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NEW QUANTUM RELATIONS

A DYNAMIC CUTT-OFF

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ABSTRACT

It’s possible to deduce new quantum relations starting from Planck’s postulate, according to which, for the radiation of the black body, it’s valid that:

$$E = h\nu n\,.$$

The relations we’ll be arriving to, in a very simple and immediate way, are fully conforming with the actual Quantum Mechanics, but they involve very deep implications.

In this essay we will limit to consider only one relation consisting in the possible elimination of the singleness afflicting the actual theoretical physics.

1 A NEW QUANTUM FORMULA

If we consider an electromagnetic dipole constituted by a proton and an electron. It's possible to show the theoretical validity of the new quantum relation

$$\boxed{\lambda = 2\pi 137 \psi n} \quad (1.1)$$

for that dipole; where λ is the electromagnetic wavelength emitted or absorbed by the dipole and ψ is the average oscillation amplitude of the peripheral charge (average ray of the electron orbit).

It's possible to reach the said relationship in various ways. If we consider, for example, a surge of electromagnetic energy $E = h\nu n$ moving in the empty space and it is about to be completely captured by an absorbent surface (electromagnetic dipole constituting the said wall (black body)).

If this energy, as it was said, is integrally absorbed by the matter then, for the principle of the conservation of energy, it will be had

$$h\nu n = h\frac{C}{\lambda}n = \frac{e^2}{\psi_2} - \frac{e^2}{\psi_1} \quad (1.2)$$

and that is the increase of total energy of the dipole will be, after the interaction, exactly equal to the one of the electromagnetic surge absorbed by the last mentioned one.

If it is assumed that the energy of the dipole is void in correspondence of $\psi_1 \to \infty$ it's had in a more simply way that

$$h\nu n = h\frac{C}{\lambda}n = \frac{e^2}{\psi_2} = \frac{e^2}{\psi}. \quad (1.3)$$

From the relation (1.3), by introducing in it the known identity

$$2\pi 137 e^2 = hC, \quad (1.4)$$

the (1.1) is obtained. An even more simple way to get (1.1) is the following. It is multiplied the numerator and the denominator of the total energy of the dipole for the same quantity $(2\pi 137 n)$ and

$$E = \frac{e^2}{\psi} = \frac{e^2}{\psi}\frac{2\pi 137 n}{2\pi 137 n} = \frac{hC}{2\pi 137 \psi n}n \quad (1.5)$$

is obtained. This formula comes to coincide with Planck's empirical one if it's posed that

$$\lambda = 2\pi 137 \psi n. \quad (1.6)$$

2 COHERENCE WITH THE ACTUAL QUANTUM MECHANICS

Let's show the way Bohr's relations related to the hydrogen atom and new formulas come down in coherent way from (1.1).

Energy of the hydrogen atom

By multiplying both the members of the (1.1) for the dipole frequency

$$\lambda \nu = 2\pi 137\psi \ \nu n = C \tag{1.7}$$

it's had and so

$$137\psi \omega n = 137 v n = C \tag{1.8}$$

from which follows that the average speed of the orbiting charge is

$$v = \frac{C}{137}\frac{1}{n} . \tag{1.9}$$

That involves energy is given by

$$\boxed{E = \frac{1}{2}\frac{mC^2}{137^2}\frac{1}{n^2}} \tag{1.10}$$

relation that, keeping on mind the (1.4), it becomes

$$\boxed{E = \frac{2\pi^2 m e^4}{h^2}\frac{1}{n^2}} \tag{1.11}$$

coinciding with Bohr's known formula [1].

