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The Correlation of the Fine Structure Constant with the Redistribution of Intensities in Interference of the Circularly Polarized Compton's Wave

(The Possible Solution of the 20-th Century Mystery [1])

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Key words: Fine Structure Constant, Elementary Charge, Huygens – Fresnel's principle, Compton's Wave, Elementary Particle, Standard Model.

Abstract: It is shown that the Fine Structure Constant is correlated with the redistribution of intensities in the interference of circularly polarized Compton's wave, in classical representation. The theoretically obtained number coincides with measured value of α in the accuracy range of last measurement: 10^{-10}

1. INTRODUCTION

As known, there are no theoretical or conceptual interpretations of the nature of Fine Structure Constant $\alpha \approx 1/137$ in contemporary physics. According to standard formalism, its value can be obtained exclusively by experimental measurements. We will just remind that many of genius physicists (such as P. Dirac and R. Feynman) had attempted to determine α theoretically; which continues to be an open question. It is possible to judge the extreme importance and all the complications related to this dimensionless constant from [1]. The continuous attempts of representing α by means of artificial combinations of other known constants (numerological representations, etc.) are not considered as theoretical interpretations. We can refer to Feynman's known critical remark [2] on this question. The unsuccessful efforts to deduce this important number from quantum theories or from other fundamental physical constants of a microcosm analytically, force us to look back to the wavy phenomena and classical representations. We have looked at the problem of Fine Structure Constant in conjunction with the global problem of revealing the physical essence of the elementary particles, since it appears indivisible from those, as their deep property. Mentioning the large circle of phenomena in microcosm where α participates as an important parameter, we will bring the expressions below, related to description of Hydrogen's atom, which help us to realize the essence of this constant. Using known relations $e=(2\varepsilon_0\alpha hc)^{0.5}$ and $m_e=h/c\lambda_e$ we can express the speed of an electron (v_0) on the first Bohr's orbit, the orbit's radius (a_0) and the Rydberg's constant (R) by the following simple expressions, containing α, c and Compton's wave length λ_e of the electron only:

$$v_0 = \alpha c, \quad a_0 = \lambda_e / 2\pi\alpha \approx 0{,}53\cdot 10^{-10}\,m, \quad R = \alpha^2 c / 2\lambda_e \approx 3{,}3\cdot 10^{15}\,s^{-1}$$

From these expressions we can conclude that α is an independent universal numeric constant defining the **dynamical, geometrical** and **wavy** properties of localized particles as well as photons. This conclusion allows us to accept the general principle of "construction" of all kinds of elementary particles and to link $\boldsymbol{\alpha}$ to the unique nature of all possible particles (as localized or non-localized quantum objects) although it seems to contradict to the Standard Model. Our interpretation of Fine Structure Constant corresponds to the wavy-field principle of the substance. Einstein, Schrodinger, Heisenberg and other physicists of past century were convinced supporters of such approach. The large group of experimental, theoretical and cause-logical arguments is pointing on the named concept [3]. We can remark [4] as a recent work pointing to this direction.

The wave-particle duality principle allows us to consider localized particles and photons as wavy formations. In this work it is shown that in the interference of circularly polarized waves a constant relation appears between the intensities. This relation is closely correlated to the value of the Fine Structure Constant.

2. THE STATEMENT AND SOLUTION OF THE PROBLEM

The purpose of the presented work is to prove the following relation:

$$\sum I_m / I \approx 0.085424 \approx e_* = \alpha^{0.5} \approx \sqrt{1/137} \tag{1}$$

Where: I_m is the intensity of m peak. I is the total intensity of interfering waves. $\alpha \approx 1/137$ is the Fine Structure Constant, e_* is the value of the elementary charge in the system of units: $(c = \hbar = 1)$. To prove (1) we represent the elementary particle as a standing wave appearing as a result of interference of Compton's circularly polarized waves. We have chosen described model of particle analogical to the standing de Broglie's wave on the first Bohr's orbit, implementing the following replacements: $l_{orb} = \lambda_c$ (where λ_c is the Compton's wave length) and $v_{orb} = c$. We consider number n of interfering waves as much greater than one, which corresponds to existing classical representations of quanta. We have used handbook equations and vectorial representation to describe the relations between amplitudes and intensities [5].

$$\frac{A_m}{A_0} \approx \frac{2}{(2m+1)\pi}, \quad \frac{I_m}{I_0} = \frac{A_m^2}{A_0^2} \approx \frac{4}{(2m+1)^2 \pi^2} \tag{2}$$

