Magnetic Anomaly in Black Hole Electrons

D. Di Mario

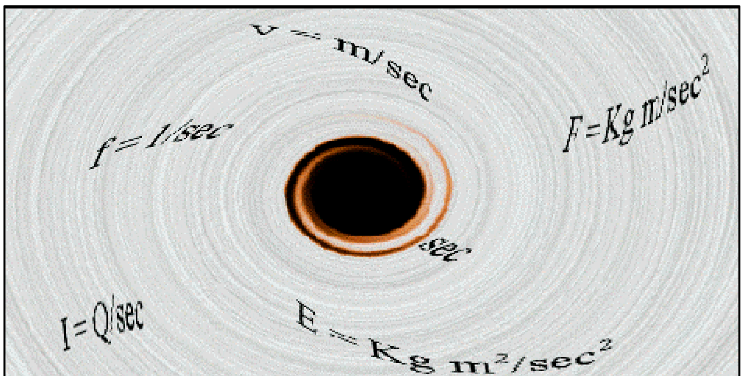
=============

A model for a black hole electron can be developed starting from three basic constants: h, c and G. The result is a comprehensive description of the electron with its own associated mass and charge. The precise determination of the rotational speed of such a particle yields accurate numbers, within one or two standard deviations, of all quantities, including one of the most critical characteristics of the electron: its magnetic moment and its magnetic moment anomaly.

=============

Introduction

When we approach a black hole strange things start to happen: time dilation is one of them. What takes place if we go further on, beyond the event horizon, is anybody's guess: our present knowledge does not go that far and we are left only with a number of educated suppositions. One of them is that time does not exist within a black hole, rather it seems to disappear in it. Conversely why not think that a time dimension will appear coming out from what should be seen, more appropriately, as a singularity? Of course, here we mean a force field rather than a material object. The result might be a change of dimensions for some of the quantities because we will use only the three basic dimensions of mass, length, and time without introducing the dimension of charge, yet the resulting numbers are the ones we are accustomed to see. In this way we will be able to link the Planck data with our real world.



In a black hole time loses its meaning and know quantities might show strange dimensions: time itself might become a dimensionless number in a black hole and vice versa. By working our way out from the black hole we discover that the particle is the electron.

This is evident when we calculate a quantity never considered before, the Planck permittivity ε_p [1]. But first we define the other Planck quantities, i.e., Planck time $t_p = (\pi hG/c^5)^{1/2}$, Planck mass $M = h/t_p c^2$ and Planck length $l_p = t_p c$. The resulting quantities differ by $2^{1/2}$ or $2^{1/2}\,\pi$ from accepted numbers, however we do not know the intimate structure and geometry of this particle, and it is just a matter of definition. We are now able to define the Planck permittivity:

$$\varepsilon_p = (t_p / 4\pi^2)^{1/4} \qquad (1)$$

The unusual dimension of the Planck permittivity allows us to build a basic particle, the electron, by means of the fundamental dimensions of mass, length, and time only. The calculation of the Planck charge Q is now relatively easy and it is defined as the charge having the same energy as the Planck mass M:

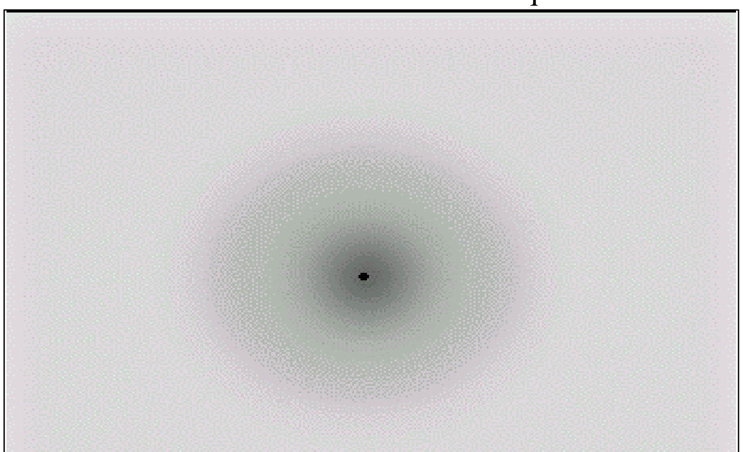
$$Q = M (4\pi \varepsilon_p G)^{1/2} \qquad (2)$$

It is time now to check whether this particle with mass M, charge Q and permittivity ε_p is indeed a black hole.

