ISSN: 2639-0108

Research Article

Advances in Theoretical & Computational Physics

A Cause of Force of Gravity between Bodies

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Submitted: 17 Oct 2019; **Accepted**: 25 Oct 2019; **Published**: 29 Oct 2019

Abstract

An isolated electric charge, in the form of an indestructible spherical shell of radius a, has its straight and radial electric fields pulling the surface charge equally outwards, directed from the center, to maintain an equilibrium. Any imbalance in the field lines of force causes the charge to move, with acceleration, in the direction of the resultant force. The field lines of adjacent charges become curved to make for the force of repulsion or attraction. It is proposed that the electric field lines from a charge open out slightly, on encountering a like charge in space, thereby reducing the force of repulsion. The field lines close in slightly, against an unlike charge, to increase the force of attraction. Thus, there is a net force of attraction between two neutral bodies composed of equal numbers of positive and negative charges. For a neutral body, the strong electrical forces of repulsion and attraction, proportional to the magnitude of a charge, in accordance with Coulomb's law, cancel out everywhere. The weak gravitational forces of attraction, proportional to the mass of a charge, which is also proportional to the square of magnitude of a charge, in accordance with Newton's law, remain and add up. It is shown that gravity is a pulling force of attraction and an electrical property emanating from a body, not a result of curvature of empty space surrounding the body, as envisaged by the theory of general relativity.

Keywords: Acceleration, Electric Charge, Electric Field, Force, Gravity, Mass, Space, Relativity, Velocity

Introduction

Over the ages, gravity has remained an enigma. The cause of gravity, such a pervasive and persistent force, may be so simple as to escape rational interpretation by modern physicists, who are racing, in the search of knowledge, at breakneck speed. Gravitation succumbed to complicated theories and complex mathematical equations. Hence, emerged the formulation of the theory of general relativity or Einstein's theory of gravitation [1-4]. Einstein's theory of general relativity which ascribes gravity to distortion, curvature or warping of four-dimensional space-time continuum, in the presence of matter, is a brilliant, revolutionary and very appealing proposition. It is the reigning doctrine of physics today. However, it is difficult to imagine how empty space, a vacuum, could become curved or distorted. It might as well be that in the presence of matter, something that is physical and could be curved, like electric field lines from electric charges, are produced from matter, to permeate empty space as the luminiferous aether.

Coulomb's inverse square law of force between two electric charges, the most important principle in physics, is the working principle of this paper. The paper gives a physical explanation of the cause of force of gravity based on force of repulsion between two like charges being slightly decreased (below the Coulomb force) and the force of attraction between two unlike charges being similarly increased The paper also explains the force of gravity between two neutral bodies each containing equal numbers of positive and negative electric charges. Let us start with the physical configuration, energy and mass of an electric charge.

Mass of an electric charge

If an electrically charged particle, like the electron, is to assume any configuration, it is most likely to be an indestructible spherical shell of radius a. The radial electric fields, directed from the center, pull the surface of the shell of such a spherical charge equally outwards, to maintain a stable structure of radius *a*.

The author showed that the intrinsic energy E_n and mass m of an electric charge of magnitude Q, in the form of a spherical shell of constant diameter$2a$, as minimum length obtainable in nature [5], are given by:

$$E_n = \frac{Q^2}{8\pi\varepsilon_o a} = \frac{1}{2}mc^2 \quad (1)$$

$$m = \frac{\mu_o Q^2}{4\pi\varepsilon_o a} \quad (2)$$

The speed of light c, in space, as determined by James Clerk Maxwell [6], is given by:

$$c = \frac{1}{\sqrt{\mu_o \varepsilon_o}} \quad (3)$$

where μ_o is the permeability and ε_o the permittivity of electric fields in space. As such, m is proportional to Q^2, and there should be a gravitational force of attraction between two electric charges, in accordance with Newton's universal law of gravity [7]. The mass m is a constant, independent of speed of a charged particle, contrary to t Einstein's theory of special relativity [8, 9].

Field lines of an electric charge

Figure *1A* shows an isolated positive charge with straight and radial lines of the electric field directed from the center, away from the charge. In Figure *1B* the straight lines of a negative charge are directed towards the charge. The lines, indicated by arrows, show the direction of force on a positive charge placed in the field. The lines of force are equally pulling the surface charge (positive or negative) outwards. In other words, the fields of an electric charge act equally, from the center, on the same charge to keep it in equilibrium. With no resultant force on the charge, it remains stationary or moves with a constant velocity **v**, taking its straight and radial field lines along with it, without distortion, as in Figures *1A* and *IB*. Any imbalance in the fields of an electric charge will cause the charge to move in the direction of the resultant electric field or force, with acceleration or deceleration in accordance with Newton's laws of motion [7], and with manifestation of inertia [10].