Where: A_m is the amplitude of m peak. A_0 is amplitude of ***0*** – peak (main), m = 1, 2, 3 … n. Since the equation (2) is an approximation, suitable for small angular distribution, we use the Kirchhoff's function, considering amplitude's dependence from direction, according to Huygens – Fresnel's principle [5]:

$$F(\theta) = 0{,}5(1 + \cos\theta) \tag{3}$$

The Kirchhoff's function satisfies conditions: $F(\theta) = 1$ at $\theta = 0$ (maximum of amplitude on direction "forward") and $F(\theta) = 0$ at $\theta = \pi$ (the amplitude becomes zero on direction "backward") (fig. 2). Using (3) in equation (2) we obtain:

$$\frac{A_m}{A_0} \approx \frac{1 + \cos\theta_m}{(2m+1)\pi} \tag{4}$$

According to mentioned condition of interference the angular distance between first and main peaks will be equal to a phase difference of the interfering waves. The angular distances between two consecutive peaks will be consequently decreasing as described further. The angular distribution of the peaks according to initial condition of interference is illustrated in the diagram (fig. 1) where: $\Delta\varphi$ is the average value of a phase shift between interfering waves, $\Delta\theta_m$ is the angular shift of peaks.

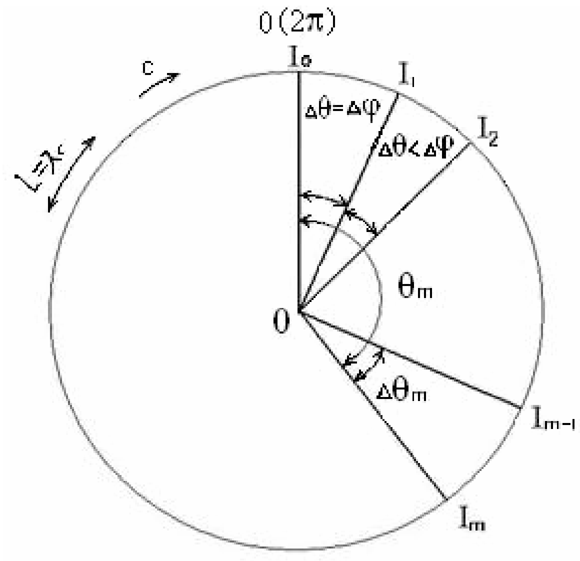

fig. 1

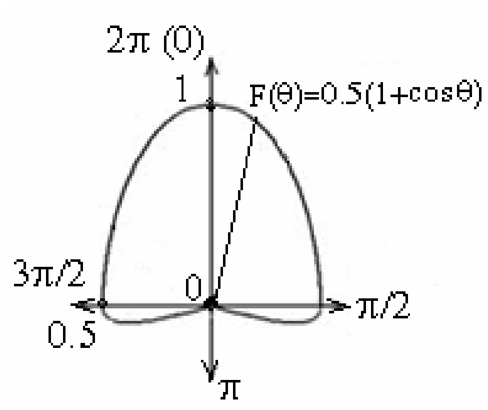

fig. 2

Considering that amplitudes of the secondary peaks differ from each other by *(±2πn)* per phase [5], we can write:

$$\sum I_m = I_1 + I_2 + ... + I_n = A_1^2 + A_2^2 + ... + A_n^2 \quad (5)$$

From equations (4) and (5) follows:

$$\frac{\sum I_m}{I_0} \approx \frac{1}{\pi^2}\sum_{m=1}^{n}\left(\frac{1+\cos\theta_m}{2m+1}\right)^2 \quad (6)$$

Considering that the secondary peaks coincide and differ by *(π/2±2πn)* from the main peak, we can represent the redistribution of intensities by the equation:

$$I^2 = I_0^2 + (\sum I_m)^2$$

From above we can write:

$$\Sigma I_m / I_0 = \tan\Delta\varphi, \ \sum I_m / I = \sin\Delta\varphi, \quad I_0 / I = \cos\Delta\varphi \quad (7)$$

Using (7) from (6) we obtain:

$$\frac{1}{\pi^2}\sum_{m=1}^{n\to\infty}\left(\frac{1+\cos\theta_m}{2m+1}\right)^2 - \tan\Delta\varphi \approx 0 \quad (8)$$

To find the functional link between θ_m and $\Delta\varphi$ we have used the vector diagram (fig. 3).

