neglecting the influence of the potential $V_{ef}(r)$. In order to take into account the Lorentz friction force, acting over emitting SchE l, taking into account the electric force from eqt.(33), instead by means of Newton motion equation (31), if the $E_{Int}$ will be taken into account by me in same way that Fermi took into account the same Lorentz’ friction force in an approach, neglecting the influence of the potential $V_{ef}(r)$. In order to take into account the Lorentz friction force, acting over emitting SchEl, taking into account the electric force from eqt. (33), instead by means of Newton motion equation (31), if the ElcInt $E_{j}$ of the external QntElcMgnFld could be determined by dint of the eqt (3). In such a way we can obtain a following presentation:

$$r_{j,q} = \left( \frac{e}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{\Omega \varepsilon_0}} I_{j,q} \left\{ \frac{a_{j,q}^+ \exp i(\omega t - q \cdot r)}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}} + \frac{a_{j,q} \exp -i(\omega t + q \cdot r)}{\{\omega^2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}} \right\}$$ (55)

$$r_{j,q}^* = \left( \frac{e}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{\Omega \varepsilon_0}} I_{j,q} \left\{ \frac{a_{j,q} \exp -i(\omega t - q \cdot r)}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}} + \frac{a_{j,q}^+ \exp i(\omega t - q \cdot r)}{\{\omega^2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}} \right\}$$ (56)

But these are an operator presentations of forced oscillation radius $r_{j,q}$ and we must write their matrices presentation in analogous of (12):

$$\langle \tilde{\Psi}^* | r_{j,q} | \tilde{\Psi} \rangle = \sum_{p,l} \lambda_p^* \lambda_l \exp i(\omega_p - \omega_l)t \left( \frac{e}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{4\tau \varepsilon_0}} \times$$

$$\left\{ \frac{\langle \phi_p^* | r_{j,o}L_{j,q} \exp -i(q \cdot r) | \phi_l \rangle}{\{\omega_2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}} \right\} \times \frac{\langle n_p | a_{j,q}^+ | n_l \rangle \exp i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}}$$

$$+ \frac{\langle n_p | a_{j,q} | n_l \rangle \exp -i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}}$$

$$\langle \tilde{\Psi}^* | r_{j,q}^* | \tilde{\Psi} \rangle = \sum_{p,l} \lambda_p^* \lambda_l \exp i(\omega_p - \omega_l)t \left( \frac{e}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{4\tau \varepsilon_0}} \times$$

$$\left\{ \frac{\langle \phi_p^* | r_{j,o}L_{j,q} \exp +i(q \cdot r) | \phi_l \rangle}{\{\omega_2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}} \right\} \times \frac{\langle n_p | a_{j,q}^+ | n_l \rangle \exp i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}}$$

$$+ \frac{\langle n_p | a_{j,q} | n_l \rangle \exp -i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}}$$

If $E_{j,q} = \sqrt{\frac{2\pi \hbar \omega}{\Omega \varepsilon_0}}$, then we could easily verify that $\frac{e}{m}E_{j,q} = \sqrt{\frac{4\pi \varepsilon_0 \hbar}{2\varepsilon_0}} = \omega^2 \sqrt{\frac{\hbar}{2m \omega}} = \omega^2 r_{j,o}$, where $r_{j,o}$ is an amplitude of an oscillation of one RlPhntn. Therefore the expression of the ElcDplMnn matrix element $\langle d_\omega \rangle$ has the following matrix presentation:

$$\langle \tilde{\Psi}^* | d_{j,q} | \tilde{\Psi} \rangle = \sum_{p,l} \lambda_p^* \lambda_l \exp i(\omega_p - \omega_l)t \left( \frac{e}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{4\tau \varepsilon_0}} \times$$

$$\left\{ \frac{\langle \phi_p^* | r_{j,o}L_{j,q} \exp -i(q \cdot r) | \phi_l \rangle}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}} \right\} \times \frac{\langle n_p | a_{j,q}^+ | n_l \rangle \exp i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 + i\tau \omega^3\}}$$

$$+ \frac{\langle n_p | a_{j,q} | n_l \rangle \exp -i(\omega t)}{\{\omega^2 - (\omega_2 - \omega_1)^2 - i\tau \omega^3\}}$$