Bohr's orbit rays

In addiction, from the comparison of the (1.9) and of the relation

$$v = \sqrt{\frac{e^2}{m\psi}} \tag{1.12}$$

it is obtained that

$$\boxed{\psi = \frac{e^2}{mC^2}137^2 n^2} . \tag{1.13}$$

This relation, according with the (1.4), becomes

$$\boxed{\psi = \frac{h^2}{4\pi^2 m e^2} n^2} \tag{1.14}$$

coinciding with Bohr's other relation [1]. From the (1.14) and the (1.6) it is deduced that

$$\lambda_{elect.} = 2\pi 137^3 \frac{e^2}{mC^3} n^3 = 2\pi 137^3 R_e n^3 = 2\pi \left(137^2 R_e n^2\right) 137 n = 137 \left(2\pi R_{Bohr}\right) n = 137 \lambda_{de Br.} n \quad (1.15)$$

and so that the electromagnetic wavelength emitted by a vibrating charge fully satisfies the disequation foreseen by the actual theory according with the [2]

$$\lambda_{elect.} \gg \frac{e^2}{mC^2}. \quad (1.16)$$

Then it can be concluded that while the frequency of the electromagnetic wave exactly coincides with the dipole one, among the wavelength of the radiation emitted by an accelerated charge and the average amplitude described by the last one mentioned the identity would subsist (1.15) or (1.1).

The photoelectric effect

Let's consider the classic relation

$$E = \frac{e^2}{\psi_2} - \frac{e^2}{\psi_1} \quad (1.17)$$

which is giving us the variation of the total energy of the dipole. If the initial energetic state is fixed it's also had that

$$E = \frac{e^2}{\psi} - W \quad (1.18)$$

but this relation can also be written as:

$$E = \frac{e^2}{\psi} - W = \frac{2\pi 137 e^2}{2\pi 137 \psi} - W = \frac{hC}{\lambda} - W = h\nu - W . \quad (1.19)$$

Einstein's deduction of the (1.19) convinced the world of the physics on the objectivity of energy quantum.

The present demonstration points out the new identity

$$\frac{e^2}{\psi} = \frac{2\pi 137 e^2}{2\pi 137 \psi} = \frac{hC}{\lambda} = h\nu \quad (1.20)$$

so the indivisible (or apparently) quantum of energy $h\nu$ comes to be exactly equal to the total energy of the dipole: e^2/ψ and so to the work, made with absolute continuity, to move the electron charge from the distance ψ from the nucleus to the infinite distance of it.

Subsequently we will also show that $h\nu$ is the work necessary to do to divide the two charges starting from the distance zero to the infinite or, if we want, we also say that $h\nu$ is the complete annihilation work of two charges.

In addiction to the (1.20) it can also be written the identity

$$\frac{1}{2}\frac{e^2}{\psi}=\frac{1}{2}h\frac{C}{\lambda}=\frac{1}{2}h\nu\,. \tag{1.21}$$

Limit of the bottom of spectrum

If some electric charges are accelerated by a potential V and they e and they are cast on a surface, an electromagnetic radiation (bremsstrahlung) occurs, and it's frequency satisfies the known relationship

$$V_o\,e=h\nu_o\,. \tag{1.22}$$

And this relationship is immediately obtained from the identity (1.20). In fact it’s had:

$$V_o\,e=\frac{e}{\psi_o}e=\frac{e^2}{\psi_o}=\frac{2\pi 137\,e^2}{2\pi 137\,\psi_o}=\frac{h\,C}{\lambda_o}=h\nu_o. \tag{1.23}$$

De Brogle’s wave

The relation (1.1) can be specified in the following way

$$\boxed{\lambda_e=2\pi 137\,\psi_{Bohr}\,n=137\,\left(2\pi\,\psi_{Bohr}\right)n=137\;\lambda_{de\,Broglie}\;n} \tag{1.24}$$

so it’s possible to synthetically write

$$\boxed{\lambda_e=137\;\lambda_d\;n} \tag{1.25}$$

with which a simple bond of proportionality is established among the wave of de Broglie and the electromagnetic one, that would mean it would be immediate to write the equation of Schrödinger also for the electromagnetic wave or, if we want, for the photon.

This relationship suggests, besides and particularly, that the experience verifying the relationship of de Broglie (diffraction of the electrons) is accompanied by an electromagnetic wave whose wavelength satisfies it (1.25).

Stefan-Boltzmann’s law

It’s known that for the Black Body (B.B.) [1] is had

$$W=\sigma T^4 \tag{1.26}$$

and so that the integral energy radiated in all the directions from the Black Body at a given temperature in the unit of time and for unit of surface is proportional to the fourth power of the temperature.

