Planck Permittivity and Electron Force

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The Planck permittivity is derived from the Planck time and becomes an important parameter for the definition of a black hole model applied to Planck quantities. The emerging particle has all the characteristics of a black hole electron and a precise evaluation of its gravitational and electric force is now possible.

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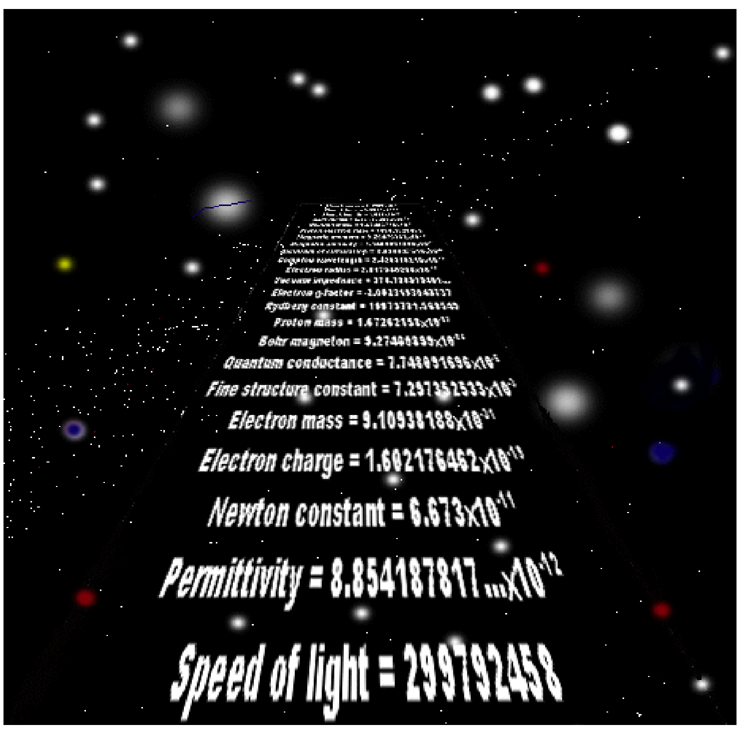
Introduction

Our universe is filled with constants, they regulate our life and we make a continuing effort to improve their accuracy. For most of them we found a reasonable explanation while for others we are still making intelligent guesses. Why we have such specific electron mass and charge? What is the relation of the constant of gravity with other quantum constants? And so forth.



The Planck particle could be the answer to our questions.

If we devise a hypothetical particle with a Planck time $t_p = (\pi hG/c^5)^{1/2}$ and a Planck mass $M = h/t_p c^2$ we have created the basis for a black hole, a Planck black hole, as mentioned in a previous paper [1] on which this present work on the Planck permittivity is based.

The Planck entity was indeed considered in the past as a possible candidate for a particle but its huge difference with any known particle was a major obstacle. In actual fact, what we would experience from our frame of reference outside this hypothetical black hole is not mass M but a much smaller mass $M_0 = Mt_p^{1/2}$. We would not be aware of the $sec^{1/2}$ dimension present in M_0 but it will be always present in any calculation and will have a ripple effect on other quantities. What we are implying is that any force or energy outside the black hole is

dependent on the Planck time. The resulting numbers are the ones we would expect from the MKS system. Paradoxically, if we would introduce the electric dimension we would exclude the possibility to find a link between electricity and gravity. In this respect the cgs system would have been a better alternative, nevertheless we will abide by the MKS system which will give us numbers we all know but we must be prepared to see quantities with different dimensions when dealing with electric parameters.
The most suitable model to represent the Planck black hole is the ring model [2,3], a toroidal force field rotating around a tiny kernel representing our black hole. This model will eventually develop in the electron but first we have to define the Planck charge Q with an energy equivalent to the Planck mass M:

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

In order to find Q we have to find the Planck permittivity ε_p and its definition will give us a better insight in the intimate structure of the Planck particle.