(59)
\[ \langle \tilde{\Psi}^* | d_{j,q}^* | \tilde{\Psi} \rangle = \sum_{p,t} \lambda_p^* \lambda_t \exp i(\omega_p - \omega_t) \left( \frac{e^2}{m} \right) \sqrt{\frac{2\pi \hbar \omega}{\Omega \tau_0}} \times \]

\[
\left\{ \phi_p^* r_{j,o} I_{j,q} \exp + i(q.r) \phi_t \right\} \times \left\{ \frac{\langle n_p | a_{j,q}^+ | n_t \rangle \exp - i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 - i \tau \omega^3} \right\}
\]

\[
+ \left\{ \phi_p^* r_{j,o} I_{j,q} \exp - i(q.r) | \phi_t \right\} \times \left\{ \frac{\langle n_p | a_{j,q}^+ | n_t \rangle \exp i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 + i \tau \omega^3} \right\}
\]

(60)

In order to obtain the total value of the ElcDplMnn matrix element we need to multiply its value \((59, 60)\) by \(\frac{8 \pi N}{\pi r_0^2} \omega^2 d\omega\) and its product to integrate from zero to \(\infty\). It will be more suitable instead \(r_0 I_j\) to write \(\langle 0 | r_j | 1 \rangle\) or \(\langle 1 | r_j | 0 \rangle\). As we can understand the different value from zero will have only the parts, satisfying the conditions \(\langle n_k | a_{jq}^+ | n_s \rangle \neq 0\) and \(\langle n_k | a_{jq} | n_s \rangle \neq 0\), depending from the correlation between \(n_k\) and \(n_s\). In order to obtain the expansions \((59, 60)\) we shall use only two OrbWvEgnFncs \(\phi_1\) and \(\phi_2\) if: \(H_0 \phi_1 = E_1 \phi_1\) and \(H_0 \phi_2 = E_2 \phi_2\). For description of the emission and absorption of photons (RlPhn and VrtPhn) we once again can use the OrbEgnWvFnc \(\Psi^o(r)\), which are OrbWvEgnFnc of the time dependent quadratic differential wave equation within potential \((QdrDfrWvEqtPrtDrv)\) of Schrodinger, having the form \((32)\). We suppose that the OrbEgnWvFncs \(\phi_n^o(r)\) of the SchEl within QoulobM potencial of the nuclear electric charge \((NcElecChrg)\) are determined in the beginning. Then in a result of using the presentations of \(r_{j,q}^*\) and \(E_{j,q}\) within potential \((29)\) we can obtain a following representation of its matrix element:

\[
\langle \phi^* | V_{fi} | \phi \rangle = \frac{e^2}{m} \sum_{q,m,s,n,l} \lambda_n^* \lambda_s \lambda_p \lambda_l \langle 2\pi \hbar \omega / \Omega \rangle (\omega_l - \omega_k)^3 \exp i(\omega_n - \omega_s + \omega_p - \omega_l) t \times \]

\[
\left\{ \int \Omega \phi_n^* (r) \phi_s (r) I_{j,q} \exp + i(q.r) d^3r \right\} \times \left\{ \frac{\langle n_n | a_{j,q}^+ | n_s \rangle \exp i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 - i \tau \omega^3} \right\}
\]

\[
+ \left\{ \int \Omega \phi_n^* (r) \phi_s (r) I_{j,q} \exp - i(q.r) d^3r \right\} \times \left\{ \frac{\langle n_n | a_{j,q}^+ | n_s \rangle \exp - i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 - i \tau \omega^3} \right\}
\]

(61)