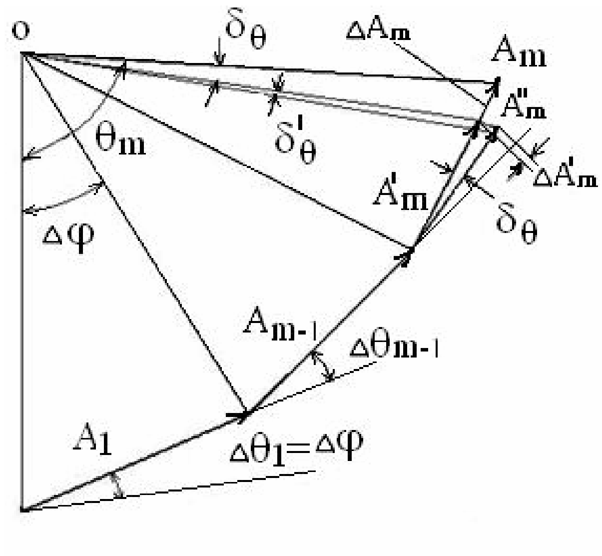

fig. 3.

Applying equation (4) instead of (2), small changes of vectors of interfering waves rise as a function of θ_m. Aftermaths, each angular distance between two peaks also changes as illustrated in the above diagram. With the reduction of the vector A_m according to (4) a respective reduction of the angle θ_m occurs. The change of the angle as a consequence of replacement (2) by (4) is defined as:

$$\delta_\theta \approx \frac{\Delta A_m}{A_0}\Delta\varphi \approx \left[\frac{2}{(2m+1)\pi} - \frac{1+\cos\Delta\varphi m}{(2m+1)\pi}\right]\Delta\varphi \approx \frac{\Delta\varphi(1-\cos\Delta\varphi m)}{\pi(2m+1)} \qquad (9)$$

Using the equation (9) and considering the relative change of angle $\Delta\varphi m$ the equation (4) becomes:

$$\frac{A^1{}_m}{A_0} \approx \frac{1+\cos\ \Delta\varphi m(1-\delta_\theta/\Delta\varphi m)}{(2m+1)\pi} \qquad (10)$$

Simultaneously, as a consequence of reduction of angle between directions A_m and A_{m-1}, the vector $A^1{}_m$ will slightly turn to the right, as a result of which it will become $A^{11}{}_m$. For this reason the projection of $A^{11}{}_m$ on A_{m-1} increases, that leads to relative increase of their sum by value: $1+(\delta_\theta/\Delta\varphi m)^2$. This factor leads to new small change of the angle and brings new small increase of the sum of the vectors. We can continue this reasoning infinitely which brings to amendments in the form of McLaurin's flows, for the angle and for the vector accordingly:

$$(\Delta\varphi\ m)^1 = \Delta\varphi m - \delta_\theta[1+(\delta_\theta/\Delta\varphi m)+(\delta_\theta/\Delta\varphi m)^2+\cdots+(\delta_\theta/\Delta\varphi m)^n] = \Delta\varphi m - \delta_\theta/(1-\delta_\theta/\Delta\varphi m)$$

$$A_m^{11}/A_m^1 = 1+(\delta_\theta/\Delta\varphi m)^2+(\delta_\theta/\Delta\varphi m)^4+\cdots+(\delta_\theta/\Delta\varphi m)^{2n} = 1/\left[1-(\delta_\theta/\Delta\varphi m)^2\right] \qquad (11)$$

Considering relations (11) we have replaced θ_m in (8) resulting to below equation:

$$\sum_{m=1}^{n\to\infty}\left(\left[\frac{1+\cos[\Delta\varphi m-\delta_\theta/(1-\delta_\theta/\Delta\varphi m)]}{(2m+1)}\right]\times\left[\frac{1}{1-(\delta_\theta/\Delta\varphi m)^2}\right]\right)^2 \approx \pi^2\tan\Delta\varphi \qquad (12)$$

Where: $\delta_\theta \approx \Delta\varphi\ (1-\cos\Delta\varphi m)/\ (2m+1)\ \pi$ (9)

By method of insertion, using the numeric calculation, the value satisfying above equation has been found:

$$\Delta\varphi \approx 0.085528781 02 \qquad (13)$$

According to representation (7), using the result (13) we obtain:

$$\sum I_m / I = \sin\Delta\varphi \approx 0.08542454286 \approx e_*$$

This value in the achieved accuracy range of measurements coincides with the elementary charge in relative units and corresponds to the value of Fine Structure Constant:

$$1/\sin^2\Delta\varphi \approx e_*^{-2} \approx 137.0359999 \approx 1/a \qquad (14)$$