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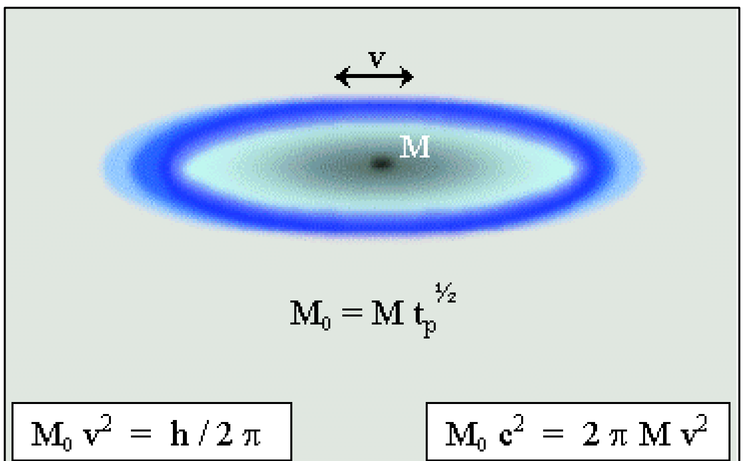
Planck permittivity

In our black hole model we might think that mass M_0 would not stand still but would move at a velocity v with the minimum quantum of action represented by h:



The Planck black hole would have a mass M and would move about with speed v resulting from the minimum quantum of action applied to M_0. outside the black hole we would experience mass M_0 only and its energy would be the same as the kinetic energy of mass M.

$$M_0\,v^2 \;=\; h\,/\,2\,\pi \qquad (2)$$

The dimension for v will become clear later in this section. As M and M_0 are really the same particle, we could think that v applied to mass M is its kinetic energy, which would be equal to the energy of mass M_0:

$$M_0\,c^2 \;=\; 2\,\pi\,M\,v^2 \qquad (3)$$

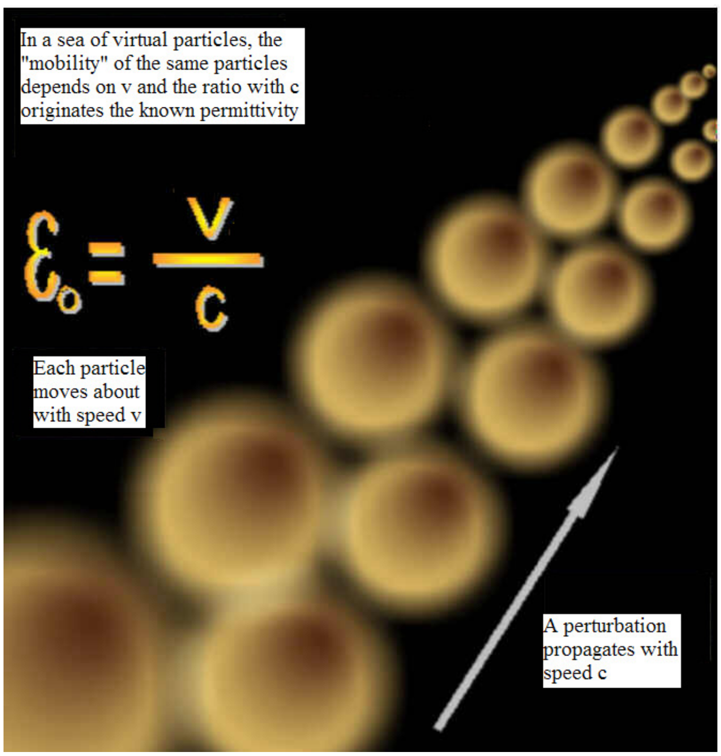
If we square both terms and multiply by the constant of gravitation we have:

$$G\,M_0^2\,/\,G\,M^2 \;=\; 4\,\pi^2\,(v\,/\,c)^4 \;=\; t_p \qquad (4)$$

We define the Planck permittivity ε_p as the ratio v/c and if we substitute the gravitational force of mass M with the equivalent force given by the Planck charge Q we have:

$$G\,M_0^2 / (Q^2 / 4\,\pi\,\varepsilon_p) \;=\; 4\,\pi^2\,\varepsilon_p^4 \;=\; t_p \qquad (5)$$

From the above equation we get ε_p directly from the Planck time and once we find charge Q we could also write $\varepsilon_p = Q^2/4hc$. The ratio of the gravitational to the electric force in a Planck black hole is exactly t_p. The same ratio applied to an electron will give us a number very close to t_p, only 0,2% off, due to the fact that rotation has not been taken care of, as yet. Here we see clearly the problem we have with the Planck particle: we expected a dimensionless ratio but in fact we find a time dimension. This time dimension must be always accounted for when we write any equation but we will not have any experience of it. This means, for example, that the actual dimension of speed v is $(m/sec)sec^{1/4}$ but we would see it only as a speed without the additional $sec^{1/4}$ attached to it. The Planck permittivity is equal to $(t_p/4\pi^2)^{1/4}$ but also in this case we would not experience the $sec^{1/4}$ dimension and it would appear to us as a dimensionless number. It is not by chance that if we ignore the $sec^{1/4}$ dimension we have exactly the same dimensions as in the cgs system where the dimension of charge is not present but only the three fundamental dimensions of space, time and mass. Now we see that eq. 2 and 3 are indeed correct also from the dimensional point of view.



