LETTERS TO PROGRESS IN PHYSICS

Take Fifteen Minutes to Compute the Fine Structure Constant

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This note complements the calculus of the fine structure constant provided in [2] in agreement with the theory of mass/resonances developed therein. It shows that the value of α can be predicted from geometry using a) the assumption of integral resonances, b) de Broglie's thesis, and c) the Wheeler-Feynman absorber theory and its time-symmetry; hence independently of precision measurement.

1 Introduction

Using Quantum Electro-Dynamics (QED), precise measurement of the electron magnetic moment anomaly enables to compute the value of the fine structure constant.

In this note, we show that the resulting value of α pulls us back almost to square one, namely Bohr's model and de Broglie's thesis, since the assumption of integral resonances used in [2] and its use of the Wheeler-Feynman absorber theory [5], [6] give the same result, straight from geometry.

2 The calculus

In order to complete the calculus, we shall need two assumptions used sequentially:

- All elementary particles are integral-number based resonances of physical currents. We uses the verb "to be" in its full sense: there is nothing else to deal with.
- The Wheeler-Feynman absorber theory [5], [6], is close to the right picture. The universe expands in a 4^{th} spatial dimension and we live at some sort of boundary or membrane that expands spherically. Up and Down-time currents exist making particles.

Now according to de Broglie [1] the phase coherence of the wave gives the Bohr orbits. Second, consider the first orbit and imagine the figure, a helicoid, in x, y, t. Considering a system of unit where the Bohr radius is 1 in x, y, and its Compton frequency is 1 on the time axis, the helix length is:

$$L_h^2 = 137^2 + (2\pi)^2.$$

According to the assumptions, this expression is the effect of a resonance, but α is the coupling of the electron with the field; therefore it is the amplitude *and the geometry* from which L_h develops. Since $\alpha < 1$, we necessarily have:

$$\alpha \leftarrow L_h^{-1}.$$

But the electron makes one turn when the helix makes two turns. With respect to the electron "being" a resonance, its rotational path length must be reduced by half and we get a resonance length:

$$L_r^2 \approx 137^2 + \pi^2.$$

Now we need to take into account the wavelength h/p as part of the electron resonance. According to de Broglie, its phase velocity is $V = c^2/v$, with v the electron velocity; here distances are inverted and velocity dependent. Its length around the proton is then $1/274$ (the electron phase repeats every 274 Compton periods). But when the wave makes one turn the electron progresses; therefore the resonance makes 275 turns when the electron resonance makes a full turn. The wave misses 1 turn over 275, which gives a negative term:

$$L_r^2 \approx 137^2 + \pi^2 - \frac{1}{275}.$$

Here the negative term is not squared. The explanation is a little less trivial than the rest of the calculus. Denoting a_n the radius of the n^{th} Bohr orbit and λ_{dn} the associated de Broglie wavelength, we have:

$$a_n = n^2 a_0; \lambda_{dn} = n \lambda_{d0}.$$

Those quantities are physical. The round trip of the wave is $n \lambda_{dn} = n^2 \lambda_{d0}$ and corresponds to quantized angular momentum; at the opposite, the same trip includes $137\, n^2$ Compton periods. Therefore a different treatment is needed for 137 and $1/275$. The former is squared in (1) and associated to n^2; then since the latter is associated to n, it cannot be squared; otherwise this expression would be orbit dependent in n. This is the physical aspect, it means that on any Bohr orbit we can use a system of units in the space dimensions where $n^2 a_0 = 1$, and the de Broglie wavelength and its angle (its phase velocity) defines the unit for $V > c$. We end-up with a system of units which is entirely defined by de Broglie's geometry, where all quantities are defined by h or $\hbar$, and the electron mass.

Let us now use the second assumption. The field is time-symmetrical for an observer which is fixed in time (this is also the perspective of QED). Time symmetry implies that the electron is composite of up and down-time currents: Up-time $= -e/2$, down-time $= +e/2$. Those currents are centered like the electron resonance (on the helix) and manifest an electric charge which contribution (sign) depends on their own sign and time-orientation. Their interaction gives $(-e/2)(+e/2) = -e^2/4$, which compares to $-e^2$, the interaction electron-proton.

We must apply the same reasoning to the wave; by symmetry it is also composed of two currents of opposite directions, but of identical charges, centered on the electron. Then we just add $1/4$ as follows:

$$L_r^2 = 137^2 + \pi^2 - \frac{1}{275}\left(1 + \frac{1}{4}\right). \quad (1)$$

Last we compute the inverse of this length to get α:

$$(1) \rightarrow L_r^{-1} = 7.29\,735\,256\,656\,433\, e^{-3}. \quad (2)$$

Compare with CODATA 2014:

$$\alpha = 7.29\,735\,256\,64\,(12)\, e^{-3}. \quad (3)$$

The difference is on the last digit and $1/7^{th}$ the uncertainty.

You can stop your chronometer.

3 Conclusions

The fine structure constant was computed from de Broglie's geometry under the following assumptions:

- The electron "is" an integral resonance,
- The existence of symmetrical currents, where we see the signature of a resonant system,
- Asymmetry in currents between space and time, which is implicit in the reasoning.

This result completes the calculus provided in [2] where a logical origin of 137 is uncovered.

Interestingly, it was possible to predict this value of α about 70 years ago pushing Wheeler-Feynman's absorber theory to its natural consequences in terms of time-symmetry, since $\alpha \approx 1/137$ was known.

By the way, it also requires to use de Broglie's geometry in its full extent; not only the wavelength $\lambda_d = h/p$, but also the phase velocity $V = c^2/v > c$ for which no experimental verification exists. We showed that this velocity is consistent with the current best estimate of α.

Last but not least, the coefficient $1/4$ in (1) addresses the wave compositeness; an aspect of importance, or rather a possibility meaning the incompleteness of wave mechanics, quantum mechanics and field theory.

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