=============

Planck Black hole

The discriminant in the Kerr-Newman equation will tell us whether our particle is a black hole or not. If we do all necessary calculations we find that such a particle satisfies the condition imposed by the discriminant for a static as well as a rotating black hole. Under the present circumstances, we cannot, as yet, identify this particle with the electron but let us see first how this black hole is measured in our real world.



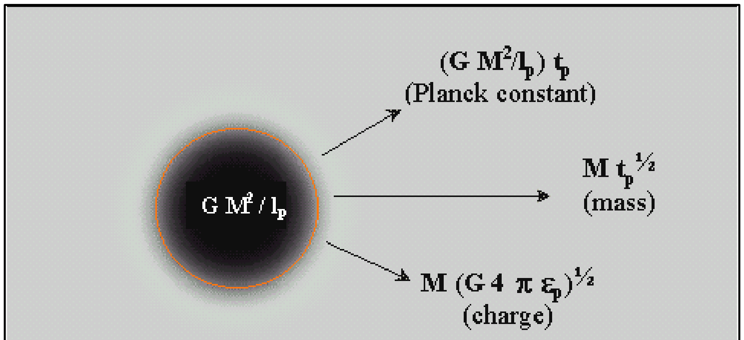
The Planck's black hole could be rendered by a tiny black dot surrounded by a spherical energy field. In this basic model there is a charge but no rotation. Its characteristics makes it a successful candidate for a Kerr-Newman black hole.

The energy of the Planck black hole is given by GM^2/l_p, but the constrain of time t_p outside the black hole would give us something slightly different, the Planck constant in fact:

$$h = (G M^2 / l_p)\, t_p \qquad (3)$$

Although this may seem obvious because the Planck constant was used initially to calculate the other Planck quantities, it is the concept behind it that should be considered: we will never be able to measure the gravitational black hole energy because there is the Planck time which imposes a severe constraint on what we really measure and experience from our reference frame outside the black hole. Here is the first important consequence: if we write eq. 3 in a different way we get $h = G(M\, t_p^{1/2})^2/l_p$. This simple rearrangement of terms shows that there might be a quantity $M_0 = M\, t_p^{1/2}$ which would be the apparent gravitational mass of the Planck particle; in other words, we would only experience mass

M_0 and not mass M because M_0 is the only mass that takes in account the effect of time t_p. Now it should come with no surprise that if we use M_0 in the Kerr-Newman discriminant we will not get a black hole. We are still talking about the very same particle but its mass will be much smaller when seen from our frame of reference. The idea of a black hole electron is not new: other researchers have thought about it in the past [2] while others were quick to point out that it does not satisfy the Kerr-Newman condition. We have seen that it is a black hole after all, but its detectable mass would be M_0 and not M as expected.



Just as we lose the time dimension in a black hole, we gain it when we go out of it. The Planck time is present in the energy of the black hole thus originating the Planck constant, in the same way we have a mass and a charge. They will be both identified with the mass and charge of the electron once rotation is taken in account.

In any case, the effect of mass M is still present in our real world, not as a gravitational mass but as an electric charge because we would experience it as an electric force, originating from a certain charge Q.

The numbers for charge Q and mass M_0 are an order of magnitude larger compared to the known charge and mass of the electron, while permittivity ε_p is a fraction of a percent off: they will agree once rotation is taken in account.

=============

Spinning black hole

The most suitable physical model that best fits a rotating black hole is the ring model [3,4]. Although there is no direct evidence, there is more than one reason to believe that some sort of toroidal force field is present around the tiny black hole. Fortunately we do not have to know its radius or other data concerning its physical size since the equations in use will eliminate any reference to it and its real size, in this context, is still undetermined.

A rotating charge will set up a magnetic field opposing its own rotation until a stability point is reached. The rotational speed u_0, meant as the speed of the ring, is a fundamental parameter and using a slightly modified equation originally proposed by Sutton and al. [5], we define a relativistic connection with what we would call the initial fine structure constant α_0:

