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The Role of Electrons in Quantum Gravity

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ABSTRACT

The ratio of the gravitational force to the electric force in an electron is of the same order as the Planck time. A more precise value is found by constructing a model for the Planck particle in which the Planck mass is √2 larger than its conventional value and the Planck length is π / 2 larger than its corresponding Schwarzschild radius. Solving for the remaining difference of about 0.2% and the apparent dimensional mismatch gives an insight into the intimate structure of quantum gravity.

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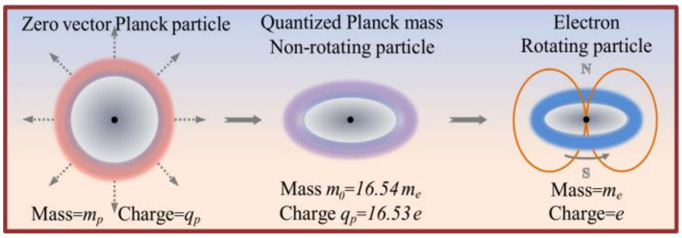
Zero vector Planck Particle

It is really surprising that a mass as large as the Planck mass has not been found. Perhaps the search should start again with basic concepts. The Planck particle could be a black hole [1] and as such it expands, and probably its antiparticle contracts, at the speed of light, but the relativistic effect will allow it to expand only over an extremely long period of time, so long in fact that it could be comparable to the age of the universe. For all practical purposes, the particle will look "frozen" [2], and the associated time can only increase in a step equal to the Planck time.

The quantities G_p, m_p, q_p, ε_p and t_p refer to the gravitational constant, mass, charge, permittivity and time of the Planck particle and the following equation shows the connection among all the above quantities.

$$G_p m_p^2 = q_p^2 / 4\pi\varepsilon_p$$

It is hypothesized that the force of the Planck mass is electric in nature and not gravitational. It is not surprising that the Planck mass has never been found, since it actually behaves as a charge that will be identified with the electron charge once its rotational speed is taken into account.



The quantity $m_0 = m_p t_p^{1/2}$ could be thought of as the quantized Planck mass and would be the gravitational mass of the Planck particle. The electron mass will be derived from m_0 but it should be noted that it retains a time dimension.

With the knowledge of the gravitational constant G_p=6.672919565x10^{-11} m^3 kg^{-1} s^{-2}, calculated in the following paragraph, it is possible to assign some numbers to the Planck particle. The dimensions associated with the various parameters may look a bit strange, so the usual dimensions are given instead.

Planck time t_p	$(\pi h G_p/c^5)^{1/2}$	2.395019985x10^{-43} s
Planck mass m_p	$(2\hbar c/G_p)^{1/2}$	3.078261296x10^{-8} kg
Quantized Planck mass m_0	$m_p t_p^{1/2}$	1.506468492x10^{-29} kg s$^{1/2}$ (kg)
Planck permittivity ε_p	$(m_0/2\pi m_p)^{1/2}$ $=(t_p/4\pi^2)^{1/4}$	8.825460007x10^{-12} s$^{1/4}$ (F m^{-1})
Planck charge q_p	$m_p(4\pi\varepsilon_p G_p)^{1/2}$	2.6481162x10^{-18} kg$^{1/2}$ m$^{3/2}$ s$^{-7/8}$(C)

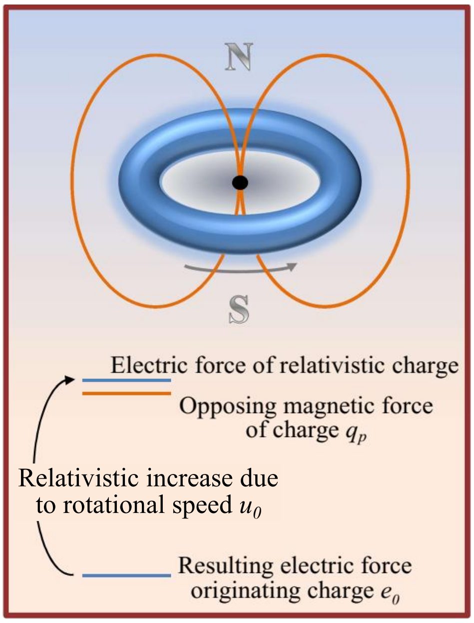
The Planck permittivity ε_p says a lot about the intimate nature of the Planck particle, and the small difference from the vacuum permittivity ε_0 will be fully justified when rotation is taken into account.