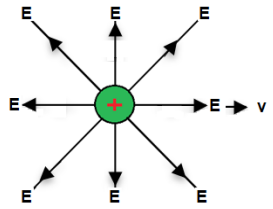

Figure 1A: Radial electrostatic field **E** lines of an isolated positive charge in the form of a spherical shell of radius a moving with constant velocity **v**.

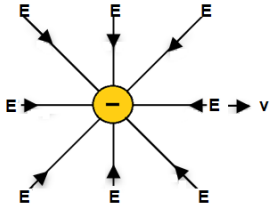

Figure 1B: Radial electrostatic field **E** lines of an isolated negative charge in the form of a spherical shell of radius a moving with constant velocity **v**.

It is useful to conceive of the field lines of an electric charge as acting on the charge producing it, equally pulling it outwards, directed from the center. Due to the finite speed of light, if the charge in Figure 1A or 1B suffers acceleration, $d\mathbf{v}/dt$ at time t, the change in velocity is not instantaneously communicated to all the fields. Fields lines inclined to the direction of velocity become curved to produce a component force in the opposite direction of acceleration. This gives the inertial force, equal and opposite to the accelerating force. Here in lies a physical explanation for inertia as a self-induced force. However, this paper is not concerned with electrodynamics [11], magnetic field or induction electric field [12], but gravity as a force of attraction between bodies, stationary or moving.

Figure 2*A* depicts two separated and stationary like charges under repulsion and in Figure 2*B* the two (stationary) unlike charges are under attraction. The field lines here are no longer straight but curved to make for the force of repulsion or force of attraction.

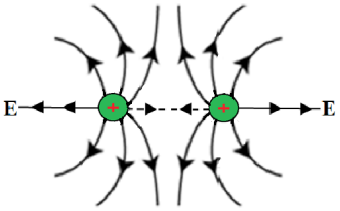

Figure 2A: Field lines of stationary like charges under repulsion.

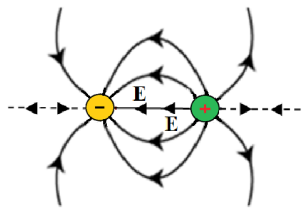

Figure 2B: Field lines of stationary unlike charges under attraction.

In Figure *2A*, with the force lines directly between the two charges subtracting but adding behind them, the charges appear as being pulled away from one another by a repulsive force. In Figure *2B*, with the force lines directly behind the two charges subtracting but adding between them, the charges appear as being pulled towards one another with a force of attraction. This gives a physical explanation of electrostatic forces of repulsion and attraction.

Electrostatic and gravitational forces

Figure 3 shows two electric charges of magnitudes Q and K as spherical shells of radii a and b and masses m_1 and m_2 respectively, distance r apart. The small force **f**, between the charges, is a combination of electrostatic forces of repulsion or attraction given by Coulomb's law and gravitational force of attraction given by Newton's universal law of gravity [7], thus:

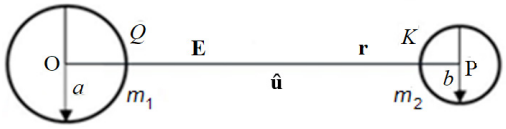

Figure 3: Force between electric charges Q at O and K at P separated by distance r in space

$$\mathbf{f} = \pm\frac{QK}{4\pi\varepsilon_o r^2}\hat{\mathbf{u}} - G\frac{m_1 m_2}{r^2}\hat{\mathbf{u}} \qquad (4)$$

where $\hat{\mathbf{u}}$ is a unit vector in the direction of force of repulsion and G is the gravitational constant. In equation (4) the force of repulsion is positive between like charges or attractive (negative) between unlike charges. The force of gravity is always attractive.

Substituting for the masses m_1 and m_2 from equation (2), where m_1 is proportional to Q^2 and m_2 is proportional to K^2, into equation (4), gives the force of repulsion, as:

$$\mathbf{f} = \frac{QK}{4\pi\varepsilon_o r^2}\hat{\mathbf{u}} - G\frac{m_1 m_2}{r^2}\hat{\mathbf{u}} = \frac{QK}{4\pi\varepsilon_o r^2}\hat{\mathbf{u}} - \chi\frac{Q^2K^2}{r^2}\hat{\mathbf{u}} \qquad (5)$$

where χ = is a "magneto-gravity" constant. For unlike charges, force of attraction becomes:

$$\mathbf{f} = -\frac{QK}{4\pi\varepsilon_o r^2}\hat{\mathbf{u}} - \chi\frac{Q^2K^2}{r^2}\hat{\mathbf{u}} = -\left(\frac{QK}{4\pi\varepsilon_o r^2} + \chi\frac{Q^2K^2}{r^2}\right)\hat{\mathbf{u}} \qquad (6)$$