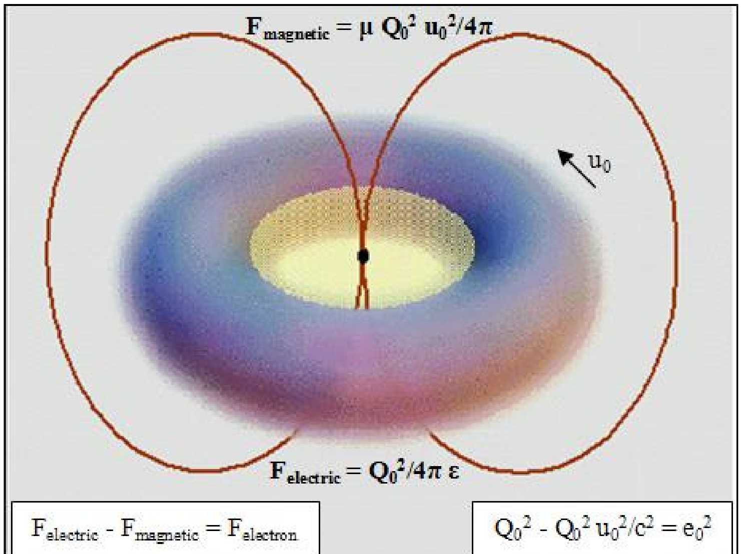
$$\alpha_0 = 2\,(1 - u_0^2 / c^2) \tag{4}$$

In order to calculate u_0 we try to relate α_0 to some electrical properties of the particle and specifically how charge Q compares with a ring of unitary charge Q_u. We define α_0 as the ratio $(W_u / W_p)^{1/2}$ where $W_u = 16\pi^4 Q_u^2 / t_u$ would be the energy of the unitary charge in the unitary time applicable to a toroidal particle and $W_p = Q^2 / t_p$ would be the energy of charge

Q within time t_p, however the ratio could have other meanings as well. After elaboration we may write α_0 in terms of fundamental quantities only:

$$\alpha_0 = 4\,\pi^2\, t_p^{1/2} / Q = (2\,\pi^2 / c)\,(\pi / c)^{1/2}\,(2\,G / h)^{1/4}\,(c / \pi\, h\, G)^{1/16} \qquad (5)$$

With the knowledge of speed u_0, hence the fine structure constant, we are able to go deeper into the details of the ring model. Its rotation at relativistic speed will slightly increase the energy associated with charge Q. At this energy level there is a corresponding charge $Q_0 = Q\, c/u_0$ which will originate the initial electron charge $e_0 = Q_0(\alpha_0 /2)^{1/2}$, also written as:



The measured electron force is the electric force of charge Q_0 minus the magnetic force generated by the same charge rotating at speed u_0. Its relativistic speed increases the energy associated with charge e_0 by a factor $2/\alpha_0$ to become the energy of charge Q_0 such that $e^2 = Q_0^2 - Q^2$.

$$e_0 = Q / (2 / \alpha_0 - 1)^{1/2} \qquad (6)$$

Q_0 will generate, in turn, a permittivity $\varepsilon = Q_0^2/4hc$ related to a rotating particle. After elaboration of our equations we may write an important relation for the gravitational constant G given in terms of quantum constants only:

$$G = \alpha_0^2\,(2 - \alpha_0)^2\,(e_0 / 4\,\pi^2)^4\, c^5 / \pi\, h \qquad (7)$$

The equation is dimensionally balanced because the factor $4\pi^2$ is actually $W_u^{1/2}$. In addition, the quantity $\alpha_0(2-\alpha_0)e_0^2$ is a constant, in other words we do not expect it to change if there is a slight variation of the rotational speed; this means that eq. 7 is still applicable if we write it in terms of known constants achieved by changing speed u_0 by a small amount, as we will see in the next section. The result is always the same and yields a very accurate constant of gravitation, quite close to experimental data. Conversely, if we extract α_0, we find two values: α_0 and a second value $2-\alpha_0$ which is 273 times larger than α_0.
As far as the electron mass is concerned, if we take in account the relativistic rotation of M_0 we have the initial electron mass m_b in the same way as we had e_0 from Q_0:

$$m_b = M_0\,(1 - u_0^2 / c^2)^{1/2} = M_0\,(\alpha_0 / 2)^{1/2} \qquad (8)$$

The same equation can be rewritten in terms of the initial electron charge:

$$m_b = (8\, h^3 / \pi\, e_0^4)\,(\alpha_0 / 2)^{1/2} / (2 / \alpha_0 - 1)^2 \qquad (9)$$

