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The proton radius precisely measured from the fine-structure constant

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Abstract
Official physics is still debating about the exact value of the proton radius, estimated to be between 0.84 and 0.87 fm depending on the measurement methodology. In 2013, Nassim Haramein, with his holographic theory, published a formula giving an excellent estimation of proton radius. In a recent paper, the author confirmed Nassim Haramein's theoretical formula, using a different approach based on Ether physics. This formula can be used in the definition of the fine-structure constant to get a very precise measure of the proton radius confirming the validity of the theoretical value up to 11 significant digits.

Keywords
Ether Physics, Quantum Physics, Particle Physics, Proton radius

Introduction

Nicolas Tesla was one of the most ardent opponents of Einstein's hypothesis used to build his general relativity theory that will also be used as a foundation for Quantum Physics, arguing that *"All literature on this subject is futile and destined to oblivion. So are also all attempts to explain the workings of the universe without recognizing the existence of the ether and the indispensable function it plays in the phenomena"*.
In a series of papers, the author has demonstrated that gravity, electromagnetism, mass, the strong nuclear force, the famous equation $E=m.c^2$, the escape velocity of a celestial body and the drift of Mercury's perihelion can be derived from the presence of an Ether pressure field.
In a recent paper, the author confirmed the theoretical formula of the proton radius published by the physicist Nassim Haramein in 2013, and this theoretical value will now be confronted to experimental values obtained with two different methods :

- the proton charge radius measurement method published in 2010 by an international research team using the Lamb shift in muonic hydrogen
- a new method derived from the fine-structure constant definition and its official CODATA value obtained with accurate measurement up to 11 significant digits.

Background

Until 1905, vacuum was considered full of ether although Michelson and Morley officially failed to demonstrate its existence in 1887, with their assumption of Earth moving in a fixed Ether. But according to Ref [1] page 57, they measured an Ether wind between 5 and 7.5 km/s while Dayton Miller, a physicist that continued and improved the measures, published in 1928 his results obtained at Mount Palomar that were between 9.2 and 11.3 km/s (Ref [1], page 109).

Ref [7] demonstrates that the assumption that gravity is the gradient of Ether pressure brings the same results concerning the variations of coordinate ct as the Schwarzschild metric, solution of Einstein's equation for a non-rotating and isolated star, at the difference that c varies instead of t.

Then Ref [8] shows that gravitation obeys to the laws of Fluid Mechanics, in the same manner than James Clerk Maxwell's theory of electromagnetism (Ref [3]).

Official science states that particles have no intrinsic mass, but get their mass by the coupling with the Higgs field of the vacuum. Ref [9] based on Ref [4] paragraph 678, reminds that an accelerated body plunged into a perfect fluid under pressure P behaves as if it had an additional apparent mass, due to the resistance of the pressure forces to the acceleration of that body.

In addition, Ref [10] shows how famous Einstein's equation $E=mc^2$ can be easily derived from ether energy density outside a particle, confirming Nikola Tesla's statement "*There is no energy in matter other than that received from the environment*".

Finally, Ref [11] brought recently a confirmation of the theoretical formula published by Nassim Haramein [Ref 2] :

$$m_p r_p = \frac{4\bar{h}}{c} = \frac{2h}{\pi c} \qquad (1)$$

Based on the official values of m_p, h, c published in [Ref 12] :

m_p = 1,672 621 923 69(51) 10^{-27} kg
h = 6,626 070 15 10^{-34} Js
c = 299 792 458 m/s

The theoretical value of r_p is :

$$r_p = 0{,}841\ 235\ 641\ 34(26) \text{ fm} \qquad (2)$$

The number in parentheses is the one-sigma (1 σ) uncertainty in the last two digits of the given value.

Experimental verification of the radius of the proton

Ref [12] teaches us that in 2010, the official value given by CODATA for the radius of the proton was 0,877(7) fm but that a new method of measurement was used by an international research team using the Lamb shift in muonic hydrogen and found a lower value of 0,841 84(67) fm, incompatible with previous CODATA value.