Unfortunately, the elaboration of the above data will not lead to the creation of the electron, but rather to the creation of a particle with the same properties as the electron, but only so slightly different numerically. A kind of proto-electron or quasi-electron, where the variation of a single parameter, namely the rotational speed of a point on the ring, will then yield all the known parameters. Apparently, every parameter is affected by this variation, including the gravitational constant [3].

A Basic Electron

This initial particle is a necessary step because the final product, the electron, is calculated only by a small change in the rotational speed u_0 directly related to the initial fine structure constant α_0, as shown in the table below.

The assumed model for the electron is a fast-rotating torus with a speed close to the speed of light [4]. As a consequence, relativistic effects must be taken into account. The fast rotation of the charge will generate a magnetic force that will oppose the force generated by the same charge. The final result is a force, still electric in nature, associated with the initial charge e_0.



The constant w_u describes the toroidal nature of the particle [5,6]. Its relation to the Planck charge gives the initial fine structure α_0, linked by a simple quadratic equation:

$$\alpha_0^2-2\alpha_0+w_ut_p/e_0^2 = 0$$

A similar path is followed for the initial mass m_b. This mass will be almost equal to mass m_0 once the increase due to the relativistic speed of rotation is accounted for.

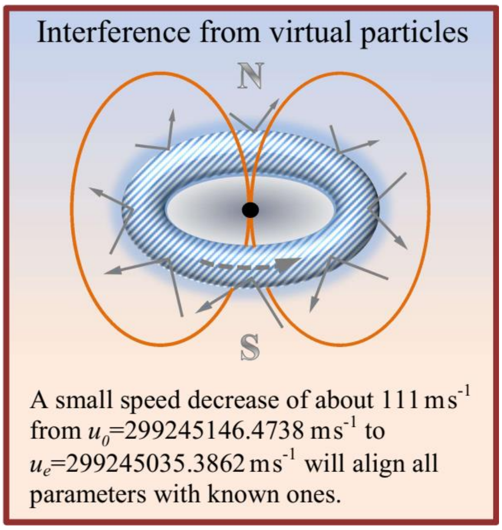
Toroid ratio unitary charge squared / unitary time w_u	$16\pi^4Q_u^2/t_u$	1558.5454565 $C^2\,s^{-1}$
Initial fine structure α_0	$(w_u t_p)^{1/2}/q_p$	7.295873076×10^{-3}
Initial rotating speed u_0	$c(1-\alpha_0/2)^{1/2}$	299245146.4738 $m\,s^{-1}$
Initial electron charge e_0	$(w_u t_p/\alpha_0(2-\alpha_0))^{1/2}$	$1.6023384803\times10^{-19}$ C
Initial electron mass m_b	$m_0(\alpha_0/2)^{1/2}(1-\alpha_0/2)^{3/8}$	$9.0863298647\times10^{-31}$ kg

In addition, a factor $(1-\alpha_0/2)^{1/8}$ will apply to each of the three radii: the elliptical section of the torus and the radius of the particle. The measure of each radius is not known, so the factor should be considered as a contribution to the size of the three radii. The resulting initial mass, charge and fine structure are now only a fraction of a percent different from the known electron parameters.