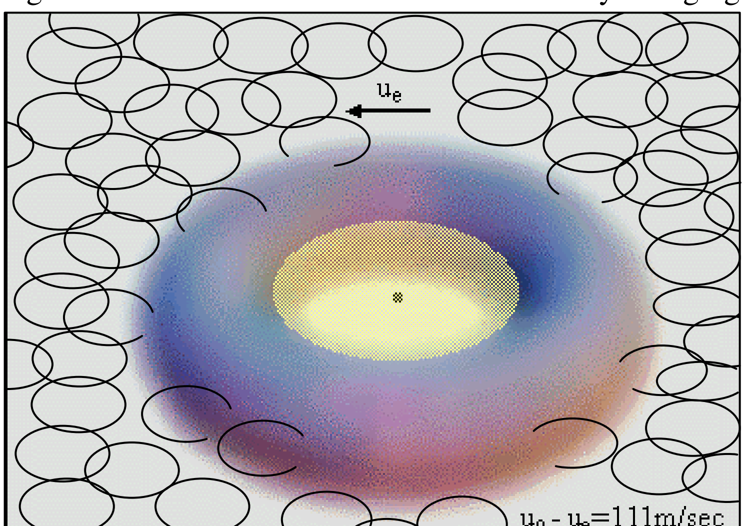
It was with some disappointment that, despite the accurate calculations, it was found that the electron parameters did not quite match the known values. The systematic difference, see table below, was puzzling at first, but then it was realized that what we have been describing so far is just the initial condition and another adjustment is therefore necessary to get the right data.

ppm difference of initial parameters				
Mass	Charge	Fine structure	Permittivity	Magnetic moment
- 1164	*+ 101*	*- 203*	*+ 405*	*+ 105*

The first adjustment is the fact that the size of this particle depends on the rotational speed u_0. The toroidal shape may have up to three different radii: the torus radius and other two radii belonging to the ring section if this is an ellipse. The factor $(1-\alpha_0/2)^{1/8} = (u_0/c)^{1/4}$ will establish by how much each radius has shortened due to speed u_0. The mathematics behind it is still not clear and, for the time being, it should be taken as an empirical factor. The second adjustment is to consider the influence of the vacuum virtual particles on the rotational speed: there seems to be a speed decrease when such interaction is taken in account.

=============

The electron slowdown and magnetic moment



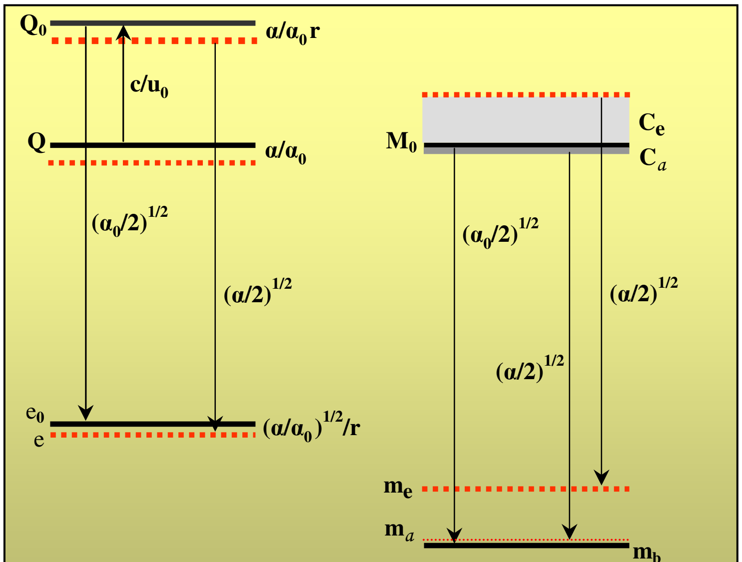
The interaction with virtual particle seems to have the effect of slowing down the rotation of the electron. The slowdown is rather small: only 111 m/s but it is enough to generate the correct electron parameters.

Agreement with known values was achieved by changing the rotational speed u_0. There is indeed a lower speed u_e yielding all expected data. It is conjectured that interaction of this electron with virtual particles has the effect of lowering its rotational speed. By elaborating eq. 7 we get a new cubic equation, see table at the end, giving the known value for α and hence speed u_e in terms of c, h and G only. There is also a more intuitive solution where speed u_0 is decreased until $\varepsilon_0 = 10^7/4\pi c^2$; this is an exact relationship and once such a condition is met we will have also all other quantities although, for the mass, we need to define an additional term. Beyond the radius variation there is also a mass variation proportional to $(\alpha/\alpha_0)^4$. As $M_0=8h^3/\pi Q^4$ we have that any speed variation will change the fine structure constant and hence charge Q, eq. 5, which will affect M_0 with the proportionality factor