Here are results of last measurements of ***1/ α***:

$$1/a \approx 137.0359990 \div 137.0359998 \qquad [6, 7]$$

3. PROPOSAL OF AN EXPERIMENTAL MEASURE OF *α* AS AN INDEPENDENT CONFIRMATION OF THE CONCEPT

The proposed concept of Fine Structure Constant demands some correction in the distribution of intensities. According to initial equations (2) we can obtain:

$$\Sigma I_m / I_0 = \tan\Delta\varphi \approx \sum_{m=1}^{n\to\infty} \frac{4}{\pi^2(2m+1)^2} \approx 0{,}094715. \qquad (15)$$

This value corresponds to *Δφ ≈ 0.094433…* that differs from (13). The task of experiments should be to define the actual value of *Δφ* and, by the same to check the accuracy of deduced results (13), (14). For such measurements we propose to use Fraunhofer's Single Slit Diffraction. The total intensity of the beam of light and intensity of main peak are necessary to establish by experiment: using photometric measurements with the same (P) photometer (or two calibrated ones) behind the slits S1 and S2 (fig. 4). It is necessary to define the constant relation between its values. The exactness of results will be conditioned by exact coincidence of the sizes of the slit S2 with the displayed sizes of main peak of interference. (The direct measurement of the total intensity of secondary peaks for a full angle of redistribution seems difficult from technical viewpoint).

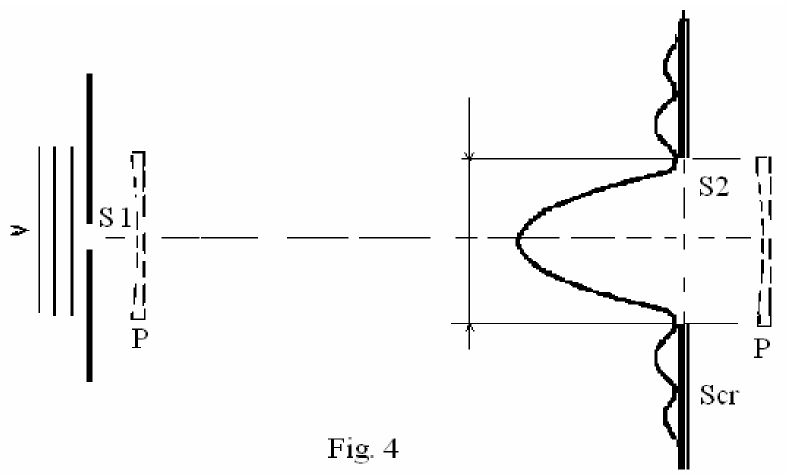

Fig. 4

By measured values of I_0 and I we can define: $I_0 / I = cos\Delta\varphi$

For the cause (15) that will be: $I_0 / I \approx 0.995544...$ (16)

For the cause (13) that should be: $I_0 / I = cos(arcsin\ \boldsymbol{e}_*) \approx 0.996344...$ (17)

The relative difference of two numbers is about $\delta \approx 8*10^{-4}$ which seems possible to measure with implementation of contemporary collaboration technique. The experimental confirmation of (17) will demonstrate the wavy origin of the elementary charge, as well as the localized particle in general.

Calculation:

The purpose of calculation is to confirm the equation (12) for the value of $\Delta\varphi$ (13)

1. We count up the right side of equation (12):

$$\pi^2 \tan(0.08552878102) \approx 0.84619960586 \quad (1a)$$

2. We applied the following program designations filling columns in a simple contest of EXCEL sheet, according to the equation (12):

A1 = *m* = 1, 2, ……100000

B1 = $\Delta\varphi$ **= 0.08552878102**

C1 = δ_θ **= B1*(1-COS (B1*A1))/((2*A1+1)*PI ())**

D1 = $\delta_\theta/(1-\delta_\theta/\Delta\varphi m)$ **= C1/(1-C1/(A1*B1))**

E1=(1+COS(A1*B1-D1))/((2*A1+1)*(1-POWER (C1/(A1*B1), 2)))

F1 = POWER (E1, 2)