In analogous with the eqn \((13)\) we can rewrite eqn \((61)\) in the equation for new coefficients \(\lambda_n:\)

\[
\sum_s \lambda_n \int \Omega \phi_n^* (r) \phi_s (r) d^3r \exp - i(\omega_s t) = \frac{2 \pi e^2}{m \Omega} \sum_{q,m,s,n,l} \lambda_n^* \lambda_s \lambda_p \lambda_l (\omega_l - \omega_k)^3 \exp i(\omega_p - \omega_s - \omega_l) t \times \]

\[
\left\{ \int \Omega \phi_n^* (r) \phi_s (r) I_{j,q} \exp - i(q.r) d^3r \right\} \times \left\{ \frac{\omega \langle n_n | a_{j,q}^+ | n_s \rangle \exp i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 + i \tau \omega^3} \right\}
\]

\[
+ \left\{ \int \Omega \phi_n^* (r) \phi_s (r) I_{j,q} \exp + i(q.r) d^3r \right\} \times \left\{ \frac{\omega \langle n_n | a_{j,q}^+ | n_s \rangle \exp - i(\omega t) \rangle}{\omega^2 - (\omega_2 - \omega_1)^2 + i \tau \omega^3} \right\}
\]

(62)
After taking into consideration the orthogonality of OrbEgnWvFnks $\phi_n^s$ and $\phi_s$ we can translate factor $\exp -i\omega t$ from the left-hand side into the right-hand side and after making essential partial multiplications the expression (62) can be rewritten in a following form:

$$\dot{\lambda}_n = \frac{4i\pi e^2}{h\Omega} \sum_{q,n,s,p,t} \lambda_s \lambda_p^* \lambda_t \lambda_n^* \lambda_{\phi} (\omega_l - \omega_k)^3 \exp i(\omega_n + \omega_p - \omega_s - \omega_l)t \times$$

$$\left\{ \int_\Omega \phi_n^s(r) \phi_s(r) r_j^o I_{j,q} \exp -i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp +i(q.r') d^3r' \times$$

$$\omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 - i\tau\omega^3 \}} + \omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 + i\tau\omega^3 \}} \times$$

$$\int_\Omega \phi_n^*(r) \phi_s(r) r_j^o I_{j,q} \exp +i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp +i(q.r') d^3r' \times$$

$$\omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 - i\tau\omega^3 \}} + \omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 + i\tau\omega^3 \}} \times$$

$$\times \int_\Omega \phi_n^*(r) \phi_s(r) r_j^o I_{j,q} \exp +i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp +i(q.r') d^3r' \right\}$$

(63)

Secular indignation of the expansion coefficients $\lambda_n$ values are determined by the parts of second power, for which the exponential factors are came to constants. For obtaining this purpose it is need one to satisfy a following equality: $\omega_l - \omega_p + \omega_s - \omega_n = 0$. If there os not the rational relations between frequencies $\omega_n$, then this equality is equivalent of other two equalities: $l = n$ and $p = s$. Then taking into consideration only the secular indignation we can obtain very simply equations:

$$\dot{\lambda}_n = \frac{4i\pi e^2}{h\Omega} \sum_{q,n,s,p,t} \lambda_s \lambda_p^* \lambda_t \lambda_n^* \lambda_{\phi} (\omega_l - \omega_k)^3 \exp i(\omega_n + \omega_p - \omega_s - \omega_l)t \times$$

$$\left\{ \int_\Omega \phi_n^s(r) \phi_s(r) r_j^o I_{j,q} \exp +i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp +i(q.r') d^3r' \times$$

$$\omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 - i\tau\omega^3 \}} + \omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 + i\tau\omega^3 \}} \times$$

$$\int_\Omega \phi_n^*(r) \phi_s(r) r_j^o I_{j,q} \exp -i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp -i(q.r') d^3r' \times$$

$$\omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 - i\tau\omega^3 \}} + \omega^2 \left( \langle n | a_{j,q}^+ | n_s \rangle \times \langle n_p | a_{j,q} | n_t \rangle \right) \frac{1}{\{ \omega^2 - (\omega_2 - \omega_1)^2 + i\tau\omega^3 \}} \times$$

$$\times \int_\Omega \phi_n^*(r) \phi_s(r) r_j^o I_{j,q} \exp -i(q.r) d^3r \times \int_\Omega \phi_p^* (r') \phi_t (r') r_j^o I_{j,q} \exp -i(q.r') d^3r' \right\}$$