$(\alpha/\alpha_0)^4$. For any change of the rotational speed there is a variation of the three radii which would equally influence the electron mass. We will call $C_e=(1-\alpha/2)^{3/8}(\alpha/\alpha_0)^{12}$ the term taking care of the radii and mass variation. Thus the resulting electron mass m_e would be:

$$m_e \;=\; C_e\, M_0\, (\alpha\,/\,2)^{1/2} \;=\; M_0\, (\alpha\,/\,2)^{1/2}\, (1 - \alpha\,/\,2)^{3/8}\, (\alpha\,/\,\alpha_0)^{12} \qquad (10)$$

One wonders whether among the actual data concerning the electron there is any reminiscence of its initial state, before the slowdown. Indeed there is a quantity, the magnetic moment, which confirms that the initial quantities we have seen so far, such as α_0, u_0 and e_0 are real and not just the result of mathematical manipulation. We start by considering the speed variation, from u_0 to u_e, of a point on the ring. The ratio $r = u_0/u_e = ((2-\alpha_0)/(2-\alpha))^{1/2}$ together with the radius shortening factor $(1-\alpha/2)^{1/8}$ and the mass variation $(\alpha/\alpha_0)^4$ could give us, for example, an "anomalous" mass m_a to be placed, instead of the electron mass in the equation giving the electron magnetic moment. For this purpose we first calculate the quantity $C_a = r^{16}(\alpha/\alpha_0)^4(1-\alpha/2)^{1/4}$, then the anomalous mass $m_a = C_a M_0(\alpha/2)^{1/2}$ and finally the electron magnetic moment $\mu_e = eh/4\pi m_a$. Actually there is no need to know the electron charge as μ_e can be calculated directly in terms of Planck quantities and the known fine structure:



A detailed picture is necessary to account for the magnetic moment. Every variation due to the change of velocity originates the ratios α/α_0 and $r = u_0/u_e$. The magnetic moment is connected with these ratios and its accurate calculation is possible once α/α_0 and r are taken in due account. C_e, C_a and the "anomalous" mass m_a are also shown.

$$\mu_e \;=\; (Q\, h\,/\,4\,\pi\, M_0)\, (\alpha_0\,/\,\alpha)^5\, (2 - \alpha)^8\,/\,(2 - \alpha_0)^8\, (1 - \alpha\,/\,2)^{3/4} \qquad (11)$$

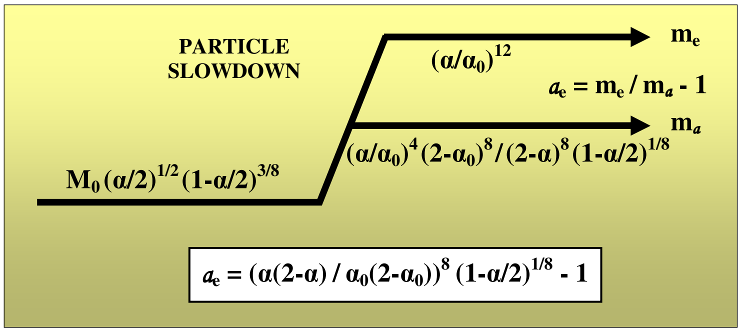
The diagram above shows how the mass variation is related to the charge variation. The black lines represent the initial values relevant to the basic particle while the red dotted lines refer to the final values after rotation and subsequent slowdown.

=============

Magnetic anomaly

The magnetic moment is related to the electron magnetic anomaly and Quantum Electrodynamics (QED) offers a solution [6] where a number of terms lead eventually to the theoretical value of the magnetic anomaly. These terms involve fairly complex calculations and in the end there is a result that closely matches the experimental value.

In this theory the starting point is a black hole, leading to an initial electron with a very accurate mass and charge. Any slight change of the rotational speed brings about a variation of every parameter but they are always in a very well defined relationship. We know the initial and final value of the fine structure constant, the initial and final value of the electron charge, and so on. The magnetic moment was first calculated by means of the anomalous mass m_a or directly with more basic quantities. However we would expect the magnetic moment to be related also to a charge variation. By combining data from eq. 11 and the anomalous mass m_a it is possible to compute exactly the charge variation, from e_0 to e, yielding the magnetic moment anomaly. Eventually we may write an equation for the electron magnetic moment anomaly a_e as a ratio between m_e and m_a, see drawing, or more appropriately, by considering the electron charge variation:



$$a_e = (\alpha (2 - \alpha) / \alpha_0 (2 - \alpha_0))^8 (1 - \alpha / 2)^{1/8} - 1 = (e_0 / e)^{16} (1 - \alpha / 2)^{1/8} - 1 \qquad (12)$$

