Connecting Fundamental Constants

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Abstract. A model for a black hole electron is built from three basic constants only: h, c and G. The result is a description of the electron with its mass and charge. The nature of this black hole seems to fit the properties of the Planck particle and new relationships among basic constants are possible. The time dilation factor in a black hole associated with a variable gravitational field would appear to us as a charge; on the other hand the Planck time is acting as a time gap drastically limiting what we are able to measure and its dimension will appear in some quantities. This is why the Planck time is numerically very close to the gravitational/electric force ratio in an electron: its difference, disregarding a $\pi\sqrt{2}$ factor, is only 0.2%. This is not a coincidence, it is always the same particle and the small difference is between a rotating and a non-rotating particle. The determination of its rotational speed yields accurate numbers for many quantities, including the fine structure constant and the electron magnetic moment.

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Planck Black Hole and Planck Permittivity. If we devise a particle with a Planck time $t_p = \sqrt{\pi h G/c^5}$ and a Planck mass $M = h/t_p c^2$ we have created the basis for the Planck black hole. The gravitational force is GM^2 but the severe constrain of time t_p outside the black hole will allow us to measure only an energy which depends on this time. It behaves like a very fast shutter that allows us to see only an infinitesimal fraction of the energy. We experience only this minute energy and we would see it as generated by a mass $M_0 = M\sqrt{t_p}$. Now it should come with no surprise that if we use M_0 we will not get a black hole because this mass will not satisfy the Kerr-Newman condition. It is a black hole after all, but the measured mass is M_0 and not M as expected. We are still talking about the very same particle but its mass will undergo the limitation of time t_p. We would still feel the effect of mass M, but we do not see it as a gravitational force but as an electric force generated by what we would call the Planck charge $Q = M\sqrt{4\pi\varepsilon_p G}$ where ε_p is the Planck permittivity. We can calculate ε_p if we think that mass M_0 would not stand still but would move at a velocity v with the minimum quantum of action $\hbar$:

$$M_0 v^2 = \hbar \tag{1}$$

The dimension for v will be clear later. As M and M_0 are the same particle, we could think that the kinetic energy applied to mass M is the same as the energy of mass M_0:

$$M_0 c^2 = 2\pi M v^2 \tag{2}$$

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

$$GM_0^2/GM^2 = 4\pi^2 (v/c)^4 = t_p \tag{3}$$

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:

$$GM_0^2/(Q^2/4\pi\varepsilon_p) = t_p \tag{4}$$

From Eq. 4 we see that the ratio of the measurable gravitational force and the electric force in a Planck particle is exactly t_p. Both charge Q and mass M_0 are an order of magnitude larger then the expected electron charge and mass while permittivity is only 0.3% off the known value. This is due to the fact that this is a non-rotating particle where the dynamic interaction of the electric and magnetic force is not yet taken in account. We have an additional time dimension in M_0 because time t_p is acting as a fast shutter. The same happens with velocity v whose actual dimension is $(m/sec)\sqrt[4]{sec}$ and numerically is identified with the vacuum conductance. The additional time dimension will have an effect on other quantities as well and must be always accounted for.

Rotating Particle and Magnetic Anomaly. A suitable physical model is the ring model with some sort of toroidal force field around the tiny black hole. A rotating charge will set up a magnetic field opposing its own rotation until a stability point is reached where the resulting electron force would be the difference between the electric and the induced magnetic force. The rotational speed u_0 is a fundamental parameter and with a slightly modified equation originally proposed by Sutton et al. in 1992, we define a relativistic connection with what we would call the initial fine structure constant α_0:

$$\alpha_0 = 2(1 - u_0^2/c^2) \tag{5}$$

In order to calculate u_0 we try to relate α_0 to some 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 $\sqrt{W_u/W_p}$ 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. This initial fine structure constant gives the initial rotational speed, Eq. 5, and is an intrinsic property of the Planck black hole and can be calculated directly from basic constants: $\alpha_0 = (2\pi^2/c)\sqrt{\pi/c}\,\sqrt[4]{2G/h}\,\sqrt[16]{c/\pi hG}$. This particle is rotating at relativistic speed and will increase its energy to a level corresponding to a charge $Q_0 = Q(c/u_0)$. It is on charge Q_0 that we must calculate the effect of the electric force and the induced magnetic force in order to get the initial electron charge e_0:

$$e_0 = \sqrt{Q_0^2 - Q_0^2 u_0^2/c^2} = Q_0\sqrt{\alpha_0/2} = Q/\sqrt{2/\alpha_0 - 1} \tag{6}$$

We have the initial electron mass m_b from M_0 in the same way as we had e_0 from Q_0:

$$m_b = M_0\sqrt{1 - u_0^2/c^2} = M_0\sqrt{\alpha_0/2} \tag{7}$$

If numerical calculations are carried out we find a difference ranging from 0.01% to 0.1% compared to known quantities. Total agreement was achieved by changing the rotational speed u_0. There is indeed a slightly lower speed u_e yielding all expected data although, for the mass, we have to define an additional term that takes care of the

radii variation. The hypothesis is that the interaction of this basic electron with virtual particles in the vacuum has the effect of lowering its rotational speed.
There is a direct relationship between permittivity and the charge originating it: for a static particle we have $\varepsilon_p = Q^2/4hc$ that will increase to $Q_0^2/4hc$ for a rotating particle. Our current value for permittivity is $\varepsilon_0 = 10^7/4\pi c^2$ and is an exact quantity so we could lower speed u_0 until we have ε_0. The result is a speed decrease of $111 m/sec$ and a slightly lower value for Q_0, Q and e_0 which now coincides with the electron charge e.
As no other constant was used but h, c and G, it is possible to elaborate all the available data and write two equations showing the relationship among all these quantities:

$$\alpha^2 - 2\alpha + (4\pi^2/ec)^2\sqrt{\pi hG/c} = 0 \tag{8}$$

$$\alpha^3 - 2\alpha^2 + 10^{-7}(2\pi)^5\sqrt{\pi G/c^3h} = 0 \tag{9}$$

So far we have not considered the radius variation due to the change of the rotational speed. As $M_0 = 8h^3/\pi Q^4$ we have that the black hole radius variation of M_0 is related to the fourth power of the variation of Q hence to the fourth power of the fine structure constant variation. We would now consider the radius variation of the ring and the radii variation of the ring section, most likely an ellipse. These three radii variation would influence the electron mass m_e with the factor $C_e = (\alpha/\alpha_0)^{12}\sqrt[8]{(1-\alpha/2)^3}$. Eventually we would have:

$$m_e = M_0\sqrt{\alpha/2}\,(\alpha/\alpha_0)^{12}\sqrt[8]{(1-\alpha/2)^3} \tag{10}$$

Based on certain assumptions still under investigation, it is possible to describe the ring speed variation. This will originate a factor $C_a = \sqrt[4]{1-\alpha/2}\,(\alpha/\alpha_0)^4(2-\alpha_0)^8/(2-\alpha)^8$. The quantity $C_e/C_a - 1$ would be the electron magnetic anomaly a_e:

$$a_e = [(2-\alpha)\alpha/\alpha_0(2-\alpha_0)]^8\sqrt[8]{1-\alpha/2} - 1 = (e_0/e)^{16}\sqrt[8]{1-\alpha/2} - 1 \tag{11}$$

While the ratio C_e/C_a will give us the electron magnetic moment $\mu_e = (C_e/C_a)e\hbar/2m_e$.