It's possible to deduce this law with classic thermodynamic considerations (and so without the help of Planck's theory) but that does not allow do determine, as known, also the value of the constant σ.

Let's see how to reach the (1.26) through the relation (1.20), by being able also to determine the numeric value of σ.

Let's consider and electromagnetic dipole of B. B. wall which Energy is given by

$$E = \frac{1}{2}\frac{e^2}{\psi}, \tag{1.27}$$

so the volumic power (referred to the wavelength) will be given by

$$P_{vol} = \frac{1}{2}\frac{e^2}{\psi}\frac{1}{T}\frac{1}{\lambda^3} = \frac{1}{2}\frac{e^2}{\psi}\frac{\nu}{\lambda^3} = \frac{1}{2}\frac{e^2}{\psi}\frac{C}{\lambda^4}. \tag{1.28}$$

If the dipole is in thermodynamic equilibrium it will have also result

$$\frac{3}{2}kT = \frac{1}{2}\frac{e^2}{\psi} = \frac{1}{2}\frac{hC}{\lambda} \tag{1.29}$$

from which is drawn that

$$\lambda = \frac{hC}{3kT}. \tag{1.30}$$

The integral volumic power will be therefore equal to

$$P_{\text{int}} = \frac{1}{2}\frac{e^2}{\psi}\frac{C}{\lambda^4}\lambda = \frac{1}{2}\frac{hC^2}{\lambda^4}, \tag{1.31}$$

formula that, keeping on mind the (1.30), it becomes

$$P_{\text{int}} = \frac{1}{2}\frac{hC^2}{\frac{h^4C^4}{3^4k^4T^4}} = \frac{1}{2}\frac{3^4k^4}{h^3C^2}T^4 = \frac{1}{2}\frac{3^4\left(1.39\times10^{-16}\right)^4}{\left(6.62\times10^{-27}\right)^3\left(2.998\times10^{10}\right)^2}T^4 = 5.65\times10^{-5}\,T^4 \tag{1.32}$$

so it's had that

$$\sigma = 5.65\times10^{-5}\,[sistema\ c.g.s.] \tag{1.33}$$

against the experimental value of

$$\sigma = 5.67\times10^{-5}\,[sistema\ c.g.s.]. \tag{1.34}$$

The (1.32), in terms of beaming flow Φ, can also be written [3]

$$\Phi = \sigma\,\Theta^4 \tag{1.35}$$

where

$$\sigma = 1.03 \times 10^5 \, [J / cm^2 \, s (Ve)^4] \tag{1.36}$$

and the temperature is expressed in eV $\left(1eV \approx 11400\,K\right)$.

Wien's law

Always for the black body it's shown that [1]

$$P_{V\,\max} = BT^5 . \tag{1.37}$$

Likewise the previous case it's possible to theoretically determine the (1.37) but it's not possible to establish the value of the constant B.

In this case it's had

$$P_V = \frac{1}{2}\frac{e^2}{\psi}\frac{C}{\lambda}\frac{1}{\lambda^3} = \frac{1}{2}\frac{hC^2}{\lambda^5} \tag{1.38}$$

and, because of the (1.30), it's obtained that

$$P_V = \frac{1}{2}\frac{hC^2}{\lambda^5} = \frac{3^5}{2}\frac{k^5}{h^4 C^3} T^5 \tag{1.39}$$

and so

$$B = \frac{3^5}{2}\frac{k^5}{h^4 C^3} = 1.2 \times 10^{-4} \tag{1.40}$$

against the experimental value of

$$B = 1.28 \times 10^{-4} \left[erg / \left(cm^3 \sec k^5 \right) \right]. \tag{1.41}$$