This last equation gives us a clue on what the magnetic anomaly really is: the variation of the electron charge, from e_0 to e, brings about a change in the magnetic moment that is reminiscent of the particle slowdown. The number for the magnetic anomaly is well within known uncertainties while the magnetic moment shows a difference of 1.8 standard deviations compared to the latest accepted values (Codata 2006). It must be said that a_e is very sensitive to the fine structure constants, both the initial and the final one. This means that they must be given with the highest degree of precision. All relevant calculations were carried out with a 38 digit precision program to ensure self-consistency and a reasonable agreement with known data. The fine structure constants were obtained from h, c and G, the latter being calculated with eq. 7 in order to have a very restricted range of values. Eq. 12 is now a more straightforward solution than the one suggested by QED.

=============

Conclusion

A rotating Planck particle is able to explain all the main electron features. All quantities can be calculated with high accuracy and although the right numbers do not necessarily mean that the theory is correct, (Sir Arthur Eddington knew something about this back in 1919) it is remarkable that there is no need to introduce any other constants but h, c, and G in order to have a reasonable description of the electron.

A summary table is shown below together with the main equations and the resulting numbers. The constant of gravitation was first calculated with known constants and then a refined value was used as part of the initial data, hence the small difference between the value given by the equation and the one adopted.

Initial data		
$c = 299792458$	$h = 6.62606837306 \times 10^{-34}$	$G = 6.67291773245 \times 10^{-11}$
Basic quantities		
Apparent Planck mass M_0	$h / (\pi h G c^3)^{1/4}$	$1.5064683 \times 10^{-29}$
G, with known data	$\alpha^2 (2 - \alpha)^2 (e / 4 \pi^2)^4 c^5 / \pi h$	$6.67291834 \times 10^{-11}$
Initial fine structure const. α_0	$(2 \pi^2 / c) (\pi / c)^{1/2} (2 G / h)^{1/4} (c / \pi h G)^{1/16}$	$7.295873293 \times 10^{-3}$
Initial electron charge e_0	$Q / (2 / \alpha_0 - 1)^{1/2}$	$1.602338233 \times 10^{-19}$
Electron parameters		
Fine structure constant α	Solve: $\alpha^3 - 2 \alpha^2 + 10^{-7} (2 \pi)^5 (\pi G / c^3 h)^{1/2} = 0$	$7.2973525329 \times 10^{-3}$
Mass m_e	$M_0 (\alpha / 2)^{1/2} (\alpha / \alpha_0)^{12} (1 - \alpha / 2)^{3/8}$	$9.10938135 \times 10^{-31}$
Charge e	$Q / (\alpha / \alpha_0) (2 / \alpha - 1)^{1/2}$	$1.602176416 \times 10^{-19}$
Magn. moment μ_e	$(Q h/4\pi M_0) (\alpha_0/\alpha)^5 (2-\alpha)^8 / (2-\alpha_0)^8 (1-\alpha/2)^{3/4}$	$9.28476335 \times 10^{-24}$
Magnetic moment anomaly a_e	$(e_0 / e)^{16} (1 - \alpha / 2)^{1/8} - 1$	0.00115965218103
Rotational speed		
Initial rotational speed u_0	$c (1 - \alpha_0 / 2)^{1/2}$	299245146.458
Final rotational speed u_e	$c (1 - \alpha / 2)^{1/2}$ or: u_0 decreased until $\varepsilon_0 = 10^7 / 4 \pi c^2$	299245035.389
Speed difference Δu	$u_0 - u_e$	111.0690478732

=============

References

1) D. Di Mario, (2003), *Planck permittivity and electron force*, http://digilander.iol.it/bubblegate/planckpermittivity.pdf

2) David Finkelstein, *Black holes*, http://www.valdostamuseum.org/hamsmith/BlackHole.html

3) D. L. Bergman & J. P. Wesley, (1990), *Spinning charged ring model of electron yielding anomalous magnetic moment*, Galilean Electrodynamics, Vol. 2, 63-67.

4) Ph. M. Kanarev, *Planck's constant and the model of the electron*, http://www.journaloftheoretics.com/links/Papers/Kanarev-Electron.pdf

5) C. Spaniol and J.F. Sutton, (1992), *Classical electron mass and fields*, Part II, Physics Essay, vol. 5(3), p. 429-430

6) Peter J. Mohr & Barry N. Taylor, (2000), *Quantum electrodynamics and the fundamental constants,* Electronic journal of differential equations, 4, 231-242, http://emis.kaist.ac.kr/journals/EJDE/conf-proc/04/m1/mohr.pdf