# The Nature of Gravitation

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## Abstract

Taking into account the equivalent principle of Einstein and the special relativity equations, we infered, for a flat space time, a new formulae of gravitation. We assume two reference frames, one of these at rest, in the center of gravitatiuonal field, and another one, corresponding to the field itselft. If the gravitational field is an inverse square law, the rest frame field results a modified newtonian force. We applicate the same procedure to the electrical field and results a weak force comparable with gravitation strength. The proportional constant must be the gravitational constant. We calculate the gravitatiobal constant using the value of the electrical constant and the parameter of the electron, and we found a close value with the expererimental results sugesting the the gravitation is a residual product of the electricity.

**Key words**: gravitation

## 1 Introduction

General Relativity (GR) is sustained by the Equivalent Principles (EP) of Einstein. The consequences of EP are that the special relativity is locally valid in each point of a Gravitational Field (GF), and the GF is equivalent to an accelerated reference frame. GR was elaborated with curved space. In this paper we use the EP in the way it was postulated, without curved space, and we shall deduce the GF at rest frame centered in the mass M from that of an accelerated frame moving radially in a newtonian GF. Then we make the same for an electrical field. Finally, we obtaine the sum of the forces between an electron and a proton and analize the results.

## 2 The Rest Frame Gravitational Field

We have to consider two reference frames: one of these at rest, centered in the GF, and the another one corresponding to the GF itself. Then, we have to obtain the GF in the first frame, from the second one. Let S be the reference frame centered in a puntual mass M. Let S' be the instantaneous rest frame of a particle moving freely in a newtonian GF, being its velocity at infinity cero. S and S' are in standard configuration, i.e. their origins at $t = 0$ and their axis in the direction of motion coincide. In every instantaneous position, S' moves with constant velocity $v$, while the particle position and velocity measured in this reference frame is momentarily cero. This is in accordance with the EP, then we can use the special relativity equations to derive the acceleration in both reference frames.

Let $w$ and $w'$ be the velocities of a particle, measured in S and S' respectively. From special relativity, we have

$$w = \frac{(w' + v)}{(1 + w'v/c^2)}.$$

Then

$$dw = \frac{(1 + w'v/c^2) - (w' + v)v/c^2}{(1 + w'v/c^2)^2} dw'.$$

Momentarily $w' = 0$ and $w = v$, being $v$ constant while $w$ and $w'$ are not.

Then $dw = (1 - w^2/c^2)dw' = \gamma^{-2}(w)dw'$

by time dilation $dt' = dt\gamma^{-1}(w)$

Let $\alpha = dw'/dt'$ be the acceleration respect to its instantaneous rest frame.

Thus $dw = \alpha dt \gamma^{-3}(w)$

and $dw'/dt' = (1 - w^2/c^2)^{-\frac{3}{2}} dw/dt$

This equation relates the acceleration in both reference frames. Let $r$ and $r'$ be the instantaneous distance modulus between the origins of S and S', measured in first and second frames, respectively. We introduce here the newtonian law for S' frame. Then we have

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$$dw'/dt' = -\frac{GM}{(r')^2}$$

by length contraction

$$dw'/dt' = -\frac{GM}{r^2}(1-w^2/c^2)^{-1}$$ or

$$\frac{dw/dt}{\sqrt{1-w^2/c^2}} = -\frac{GM}{r^2}$$

$$\frac{(dw/dr)(dr/dt)}{\sqrt{1-w^2/c^2}} = \frac{wdw/dr}{\sqrt{1-w^2/c^2}}$$

$$\frac{wdw}{\sqrt{1-w^2/c^2}} = -\frac{GM}{r^2}dr$$

We introduce the variable $\sigma = w^2/c^2$

so

$$d\sigma = 2wdw/c^2$$

Then we have

$$\frac{c^2}{2}\frac{d\sigma}{\sqrt{1-\sigma}} = -\frac{GM}{r^2}dr$$

Integrating

$$-c^2\sqrt{1-\sigma} = \frac{GM}{r} + C\,.$$

We take $w = 0$ at $r = \infty$ . Depending on the sign of the square root we have

$C = \pm c^2$, and

$$\sqrt{1-w^2/c^2} = \left(1-\frac{GM}{c^2 r}\right)$$

or

$$dw/dt = -\frac{GM}{r^2}\left(1-\frac{GM}{c^2 r}\right)$$

This is finally the force per mass unit in the reference frame S. The equation is a modified newtonian law, being stronger at shorter distancies, comparing with the square law alone.

## 3 A Subproduc of Electricity

The inverse square law for electrical field can be deducted a follow:

the distance per unit time can be written as $\frac{c}{r}$, the asceleration as $\frac{c^2}{r^2}$

The electrical force per unit mass can be replaced as $\frac{kq^2}{mr^2}$, where k is the Coulomb constant, q the electrical charge, m the mass of the electron, and c the velocity of light.

If generalize the equivatece between the gravitational fiel and a ascelerated reference frame to the electrical fiels, the electrical force per unit mass is:

$$dw/dt = -\frac{kq^2}{mr^2}\left(1 - \frac{kq^2}{mc^2 r}\right)$$

The electrical force $\frac{kq^2}{r^2}$ excert by the electron and the proton together is cero, but the field due to the sum of forces showed by the previous equation gives

$\frac{kq^2}{c^2r^3}\frac{m_p - m_e}{m_p.m_e}$, where $m_p$ and $m_e$ are the masses of proton and electron. This quantity is aproximately

$$\frac{kq^2}{m_e c^2 r^3}$$

which is not cero, and because the weakness of it there is the suspection to be the responsable of gravitation. From this point of view the gravitation is a residual of electric force, a sub product of it.

The integrated force excerted by two masses would be the gravitational forces betwen the masses. The integration over all the azimuthal angles and the meridien angles plus the integration over a sphere of radius R, two integration from the origin to the spheres and another over both spheres, have to multiplie by two factor of $2\pi$ and $\frac{4}{3}\pi$, all squared because the two masses. The force is inversally proportional to the cube of distance, but after the integration is inversally proportional to the squere of distance. If this force is the gavitational force then the proportional constant must be the gravitational constant G. This is a crucial point because it would demonstrate our tesis. Thus G is

$$G = \frac{kq^2}{m_e.c^2}.16/9.4.\pi^7$$

With the values $k = 10^{10} New - m^2/coul^2$, $q = 1.6x10^{-19} coul$, $m = 9x10^{-31} kg$, $c^2 = 9x10^{16} m/seg$, the final value is $G = 6.7810^{-11} N.m^2/kg^2$. The experimental value for G is $6,6710^{-11} N.m^2/kg^2$, which is close to our value. However our vale was obtaine theoretically, from the electrical constant and the parameters of the electron.

Finally it is important to pointed out that the artificial generation of antigravitation or levitation it is possible to carried out, since the force depends of the diference between the mass of electron and proton. If it is possible to enhance the electron masses comparable with the proton masses the force is avoided. In particular if an electrical current is passed through a cable at an enough potential, the cable will suffer an antigravitation effect.