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Planck Permittivity and Electron Forces

D. Di Mario d.dimario@iol.it

Abstract: 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 gravitational and electric forces is now possible.

Keywords: permittivity, Planck mass, Planck time, black hole, electron.

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 the other quantum constants? And so forth.

The Planck particle may be the answer to our questions.

If we devise a hypothetical particle with a Planck time $t_p = (\pi hG/c^5)^{½}$ and a Planck mass $M = h/t_pc^2$ we have created the basis for a black hole, a Planck black hole, as it was shown in previous papers [1,2] 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 measure from our frame of reference outside this hypothetical black hole is not mass M but a much smaller mass $M_0 = Mt_p^{½}$. We do not experience the $sec^{½}$ dimension present in M_0 but it will be always present in any calculation and will have a ripple effect on other quantities. This apparent change of dimension is due to the peculiarities of the black hole and as the cgs system was showing certain limitations regarding the description of electric phenomena, so the present MKS system seems to show its limitation when it comes to the description of the consequences of the Planck black hole on our world. In this paper we will abide by the standard system with the advantage of having familiar numbers although we will have to put up with the additional time dimension when dealing directly with the Planck black hole and hence with the electron.

The most suitable model to represent the Planck black hole is the ring model [3,4], a toroidal force field rotating around a small kernel where the Planck mass would reside. This model will eventually develop in the electron but we need first to define the Planck charge Q with an energy corresponding to the Planck mass M:

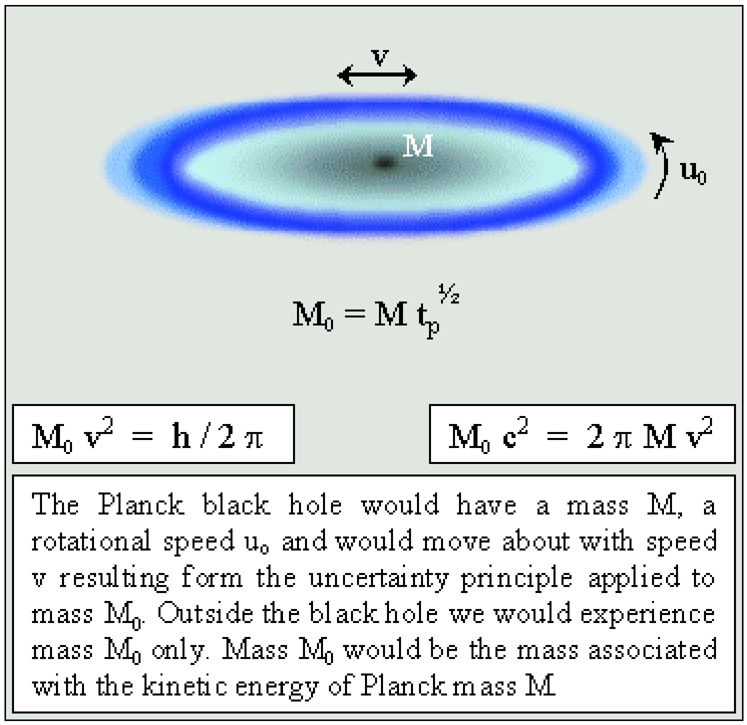
$$Q = M\,(4\,\pi\,\varepsilon_p\,G)^{1/2} = (4\,\varepsilon_p\,h\,c)^{1/2} \ .$$

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

Planck Permittivity

In our black hole model we might think that mass M would not stand still but would move with a certain speed v calculated by applying the uncertainty principle to mass M_0. This movement will represent the kinetic energy of mass M. We could experience this energy as the manifestation of mass M_0 and as such, we could write the following relation:

$$M_0\, c^2 \;=\; 2\,\pi\, M\, v^2\ .$$



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

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

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:

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

From this equation we get ε_p directly from the Planck time and once we find charge Q we may relate ε_p to Q as follows: $\varepsilon_p = Q^2/4hc$. As the resulting particle will be the electron, once rotation is taken in account, we expect the ratio of the gravitational to the electric force in an electron to be related to the Planck time, whose time dimension we are unaware of. 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 will experience 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.

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 it is felt that proper experiments should be able to identify a physical speed v.

It is time now that we take in account the rotation or spin of the particle. A point on the spinning ring would have a speed u_0 related, as a hypothesis, to the initial fine structure constant α_0 as follows:

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

It is also felt that α_0 is an indication of the difference 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: $\alpha_0^2 = (16\pi^4 Q_u^2/t_u)/(Q^2/t_p)$. Once all elaborations are diligently carried out we may write the initial fine structure constant α_0 in terms of fundamental constants:

$$\alpha_0 = (4\,\pi^5 / c^3)^{1/2}\,(2\,G / h)^{1/4}\,(c / \pi\, h\, G)^{1/16} \;.$$

The resulting speed u_0 will originate a set of parameters quite close to known ones, including a better value for the permittivity now equal to $(Q\, c/u_0)^2/4hc$. A perfect correspondence is achieved once we adjust the rotational speed to a slightly lower value.

Electron forces

Due to possible 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 given by one of the solutions of a third order equation. Its variation α/α_0 will appear in every equation where the electron mass or charge is involved.

The electron mass can be calculated in more ways: in this context it is fit to see it in terms of the measurable Planck mass M_0 and its volume, whose radius is proportional to the fourth power of the fine structure variation. Eventually we have:

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

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

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

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 an electron: the gravitational force originates in the rotating Planck black hole and it is strongly limited by the Planck time while the electron charge does not undergo such a limitation and the full force of mass M is experienced through charge Q. We have seen also that time t_p and permittivity ε_p are directly related and as a consequence we may write a relationship linking directly electric and gravitational forces in an electron.