Permittivity is a fundamental property of vacuum and to define it as the v/c ratio throws some light on what could be the property of the virtual particles present in it. Numerically, v is the vacuum conductance but proper experiments might be able to identify it also as a physical speed v.

It is time now to take in account the rotation of the particle. A speeding point on the spinning ring would be the result of two equal relativistic velocities u such that a point on the torus, or ring, would follow a helical path with a resulting speed u_0. We would then relate the initial fine structure constant α_0 to u_0 as follows:

$$\alpha_0 \;=\; 2\,(1 - u_0^2 / c^2) \qquad (6)$$

In order to find u_0 we must first find α_0. It was felt that α_0 would be mirrored on some physical property of our black hole and we would see it as an indication of the energy of the Planck charge within time t_p compared to the energy of the unitary charge Q_u within the unitary time t_u. In this respect we create a charged ring with unitary charge Q_u and form factor $4\pi^2$, in order to have a reference against which we can measure the strength of charge Q. Its ratio would give us the initial fine structure constant α_0:

$$\alpha_0^2 \;=\; (16\,\pi^4\,Q_u^2\,/\,t_u)\,/\,(Q^2\,/\,t_p) \qquad (7)$$

It follows that we can write the initial fine structure constant α_0 in terms of fundamental constants only, as shown in the appendix. The resulting speed u_0 will originate a set of parameters close to the ones we known, including a better value for the permittivity now equal to $(Q\ c/u_0)^2/4hc$. These data would apply to what we would call an initial electron and a perfect correspondence is achieved once we adjust the rotational speed to a slightly lower value.

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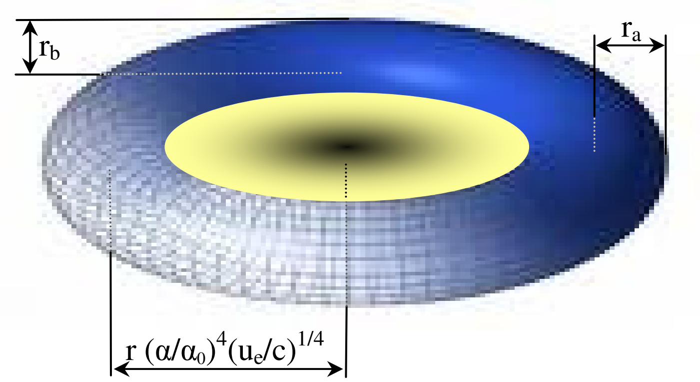
Electron force

Due to interactions with virtual particles present in the vacuum, the rotational speed would decrease by a small amount, from u_0 to u_e, just enough to yield all the electron parameters as we know them. Hence there is a set of parameters corresponding to the initial speed given by u_0, and a set of parameters corresponding to the final speed given by u_e. One important quantity is the fine structure constant and its variation from its initial value α_0 to its known value α is given by a solution of a cubic equation, see appendix, where it is written in terms of fundamental constants, which include both the unitary charge and time.



After the slowdown, the torus radius r seems to increase by the amount $(\alpha/\alpha_0)^4(1-\alpha/2)^{1/8}$. The same would apply to radius r_a and r_b of the torus ellipse. The corresponding mass increase would give the electron mass.

The electron mass can be calculated in terms of the apparent Planck mass M_0 and its radius variation proportional to the fourth power of the fine structure variation and to the ratio $(u_e/c)^{1/4} = (1-\alpha/2)^{1/8}$. The ring radius and the ring section radii would undergo a similar variation and eventually we would have:

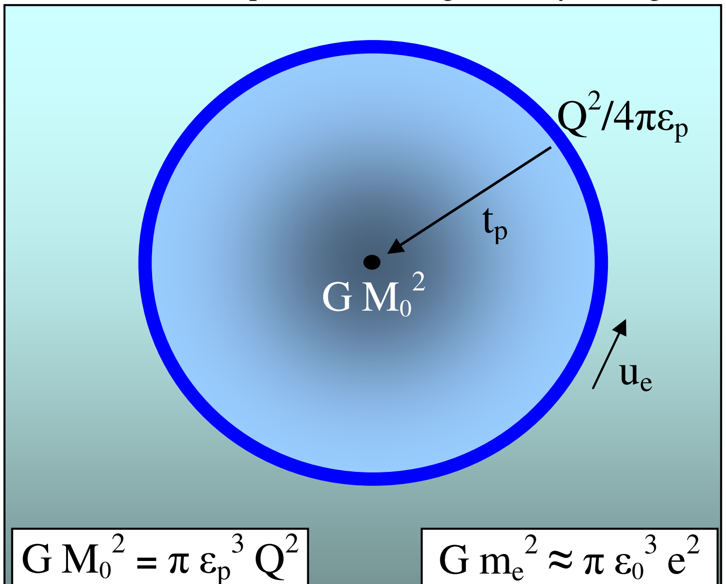
$$m_e \;=\; M_0\,(\alpha\,/\,2)^{1/2}\,(\alpha\,/\,\alpha_0)^{12}\,(1 - \alpha\,/\,2)^{3/8} \qquad (8)$$

For the electron charge e we have a similar equation and, not unexpected, we are able to write it in terms of the Planck charge Q:

$$e \;=\; Q\,(\alpha\,/\,2)^{1/2}\,/\,(\alpha\,/\,\alpha_0)\,(1 - \alpha\,/\,2)^{1/2} \qquad (9)$$

With the quantization of the electron mass and charge written in terms of its basic Planck quantities we are in a position to draw an important hypothesis on the forces present in our particle: the force given by mass M is experienced in our world as a force given by charge Q. At the same time we have a force t_p times smaller that we identify as the gravitational force. We have also seen that time t_p and permittivity ε_p are directly related and as a consequence we may write a relationship linking the electric and gravitational force in an electron.

We start from eq. 5 connecting directly the gravitational and electric force. After rearranging its terms we have:



At speed u_e all parameters will undergo a slight change, but the basic relationships remain valid making it possible to relate directly mass and charge of the electron in a beautiful equation without the need of the ubiquitous electron radius.

$$G\,M_0^2 \;=\; \pi\,\varepsilon_p^3\,Q^2 \qquad (10)$$

The same equation can be written in terms of known constants but with an additional term C_r representing the change of parameters due to rotation and its subsequent slowdown:

$$G\,m_e^2 \;=\; \pi\,\varepsilon_0^3\,e^2\,C_r \qquad (11)$$

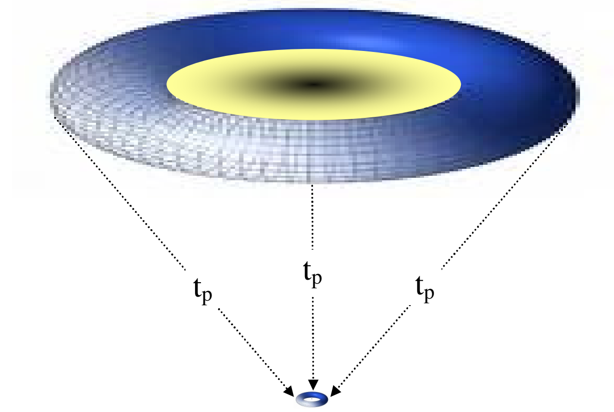
By taking in account the variation of each parameter due to the speed variation, we have $C_r = (\alpha/\alpha_0)^{32}(1-\alpha/2)^{19/4}$. This term is close to unity and if we are happy with a 1% difference between the left and right side of the equation we may write:

$$G\,m_e^2 \;\approx\; \pi\,\varepsilon_0^3\,e^2 \qquad (12)$$

Despite its appearance, eq. 12 is dimensionally balanced, as an additional time dimension is present in both terms. This equation is a good example of new relationships among electron parameters now possible through the elaboration of the black hole model. Another example is the known permittivity ε_0 that can be given in terms of the Planck permittivity ε_p and the variation of the fine structure constant:

$$\varepsilon_0 \;=\; \varepsilon_p\,/\,(\alpha\,/\,\alpha_0)^2\,(1 - \alpha\,/\,2) \qquad (13)$$

We can now explain why the ratio of the gravitational to the electric force in an electron is close but not quite the same as the Planck time. We have seen that a particle with charge Q, permittivity ε_p and apparent mass M_0 has a gravitational to electric force ratio exactly equal to Planck time t_p. The same applies to a rotating particle before the slowdown. The interaction with virtual particles decreases the rotational speed by 111m/s and yields a different set of parameters which we identify with the electron.