(64)

From eqt (64) we see that last two parts are very frequently alternating in time and therefore after some time averaging they could be ignored. In these approximation by dint of equations (67) and (68) we can obtain the presentation, known from eqt (44):

$$\dot{\lambda}_n = -\frac{2}{3} \frac{e^2}{hC^3} \sum_s \lambda_s \lambda^* \lambda_s \times (\omega_n - \omega_s)^3 . \{ \langle n | r_j | s \rangle \} \times \{ \langle s | r_j | n \rangle \}$$

(65)

The reception of known expressions for the time dependence of coefficients of the expansion $\lambda_n$ of the hybrid state of the emitting or absorbing SchEl taking into consideration the influence of the ElcInt $E_j$ and the oscillating force of a continuous transition between two energetic level allows us to obtain the resonant form of (72,73) instead the simple form (44) of the same radius deviation. After all that we should understand that the useful and obvious supposition of Fermi
about the physical consequence of the influence of Lorentz friction force is true and deserves to be used in the explanation of Plank’s rule for emission and absorption of RlPhtn in a solitary needle form. Besides that, there are no forced or spontaneous emissions and forced absorption. In reality all emissions are forced but some of them are forced from the electric fields of real photons and others of them are forced from the electric fields of virtual photons. In a time of the forced emission and the absorption the product of both coefficients $\lambda_1$ and $\lambda_2$ of both OrbWvFncs $\phi_1$ and $\phi_2$ determines the time dependence of the forced radius deviation and of the intensity of the emission or the absorption by dint of the SchEl. Therefore the participation of the SchEl in the process of the emission or the absorption is determined and limited from the Lorentz’ friction force. Therefore the emitted real photons are quants of the quantized electromagnetic energy, which have a solitary needle form.

The reception of known expressions for the ElcInt and MgnInt values of the QntElcMgn-Fld by dint of a simple transformation of an expression, describing deviation of two PutLk ElmElcChrgs of distorted dynamides into the ideal dielectric of the FlcVcm proves obviously and scientifically the true of our assumption about the dipole structure of the vacuum and about the creation way of its collective oscillation - RlPhtn. The existence of a possibility for a creation of virtual photons (VrtPhtns) as an excitation within the fluctuating vacuum (FlcVcm) renders an essential influence over the motion of a electric charged or magnetized micro particles (MicrPrts) by means of its EntElcMgnFld. The existence of a free energy in the form of micro particles (MicrPrts) can break of the connection between pair contrary PutLk ElmElcChrgs of one dynamide and to excite pair of two opposite charged MicrPrts at once.

As all MicrPrts are excitements of the vacuum then every one of them would can move freely through its ideal dielectric lattice without any friction or damping, that is to say why ones move without to feel the existence of the vacuum. Moreover, the existence of some MicrPrt in the easily polarized FlcVcm distorts its ideal crystalline lattice by influence of its high dinsity own QntElcMgnFld, created by own FnSpr ElmElcChrg. This natural distortion of the neutral molecular FlcVcm with the close-packed lattice excites and ensurses the gravitation field of the ElmMicrPrt’s mass, which by using same force show attention upon mass of another ElmMicrPrt and upon its behavior. The equivalence of both presentations, of the Coulob and Newton potentials and forces of interactions is a result of the dimensional equality of the space, within they act. In such a naturally obvious and physically clear way we understand why the force of the gravitation interaction is determined by the self energy at a rest and mass.

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