3 The new dynamic cutt-off. A possible solution of Coulomb's singleness

As it was anticipated firs, one of the most immediate implications of the (1.20) consists in the possible elimination of the singleness afflicting the actual theoretical physics. The congenital one, as it is known, it consists in the infinity reported the Coulomb's law (Newton) for $\psi \to 0$ that is

$$\lim_{\psi \to 0} \frac{Qq}{\psi^2} = \infty \tag{1.42}$$

a little earlier we have established the identity

$$\boxed{\frac{e^2}{\psi} = h\nu} . \tag{1.43}$$

Let's examine Planck's electromagnetic energy

$$E = \frac{h\nu}{\exp\left(\frac{h\nu}{kT}\right) - 1} . \tag{1.44}$$

For the (1.43), this relation can be written as

$$E = \frac{h\nu}{\exp\left(\frac{h\nu}{kT}\right) - 1} = \frac{\frac{e^2}{\psi}}{\exp\left(\frac{e^2/\psi}{m\overline{C}^2}\right) - 1} \tag{1.45}$$

which suggests to calculate the coulombian strength warning the electron in a certain thermodynamic context characterized by the greatness $m\overline{C}^2$ when said particle is at a certain average distance from the central charge. It's therefore had the following correction of Coulomb's law

$$F = -\frac{\partial E}{\partial \psi} = \frac{e^2}{\psi^2}\left[\frac{1}{\exp\left(\frac{e^2/\psi}{m\overline{C}^2}\right) - 1} - \frac{e^2}{m\overline{C}^2}\frac{1}{\psi}\frac{\exp\left(\frac{e^2/\psi}{m\overline{C}^2}\right)}{\left[\exp\left(\frac{e^2/\psi}{m\overline{C}^2}\right) - 1\right]^2}\right] . \tag{1.46}$$

By posing

$$R = \frac{e^2}{m\overline{C}^2} \tag{1.47}$$

it's also obtained

$$F = \frac{e^2}{\psi^2}\left[\frac{1}{\exp\left(\frac{R}{\psi}\right)-1} - \frac{R}{\psi}\frac{\exp\left(\frac{R}{\psi}\right)}{\left[\exp\left(\frac{R}{\psi}\right)-1\right]^2}\right]. \qquad (1.48)$$

In the figure n. 1 the (1.48), in black, Coulomb's formula, in blue, and the passing straight line for the distance given by the (1.47), in red are represented.

As we can see, because (1.48) stands in a determined thermodynamic context characterized by the value of R, a maximum of the strength to a distance of around $R/2$ is had; and then, below such distance, it gets quickly depressed as soon as the two charges get closer, while the classical formula of Coulomb strongly extends to infinite, reporting the old and perduring divergence (that physics has been dragging behind until today).

It could be thought that the charges brought by two bodies succeed in being anchored to them until a certain point. When the distance between the two masses becomes very small, some effects of tide would intervene to try to tear the charges from the bodies themselves, by making them neutral (naked mass). The union of the charges, once they are completely torn by the masses, would give origin to an electromagnetic wave. This would involve that at distance zero no strength would exist between the two considered masses.

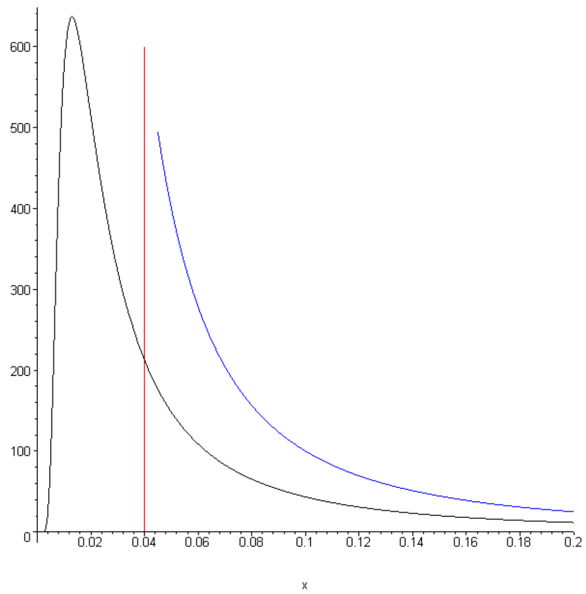

Fig. 1

The (1.45) is represented in Fig. 2.