Since 2010, 5 new measurements have been published, and table 1 summarizes theses measures.

Date	value	sigma	value-1σ	value+1σ
2010	0,84184	0,00067	0,84117	0,84251
2013	0,84087	0,00039	0,84048	0,84126
2017	0,8335	0,0095	0,824	0,843
2018	0,8414	0,0019	0,8395	0,8433
2019-1	0,833	0,01	0,823	0,843
2019-2	0,831	0,012	0,819	0,843
common range	0,841215	0,000045	0,84117	0,84126

Table 1 : Published measurements of proton radius since 2010

All these 6 measurements have a common range. The low value of this range is given by the highest "value-1σ" while the high value of this range is given by the lowest "value+1σ". The central value is then 0.841 215 fm and the uncertainty is half of this range width, ie 0,000 045 fm.

It is easy to see that the theoretical value r_p = 0.841 235... fm given in (2) falls within this common range.

But the theoretical formula found in (1) can also be used to take benefit of accurate measurements of another physical constant named the fine-structure constant, also known as α . This constant has been measured experimentally with a very high precision of 11 significant digits.

Ref [13] gives the theoretical formula for this constant, which is a dimensionless constant :

$$\alpha=\frac{e^2}{4\pi\epsilon_0\hbar c} \qquad (3)$$

The meaning of this constant is not fully understood by modern physics and will be addressed at the end of this paper.

From (1) and (3) we get :

$$\alpha=\frac{e^2}{4\pi\epsilon_0\frac{\hbar}{c}c^2}=\frac{e^2}{\pi\epsilon_0 r_p m_p c^2} \qquad (4)$$

Thus :

$$r_p=\frac{e^2}{\pi\epsilon_0\alpha m_p c^2} \qquad (5)$$

We obtain a new formula for r_p that can be evaluated with the CODATA values of these constants as given in Ref [13] :

e = 1,602 176 634 10^{-19} C
ϵ_0 = 8,854 187 8128(13) 10^{-12} F/m
α = 7,297 352 5693(11) 10^{-3}

In the CODATA values, e, c are given with exact values (ie no uncertainty) and ϵ_0, α, m_p are given with at least 11 significant digits, so we will retain only the first 11 significant digits for r_p . The computed relative uncertainty for r_p is the quadratic value of the 3 relative uncertainty for ϵ_0, α, m_p and equals 37 10^{-11}.

Thus, from (5), it comes :

$$r_p \;=\; 0{,}841\ 235\ 641\ 34...\ \text{fm} \qquad (6)$$

and its absolute uncertainty is 31 10^{-11} fm, so :

$$r_p \;=\; 0{,}841\ 235\ 641\ 34(31)\ \text{fm} \qquad (7)$$

to be compared with (2) where we got :

$$r_p \;=\; 0{,}841\ 235\ 641\ 34(26)\ \text{fm}$$

So, here we have two independent methods that give the radius of the proton with an accuracy of 11 significant digits !

Physical meaning of the fine-structure constant

According to Ref [13], the fine-structure constant has several physical interpretations. A new one is emerging from (4).

Let us call E_p the potential electrostatic energy of an elementary charge at the surface of the proton and E_m the mass energy of the proton :

$$E_p = \frac{e^2}{4\pi\epsilon_0 r_p} \qquad (8)$$

$$E_m = m_p c^2 \qquad (9)$$

From (4), it comes :

$$\alpha = 4\frac{E_p}{E_m} \qquad (10)$$

Conclusion

The theoretical value of the proton radius found thanks to Ether physics as described in Ref [11] is validated by experimental measurements of the fine-structure constant, that allows to derive the same value of the proton radius up to 11 significant digits. Furthermore, this casts new light on the physical meaning of the fine-structure constant as a ratio between the potential electrostatic energy and the mass energy of a proton to within a factor of 4.

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