# The Gravitational Electric Charge

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**Abstract**

*In this paper I introduce a new concept which I called: gravitational electric charge. The physical meaning of this quantity is still not clear, however, if confirmed it would indicate that gravity not only acts as a force between masses, in the Newtonian sense, but also as an extremely feeble electromagnetic force.*

***Keywords****: Planck's constant, Planck mass, gravitational coupling constant, electromagnetic coupling constant, Newton's gravitational constant, gravitational electric charge.*

## 1. Nomenclature

I shall use the following nomenclature for the constants and variables used in this paper

$\alpha_G$ = gravitational coupling constant for the proton
$\alpha$ = electro-magnetic coupling constant (fine-structure constant or atomic structure constant).
$c$ = speed of light in vacuum
$h$ = Planck's constant
$G$ = Newton's gravitational constant
$e$ = elementary charge
$\epsilon_0$ = permittivity of vacuum
$m_e$ = electron rest mass
$m_p$ = proton rest mass
$m$ = rest mass of any given particle
$M_P$ = Planck's mass
$Q_{gp}$ = Gravitational electric charge for the proton
$Q_g$ = General gravitational electric charge for a particle of mass $m$
$K_g$ = proportionality constant

## 1. The New Concept

Let's consider the following quantity

$$4\pi\epsilon_o G m_p^2 \tag{1}$$

Where $m_p$ is the mass of the proton.
The units of this quantity is $C^2$ , this is Coulombs square. Therefore we may define the square of the gravitational electric charge for the proton as follows

 

$$Q_{gp}^2 = 4\pi\,\epsilon_o\,G\,m_p^2 \tag{2}$$

Where $Q_{gp}$ is a electric charge produced by gravity and whose physical meaning is yet to be confirmed. Thus the gravitational electric charge for the proton is

*Gravitational electric charge for the proton*

$$Q_{gp} = 2\,m_p\sqrt{\pi\,\epsilon_o\,G} \tag{3}$$

The value of this electric charge is

$$Q_{gp} = 1.441\ \ 335\ \ 021\ \times 10^{-37}\ C \tag{4}$$

If we calculate the absolute value of the ratio between the gravitational electric charge and the charge of the electron we find that the gravitational electric charge is much smaller than the elementary charge, $e$

$$\text{abs}\left(\frac{Q_{gp}}{e}\right) = \frac{1.441\ 335\ 021\times 10^{-37}\,C}{1.602\ 176\ 565\times 10^{-19}\,C} = 8.996\,106\times 10^{-19} \tag{5}$$

Therefore the gravitational electric charge is incredibly small. If this electric charge exits, then, it would explain why it was never observed.

If we square this ratio and multiply it by the electromagnetic coupling constant, $\alpha$ , we get

$$\alpha\left(\frac{Q_{gp}}{e}\right)^2 = \alpha\left(\frac{2\,m_p\sqrt{\pi\,\epsilon_o\,G}}{e}\right)^2 \tag{6}$$

The value of this quantity is

$$\alpha\left(\frac{Q_{gp}}{e}\right)^2 = 5.905\ 741\ 832\times 10^{-39} \tag{7}$$

We recognize this value as the gravitational coupling constant for the proton, thus, we can write

*Gravitational coupling constant for the proton*

$$\alpha_G = \alpha\left(\frac{Q_{gp}}{e}\right)^2 \tag{8}$$

The last equation is the formula for the gravitational coupling constant for the proton in terms of two electric charges, $Q_{gp}$ and $e$ , and the electromagnetic coupling constant. If we do some algebra on equation (8) we shall get to the more familiar expression

$$\alpha_G = \left(\frac{m_p}{M_P}\right)^2 \tag{9}$$

Where $M_P$ is the Planck's mass which is defined as

$$\textit{Planck mass} \qquad M_P \equiv \sqrt{\frac{hc}{2\pi G}} \tag{10}$$

## 2. Conclusions

If exists, the gravitational electric charge would be an electrical charge produced by gravity. Furthermore, it would indicate that gravity is also a feeble electromagnetic force.

The questions we might ask ourselves are: What is the physical meaning of $Q_{gp}$ ? Is $Q_{gp}$ a real electric charge associated with the proton or is simply a mathematical illusion? Do all charge particles have also a gravitational electric charge associated with them? Do neutral particles, such as neutrons, possess gravitational electrical charges as well? In other words, do all particles in the universe possess gravitational electric charges in the manner described by the general equation

$$\textit{General equation for the gravitational electric charge} \qquad Q_g = \left(2\sqrt{\pi \epsilon_o G}\right) m \tag{11}$$

that we haven't been able to measure yet?

We may also define the proportionality constant, $K_{Gm}$ , that converts masses into electric charges and viceversa

$$K_{Gm} \equiv 2\sqrt{\pi \epsilon_o G} = 8.617\,220\,23 \times 10^{-11}\, C/Kg \tag{12}$$

Another point to consider is that according to the QCD theory, the minimum positive electrical charge in nature is *e*/3, which is the electric charge of the $\bar{d}$ , $\bar{s}$ and $\bar{b}$ anti-quarks. The gravitational electric charge is, however, much smaller than the QCD limit. But we have to remember that the origin of the electric charge is unknown, so that, gravity could play an unknown and mysterious electromagnetic roll, that we should not discard at priori. Another point to observe is that the value of $Q_{gp}$ is so small that we do not have any chance to conduct and experiment to detect it at the present time. So how can we discard something that we may possibly detect one day? In the past the ripples of space-time were too small to detect directly but the technical difficulties were overcome by LIGO and gravitational waves were finally detect it on September 14, 2015. With respect to the above questions, I do not have an answer so, maybe, time will tell.