After the elaboration of the quadratic equation, it is possible to write an equation for the gravitational constant $G_p=(c^5/\pi h)(\alpha_0(2-\alpha_0)e_0^2/w_u)^2$ very close to $(c^5/\pi h)(\alpha(2-\alpha)e^2/w_u)^2$; the latter was used as a starting quantity along with c and h to define the Planck particle. The speed of rotation is a fundamental parameter with profound effects. For example, if the speed of rotation could reach the speed of light, the particle would have no charge and no mass, because the electric and magnetic forces are equal and opposite. Furthermore, if the electron charge in the quadratic equation is replaced by the expression giving the vacuum permittivity, the equation becomes a cubic equation with one of the solutions being a negative fine structure, implying a faster than light speed of rotation and the appearance of a magnetic monopole charge [7].

Evolution of the electron

The speed of rotation is reduced by a tiny amount. Certainly the vacuum virtual particles play their part in this decrease but other causes like dark matter or even the influence of superluminal particles cannot be excluded.



The rotation speed u_0 is decremented until all electron parameters match the known ones, as reported in the table below, where the relationship with the fine structure is clearly shown. The final speed u_e and the initial speed u_0 are then related to their respective fine structure constants: $(u_0/u_e)^2=(2-\alpha_0)/(2-\alpha)$.

The calculated electron charge e_1 shows a difference of 0.8 ppb from the known exact charge e=$1.602176634\times10^{-19}$ C, and the calculated permittivity $\varepsilon_p(\alpha_0/\alpha)^2/(1-\alpha/2)$ also shows a small difference. This is probably due to the fact that the finer details of this relativistic particle are not taken into account with the advantage of having a relatively simple model to study. This also means that a factor e_1/e must be considered if a good numerical agreement with known quantities is to be expected.

Fine structure α	$2(1-u_e^2/c^2)$	$7.2973525639846\times10^{-3}$
Calculated charge e_1	$(w_u t_p/\alpha(2-\alpha))^{1/2}$	$1.6021766353\times10^{-19}$ C
Mass m_e	$m_b(\alpha/\alpha_0)^{25/2}((2-\alpha)/(2-\alpha_0))^{3/4}$	$9.1093837148\times10^{-31}$ kg
Electric force F_e	$(\alpha/2)q_p^2/4\pi\varepsilon_p = (\alpha/2)G_pm_p^2$	$2.3070775507\times10^{-28}$ N
Compton wavel. λ_C	$\pi G_p m_p^2/m_e c^2$	$2.42631023514\times10^{-12}$m
Rydberg R_∞	$\alpha^2 m_e c/2h$	10973731.568158 m^{-1}
Hartree E_h	$\alpha^2 m_e c^2$	$4.3597447222062\times10^{-18}$J

Since $m_0=8h^3/\pi q_p^4$, there is also a factor $(\alpha_0/\alpha)^4$ influencing each of the 3 radii. This means that, for the electron, there is an additional mass variation of $(\alpha_0/\alpha)^{12}$ for the initial mass m_b.

The vacuum permittivity and the Bohr magneton can be written in terms of the Planck quantities without the knowledge of the electron mass and charge.

Permittivity ε_0	$\varepsilon_p(\alpha_0/\alpha)^2/(1-\alpha/2)(e_1/e)^2$	$8.8541878192\text{x}10^{-12}\text{Fm}^{-1}$
Bohr magneton μ_B	$(q_p\hbar/m_0)(\alpha_0/\alpha)^{13}(1-\alpha/2)^{1/8}((2-\alpha_0)/(2-\alpha))^{3/8}/(2-\alpha)(e_1/e)$	$9.2740100648\text{x}10^{-24}\text{JT}^{-1}$

The e_1/e factor is only needed when calculating precise numerical values.

The gravitational and electric force ratio

This ratio is very close to the Planck time t_p. The difference is resolved by taking into account the variation due to the change in rotational speed.