Basically we start from the equation connecting the gravitational and electric force in the Planck particle:

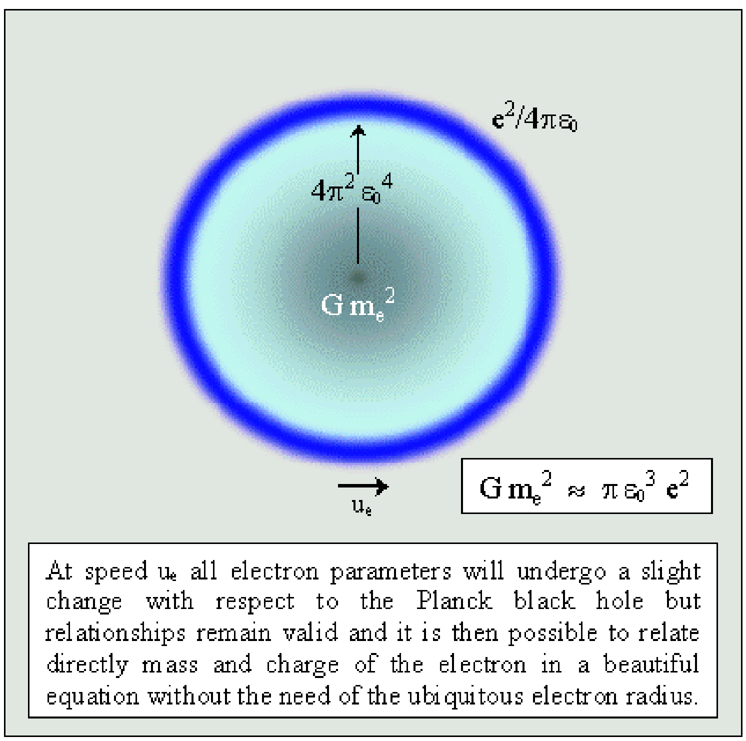
$$G M_0^2 = \pi \varepsilon_p^3 Q^2 .$$

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:

$$G m_e^2 = \pi \varepsilon_0^3 e^2 C_r .$$

By taking in account the variation of each parameter 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:

$$G m_e^2 \approx \pi \varepsilon_0^3 e^2 .$$



Despite its appearance it is dimensionally balanced, as an additional time dimension is present in both terms. This equation is a good example of a new relationship between electron parameters only 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:

$$\varepsilon_0 = \varepsilon_p / (\alpha / \alpha_0)^2 (1 - \alpha / 2) .$$

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 measurable mass M_0 has a gravitational to electric force ratio exactly equal to Planck time t_p.

A rotating particle, the electron, in fact, has a slightly different permittivity and a different measurable charge and mass but these parameters are in 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.

However we are now in a position to take in account this small difference and by calculating the variation that is taking place in each quantity we find a term that matches the equation even for the electron:

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

Conclusion

The details of the Planck particle and its behavior as a black hole give us an insight on the intimate link between the Planck particle and the electron, shedding light on its nature and on the forces surrounding it.

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 on the following page.

Initial data		
$c = 299792458$	$h = 6.6260683731\text{x}10^{-34}$	$G = 6.6729177325\text{x}10^{-11}$
Planck data (non rotating particle)		
Planck time t_p	$(\pi\ h\ G / c^5)^{1/2}$	$2.3950193\text{x}10^{-43}$
Planck mass M	$h / t_p\ c^2$	$3.0782613\text{x}10^{-8}$
Measurable Planck mass M_0	$M\ t_p^{1/2}$	$1.5064683\text{x}10^{-29}$
Planck permittivity ε_p	$(t_p / 4\ \pi^2)^{1/4}$	$8.825459393\text{x}10^{-12}$
Planck charge Q	$(4\ \varepsilon_p\ h\ c)^{1/2}$	$2.6481157\text{x}10^{-18}$
Electron data (rotating Planck particle)		
Initial fine structure const. α_0	$(4\ \pi^5 / c^3)^{1/2}\ (2\ G / h)^{1/4}\ (c / \pi\ h\ G)^{1/16}$	$7.2958732928\text{x}10^{-3}$
Fine structure constant α	solve: $\alpha^3 - 2\alpha^2 + (2\pi)^5\ (\pi\ G/c^3\ h)^{1/2}\ 10^{-7} = 0$	$7.2973525329\text{x}10^{-3}$
Permittivity ε_0	$\varepsilon_p / (\alpha / \alpha_0)^2\ (1 - \alpha / 2)$	$8.8541878176\text{x}10^{-12}$
Mass m_e	$M_0\ (\alpha / 2)^{1/2}\ (\alpha / \alpha_0)^{12}\ (1 - \alpha / 2)^{3/8}$	$9.10938135\text{x}10^{-31}$
Charge e	$Q / (\alpha / \alpha_0)\ (2 / \alpha - 1)^{1/2}$	$1.602176416\text{x}10^{-19}$
Electric force $e^2 / 4\ \pi\ \varepsilon_0$	$(\alpha / 2)\ Q^2 / 4\ \pi\ \varepsilon_p$	$2.30707692\text{x}10^{-28}$
Gravitational force $G\ m_e^2$	$\pi\ \varepsilon_0^3\ e^2\ (\alpha / \alpha_0)^{32}\ (1 - \alpha / 2)^{19/4}$	$5.5372424\text{x}10^{-71}$
Gravity to electric force ratio F_g / F_e	$t_p\ (\alpha / \alpha_0)^{24}\ (1 - \alpha / 2)^{3/4}$	$2.4001117\text{x}10^{-43}$

References

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