3. We counted up the sum of column **F** for the first 10^5 members only:

$$\sum_{m=1}^{100000} F_m \approx 0.846195855824 \quad (2a)$$

4. We defined the value of remaining member $R_{100000-\infty}$ of a flow (2a) as follows:

Noticing, that a descending flow (3a) is asymptotical for the same in (12), we defined its sum for an interval $(1 \div \infty)$. For this purpose we preliminary opened it in the following form:

$$\sum (2/2m+1)^2 = 4\left[\sum 1/m^2 - \sum 1/(2m)^2 - 1\right] = 4\left(0.75 \sum 1/m^2 - 1\right) \quad (3a)$$

The sum of standard flow (4a) is presented in textbooks:

$$\sum 1/m^2 = \pi^2/6 \approx 1.6449340668 \quad (4a)$$

In view of (4a) from (3a) we got:

$$\sum (2/2m+1)^2 = 0.9348022005446 \quad (5a)$$

We counted up the sum of (5a) for the first *100000* members only:

$$4\sum_{m=1}^{100000} 1/(2m+1)^2 = 0.934792190 6 \quad (6a)$$

By difference (5a) and (6a) we found the remaining member of the flow (6a): $R^1_{100000-\infty} \approx 1.00100*10^{-5}$. We count up the sums for *10000* members for both flows (2a) and (5a) for an interval: $m = (90000 - 100000)$: $S_{90000-100000} \approx 4.167776*10^{-7}$, $S^1_{90000-100000} \approx 1.11200*10^{-6}$. We defined their ratio: $k = S/S^1 \approx 0.374800$.

This number corresponds to the average ratio of members of two flows with identical numbers, in cause m>>*1*. The residual members of two flows will have the same ratio. Further to this, we can define a residual member of the first flow:

$$R_{(100000 \leftrightarrow \infty)} \approx k * R^1_{(100000 \leftrightarrow \infty)} \approx 0.374800 * 1.00100 * 10^{-5} \approx 3.7500 * 10^{-6} \quad (7a)$$

We define the sum of the first flow by adding (7a) to (2a):

$$\sum_{m=1}^{\infty} F_m \approx 0.846195855824 + 0.0000037500 \approx 0.846199605824$$

This result does not differ from (1a) by 10^{-10} accuracy, which was required to prove.

Conclusions and discussion:

1. It is revealed that there is a constant relation concerning exclusively to a wavy properties, which has not been considered yet. Its value correlates with the electromagnetic coupling constant α, which is currently conceptually inexplicable. The obtained coincidence could confirm the beliefs of famous physicists of past century in the field-wavy nature of all possible elementary particles, as different kinds of wave formations.
2. According to this identification, the universality of α and its participation in the extremely large group of phenomena in microcosm become obvious; as the constant exposing the wavy-dynamic character of substance (analogical to π). The mentioned circumstance indirectly confirms the suggested interpretation.
3. The absolute stability of α becomes clear, which means that it is really "a constant" and it can't vary with the time, as some researchers are inclined to see.
4. This interpretation shows the deep roots of wavy-corpuscular duality principle and its applicability at the level of quantum electrodynamics.

It points on the unique nature of material world and on the possibility of unifying quantum and the classical representations, although it seems unimaginable from nowadays dominating formalistical viewpoints. This approach may open an alternative way to study the microcosm, independent from the currently developing Standard Model. By the same, it may provide physical meaning to formal-mathematical and phenomenological theories.

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References:

1. James G. Gilson, Fine Structure Constant, http://www.maths.qmul.ac.uk/~jgg/page5.html
2. Richard P. Feynman, "QED: The Strange Theory of Light and Matter", ISBN 069102417
3. G. Kirakosyan, "Natural representation the basis of a substance" (*Rus*.), Yerevan 2009, ISBN 978-9939-53-444-2
4. Massimo Auci, Guido Dematties , "An Approach to Unifying Classical and Quantum Electrodynamics", http://arxiv.org/ftp/arxiv/papers/0901/0901.2752.pdf // International Journal of Modern Physics B, Vol. **13**, No 12 (1999), 1525-1557
5. B. M. Yavorsky, A.A. Detlaf, "Directory of the Physics" (*Rus.)*, Science 1985, BBK 22.3 – Я 22 – УДК 53
6. D. Hanneke, S. Fogwell and G. Gabrielse,"New Measurement of the Electron Magnetic Moment and the Fine Structure Constant" , Phys. Rev. Lett. **100**, 120801 (2008) and arXiv:0801.1134v1 [physics.atom-ph].
7. G. Gabrielse, D. Hanneke, T. Kinoshita and others, "New Determination of the Fine Structure Constant from the Electron g Value and QED"- *Phys. Rev. Letters* **97**, 030802 (2006).