Gravitational and Electric Force. From Eq. 3 and 4, for a static particle, we have:

$$GM_0^2 = \pi\varepsilon_p^3 Q^2 \tag{12}$$

We could write Eq. 12 in terms of known quantities providing we take in account the rotation and slowdown of the particle. The change in each quantity has been calculated and placed in a single term $C_r = (\alpha/\alpha_0)^{32}\sqrt[4]{(1-\alpha/2)^{19}}$ thus getting:

$$Gm_e^2 = \pi\varepsilon_0^3 e^2 C_r \approx \pi\varepsilon_0^3 e^2 \tag{13}$$

As C_r is close to unity we could ignore this term if we are satisfied with a difference of about 1% between the right and the left term. From Eq. 4 we see that the gravitational to the electric force ratio is exactly t_p. This ratio is slightly modified because of the rotation of the particle and if no corrective factor is introduced we will be left with a difference of about 0.2%. Now we can calculate this corrective factor and eventually we have:

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

The electric force F_e can be calculated directly from the rotating Planck mass M:

$$F_e = e^2/4\pi\varepsilon_0 = GM^2(\alpha/2) \tag{15}$$

The electric force appears to be a gravitational force but with a fundamental difference: it has a polarity, positive or negative. We could possibly explain the existence of a polarity if we think that the Planck mass is a black hole trying to get larger and larger or smaller and smaller. This tendency will be experienced as a polarity: a variable gravitational field over an extremely long time. Time dilation in a black hole causes the variation of the gravitational field to take place over a long period of time, probably the age of the universe, and we would be left only with a polarity: negative or positive and in our everyday experience we would see the Planck mass as a steady and ageless particle, a charge in fact. A fitting application could be the creation of an electric field directly from the gravitational field variation taking place during the materialization of an electron-positron pair from a gamma ray. The materialization time $t_e = h/m_e c^2$ originates a variable gravitational field Gm_e/t_e and once we introduce the quotient $K_p = Q/M(\alpha/\alpha_0)\sqrt{1-\alpha/2}$ and consider the rotation of the particle, we have the electric field E_e generated by the electron without the prior knowledge of its charge:

$$E_e = (Gm_e/t_e)\sqrt{2/\alpha}\,/K_p(\alpha/\alpha_0)^{24}\sqrt[4]{(1-\alpha/2)^3} \tag{16}$$

In our world there would be a very small additional tug between two bodies whose distance changes with time. This could be important, among other things, in the measurement of the gravitational constant: any experiment entailing a moving mass could be flawed and give different results depending on the mass distance and relative motion.

Conclusion. Planck time t_p is the time window through which we experience the presence of the Planck mass and its energy. Time t_p is extremely short and we will detect only a minute fraction of the Planck mass. This small mass has an additional time dimension and is identified with the electron. The precise determination of its rotational speed yields all known electron parameters and a link with the gravitational constant.

Elaboration of existing equations allows a given quantity to be written in many interesting ways and the electron charge e below is just an example. $4\pi^2$ in the right term is part of W_u which includes the unitary dimension of charge and time:

$$e = Q/(\alpha/\alpha_0)\sqrt{2/\alpha - 1} = e_0\sqrt{(2-\alpha_0)\alpha_0/\alpha(2-\alpha)} = 4\pi^2\sqrt{t_p/\alpha(2-\alpha)} \tag{17}$$

It should be mentioned that Eq. 9 gives also a negative fine structure constant, $-\alpha + \delta$, where $\delta = 1 + \alpha/2 - \sqrt{1 + \alpha - (3/4)\alpha^2} = 2.653\times10^{-5}$. Such negative value would imply a speed faster than light by 0.18%. It would not involve any material particle but would substantially add to the complexity of vacuum. The other solutions are α, common to both Eq. 8 and 9, then $2-\alpha$ for Eq. 8 and $2-\delta$ for Eq. 9.

A numerical exercise was carried out to verify agreement with the latest Codata listing (2006). The adopted values are $c = 299792458$, $h = 6.62606837306\times10^{-34}$ and $G = 6.67291773245\times10^{-11}$. All results are within one or two standard deviations.