By manipulating the Planck quantities, it is possible to write an exact relationship connecting the gravitational force of the quantized mass m_0 with the Planck permittivity and charge, see below. This relationship can be translated into known electron parameters, but the equation now shows a difference of about 1% [8].

$$G_p m_0^2 = \pi\varepsilon_p^3 q_p^2$$
$$G_p m_e^2 \approx \pi\varepsilon_0^3 e^2$$

An exact relation is obtained if the speed variation is calculated for each quantity (a rather tedious operation):
$G_p m_e^2=\pi\varepsilon_0^3 e^2((1-\alpha/2)(e_1/e)^2(\alpha/\alpha_0)^8)^4((1-\alpha/2)(2-\alpha)/(2-\alpha_0))^{3/4}$.

It is possible, with further elaboration, to have the electron gravitational force F_g that does not even require the gravitational constant although it is still part of the Planck time t_p.

$$F_g = G_p m_e^2 = t_p \hbar c \alpha (\alpha/\alpha_0)^{24}((1-\alpha/2)(2-\alpha)/(2-\alpha_0))^{3/4}$$
$$F_g/F_e = (2/\alpha)(m_e/m_p)^2 = t_p(\alpha/\alpha_0)^{24}((1-\alpha/2)(2-\alpha)/(2-\alpha_0))^{3/4}$$

The ratio F_g/F_e between the gravitational and electric forces is now equal to the Planck time t_p but with an additional term that takes care of the speed variation, thus resolving the difference mentioned at the beginning of this paper. In addition, there is a time dimension on both sides of the equation, because the gravitational force includes an implicit time dimension that remains imperceptible to us.

The gravitational constants

All calculations require the gravitational constant G_p, but when the slowdown is taken into account there seems to be a change, with the measured gravitational constant G being larger by a factor of $(e_0/e_1)^2=\alpha(2-\alpha)/\alpha_0(2-\alpha_0)$ with respect to G_p. This is rather puzzling, since there are now two gravitational constants: G_p, which is used for all calculations at the quantum level, and an experimental G that is 0.02% larger. The influence of the factor e_1/e, if any, is so small that it can be neglected at the level of precision expected from the measurements of the Newtonian constant G.

Measured constant G	$(c^5/\pi h)(\alpha(2-\alpha)e_0 e_1/w_u)^2$	$6.6742678666\text{x}10^{-11}\ \text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}$
Quantum constant G_p	$(c^5/\pi h)(\alpha_0(2-\alpha_0)e_0^2/w_u)^2$	$6.6729196595\text{x}10^{-11}\ \text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}$

All current measurements of G use a relatively large test mass in one form or another, with the exception of experiments based on atom interferometry, where the mass involved is very small and where the quantum effect is likely to begin to appear, giving a value for the constant that is close to G_p [9].

Admittedly, it is not easy to conceive two constants, much less a range from G_p to G, although there is a hint of this possibility [10], in any case, it is a starting point from where to proceed.

Conclusion

The elusive Planck particle is not so elusive after all: it is the electron itself. The Planck quantities provide everything necessary to characterize the electron as it is known. First, the Planck particle is assumed to be a black hole and the force of the Planck mass is electric, not gravitational. Second, its ring structure is rotated at nearly the speed of light, creating a magnetic force that opposes the electric force, thus yielding the known electron charge.

The same rotation, applied to the quantized Planck mass, originates the electron mass, provided that the subsequent speed variation, and thus the fine structure variation in the transition from the basic electron to the actual electron, is taken into account.

It might be interesting to see, for example, both the electron mass and charge written directly with the Planck quantities and the speed variation.

$$m_e = (8h^3/\pi q_p^4)(\alpha/2)^{1/2}(\alpha/\alpha_0)^{12}((1-\alpha/2)(2-\alpha)/(2-\alpha_0))^{3/8}$$
$$e_1 = q_p \alpha_0/(\alpha(2-\alpha))^{1/2}$$

The numerical results are always the same, and more equations are possible.

The hunt for the Planck particles is over, they are all around us, but as is often the case in the world of physics, this is just a step towards new ideas and proposals.

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