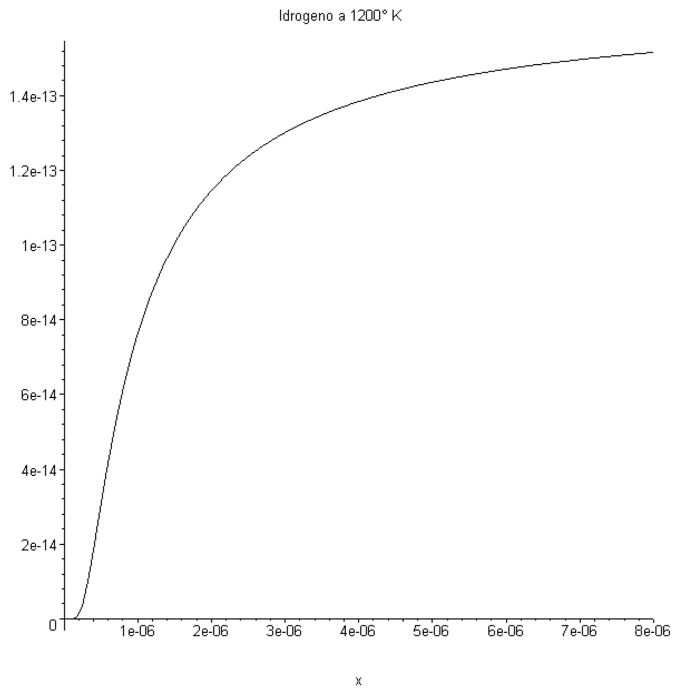

Fig. 2

If the work of separation or annihilation of the two charges is calculated, contrarily to the infinite value given by Coulomb's formula (and Newton's), it is found

$$L = \left[\frac{\frac{e^2}{\psi}}{\exp\left(\frac{e^2/\psi}{m\overline{C}^2}\right) - 1} \right]_{\psi=0}^{\psi=\infty} = m\overline{C}^2 = kT \qquad (1.49)$$

or

$$L = \left[\frac{\frac{e^2}{\psi}}{\exp\left(\frac{R}{\psi}\right) - 1} \right]_{\psi=0}^{\psi=\infty} = \frac{e^2}{R} = h\overline{\nu} = m\overline{C}^2 = kT \qquad (1.50)$$

it must expressly be kept on mind the constant $\overline{C}$ of the (1.49) it is not necessarily equal to the speed of light. This would involve that the transformation of the mass in energy would happen according with the relationship

$$E = m\overline{C}^2 \qquad (1.51)$$

and therefore there would also be transformations of mass in energy for lower values of those foreseen by the relativistic formula. Then, this type of transformations would also interest the common thermodynamic phenomena. For the same motive the value of

$$R = \frac{e^2}{m\overline{C}^2} \qquad (1.52)$$

it can also be greater than the classical ray of the electron. This because of the value $\overline{C}$ is determined by the position

$$\overline{C} = \sqrt{\frac{kT}{m}} \, . \qquad (1.53)$$

It's simply observed that the said cutt-off, more general than the one postulated by Abdus Salam [4,5,6,7], derives from Planck's formula, which origin, all experimental, is indisputable.

This implicates that if the conjecture of Abdus Salam is true [4] according to which the gravity (even it affected by analogous singleness) it can avoid and stop the coulombian singleness, it's not to exclude that the dynamic cutt-off deriving from it (1.45) can also have its gravitational component.

Bibliography

[1] G. Castelfranchi **Fisica Moderna Atomica e Nucleare pag. 593** HOEPLI

[2] W. Heitler **The Quantum Theory of Radiation,** Oxford Press pag. (27)

[3] H. Knoepfel **Alte densità di energia in laboratorio** Annuario EST 1973

[4] C.J. Isham, Abdus Salam **Gravitazione ed elettrodinamica quantistica** Annuario EST 1973;

[5] C.J., Salam A., Strathdee J., **Infinity suppression in gravity-modified quantum electrodinamics**, in Physical Review, D3, 1805 (1971);

[6] C.J., Salam A., Strathdee J., **f-dominance of gravity**, in Physical Review, D3, 867 (1971);

[7] C.J., Salam A., Strathdee J., **Momentum space behaviour of integrals in non-polynomial lagrangian theories,** in Physical Review, 3296 (1970);