The gravitational force of the Planck particle is drastically reduced by the limitation imposed by Planck time t_p. The gravitational force of the resulting particle, the electron, has now a time dimension which must be taken care of. A precise correspondence with the electric force is established once the rotational factor = $(\alpha/\alpha_0)^{24}(1-\alpha/2)^{3/4}$ is considered.

A spinning electron has a slightly different permittivity, charge and mass but these parameters are in a well-defined relationship with the original Planck quantities. Eventually the ratio of the gravitational to the electric force F_g/F_e in an electron will result in a modest 0.2% difference from the Planck time.

We are now in a position to account for this small difference and by calculating the variation taking place in each quantity we find the term related to the ratio F_g/F_e applied to an electron:

$$F_g / F_e = t_p (\alpha / \alpha_0)^{24} (1 - \alpha / 2)^{3/4} \approx t_p \qquad (14)$$

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Conclusion

The details of the Planck particle and its behavior as a black hole give us an insight in the link between the Planck particle and the electron, shedding light on its nature and on the forces surrounding it. An additional time dimension is present in many quantities concerning the basic Planck particle. Such a particle, once its rotation is taken in account, appears to us as the electron.

We have seen that every quantity is not the result of chance but rather the result of a cleverly interwoven fabric where each piece fits nicely as shown in the summary table below and makes you think of a Higher Order behind all this.

Numerical results are mostly within one standard deviation of the latest Codata listing (2006) with a few exceptions at around two standard deviations. Calculations should be carried out with a high precision program, 20 digit precision is the required minimum.

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References

1) D. Di Mario, (2003), *Magnetic anomaly in black hole electrons*, http://digilander.iol.it/bubblegate/magneticanomaly.pdf

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

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

Appendix

Initial data		
$c = 299792458$	$h = 6.62606837306 x 10^{-34}$	$G = 6.67291773245 x 10^{-11}$
Planck data - non rotating particle		
Planck time t_p	$(\pi h G / c^5)^{1/2}$	$2.3950193 x 10^{-43}$
Planck mass M	$h / t_p c^2$	$3.0782613 x 10^{-8}$
Apparent Planck mass M_0	$M t_p^{1/2}$	$1.5064683 x 10^{-29}$
Planck permittivity ε_p	$(t_p / 4 \pi^2)^{1/4}$	$8.825459393 x 10^{-12}$
Planck charge Q	$(4 \varepsilon_p h c)^{1/2}$	$2.6481157 x 10^{-18}$
Electron data - rotating Planck particle		
Initial fine structure const. α_0	$(4\pi^5 / c^3)^{1/2} (2 G / h)^{1/4} (c / \pi h G)^{1/16}$	$7.2958732928 x 10^{-3}$
Fine structure const. α	solve: $\alpha^3 - 2\alpha^2 + 10^{-7}(2\pi)^5 (\pi G/c^3 h)^{1/2} = 0$	$7.2973525329 x 10^{-3}$
Permittivity ε_0	$\varepsilon_p / (\alpha / \alpha_0)^2 (1 - \alpha / 2)$	$8.8541878176 x 10^{-12}$
Mass m_e	$M_0 (\alpha / 2)^{1/2} (\alpha / \alpha_0)^{12} (1 - \alpha / 2)^{3/8}$	$9.10938135 x 10^{-31}$
Charge e	$Q / (\alpha / \alpha_0) (2 / \alpha - 1)^{1/2}$	$1.602176416 x 10^{-19}$
Electric force $e^2 / 4 \pi \varepsilon_0$	$(\alpha / 2) Q^2 / 4 \pi \varepsilon_p$	$2.30707692 x 10^{-28}$
Gravitational force $G m_e^2$	$\pi \varepsilon_0^3 e^2 (\alpha / \alpha_0)^{32} (1 - \alpha / 2)^{19/4}$	$5.5372424 x 10^{-71}$
Gravity to electric force ratio F_g / F_e	$t_p (\alpha / \alpha_0)^{24} (1 - \alpha / 2)^{3/4}$	$2.4001117 x 10^{-43}$

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