The gravitational force of attraction in equations (5) and (6) is:

$$\mathbf{f}_G = -\chi \frac{Q^2K^2}{r^2}\hat{\mathbf{u}} \qquad (7)$$

Decrease in the force of repulsion

If an electric field emanating from a charge Q encounters another charge K in space, as in Figure 3, the field is not likely to remain unaffected. It is proposed that an electric field $\mathbf{E}_Q$, from the charge Q, on encountering a like charge K at its location, is slightly reduced (by opening out?) to $\mathbf{E}_Q - \alpha K\mathbf{E}_Q$, where α is a constant of proportionality. The force of repulsion on charge K is slightly reduced and it becomes:

$$\mathbf{f} = (\mathbf{E}_Q - \alpha K\mathbf{E}_Q)\,\mathrm{K} \qquad (8)$$

Similarly, the equal force of repulsion on charge Q, due to field $\mathbf{E}_K$ from charge K, becomes:

$$\mathbf{f} = (\mathbf{E}_K - \beta Q\mathbf{E}_K)\,\mathrm{Q} = (\mathbf{E}_Q - \alpha K\mathbf{E}_Q)\,K \qquad (9)$$

where β is another constant. Equations (8) and (9), with $K\mathbf{E}_Q = Q\mathbf{E}_k$, gives:

$$\alpha K = \beta Q \qquad (10)$$

Equations (10) obtains if $\alpha = xQ$ and $\beta = xK$, where x is a constant, giving equations (8) as:

$$\mathbf{f} = \mathbf{E}_Q K - xQK^2\mathbf{E}_Q = \frac{QK}{4\pi\varepsilon_o r^2} - \frac{xQ^2K^2}{4\pi\varepsilon_o r^2} \qquad (11)$$

Equation (11) is identical to equation (5) if $x/4\pi\varepsilon_o = \chi$.

Increase in the force of attraction

An electric field $\mathbf{E}_Q$, from a charge Q, on encountering an unlike charge, $-K$ at its location, is slightly increased (by closing in?) to $\mathbf{E}_Q + \alpha K\mathbf{E}_Q$, where α is a constant of proportionality. The force of attraction on charge K is slightly increased and it becomes:

$$\mathbf{f} = -(\mathbf{E}_Q + \alpha K\mathbf{E}_Q)\,K \qquad (12)$$

An equal force of attraction on charge Q is:

$$\mathbf{f} = -(\mathbf{E}_K + \beta Q\mathbf{E}_K)\,Q = -(\mathbf{E}_Q + \alpha K\mathbf{E}_Q)\,K \qquad (13)$$

where β is another constant. Equations (12) and (13), with $K\mathbf{E}_Q = Q\,\mathbf{E}_k$, gives:

$$\alpha K = \beta Q \qquad (14)$$

Equations (14) obtains if $\alpha = xQ$ and $\beta = xK$, where x is a constant, giving equations (12) as:

$$\mathbf{f} = -\left(\mathbf{E}_Q K + xQK^2\mathbf{E}_Q\right) = -\left(\frac{QK}{4\pi\varepsilon_o r^2} + \frac{xK^2Q^2}{4\pi\varepsilon_o r^2}\right) \qquad (15)$$

Equation (11) is identical to equation (5) and equation (15) is identical to equation (6) if $x/4\pi\varepsilon_o = \chi$, the 'magneto-gravity' constant.

"Magneto-gravity" Constant

Equation (5) gives the "magneto-gravity", a new physical constant χ, as:

$$\chi = \frac{Gm_1m_2}{Q^2K^2} \qquad (16)$$

Substituting for $m_1 \propto Q^2$ and $m_2 \propto K^2$ from equation (3) into equation (16), with charges of the same magnitude and same radius a, gives the "magneto-gravity" constant, as:

$$\chi = G\left(\frac{\mu_o}{4\pi a}\right)^2 \qquad (17)$$

Force of gravity between neutral bodies

A neutral body consists of equal numbers or equal amounts of positive and negative electric charges. It is obvious that a neutral body does not have a resultant electric field to exert any force of repulsion or attraction on other bodies or other charges, but the gravitational forces of attraction remain.

The gravitational force of attraction $\mathbf{F}_G$ between one body of mass M_1 consisting of $N_1/2$ positive charges and $N_1/2$ negative charges, each of magnitude Q and another body of mass M_2 containing $N_2/2$ positive charges and $N_2/2$ negative charges, each of magnitude K, is obtained from equations (7), as the product of sums, thus:

$$\mathbf{F}_G = -G\frac{M_1M_2}{Z^2}\hat{\mathbf{u}} = -\frac{\chi}{Z^2}\sum_{n=1}^{N_1}Q_n^2\sum_{n=1}^{N_2}K_n^2\hat{\mathbf{u}} = -\frac{\chi}{Z^2}N_1N_2Q^2K^2\hat{\mathbf{u}} \qquad (18)$$

where Z is the distance between the centers of gravity of the masses.

Results and discussion

- Newton's second law of motion, Coulomb's law of electrostatic force and basic electrostatic, electromagnetic and electro dynamic principles are employed to explain the causes of gravity without recourse to the theories of relativity or any other theory.
- It is found that the electric fields of a charged particle exert a pulling force on the charge and that the force of repulsion or attraction, between two charged particles, is due to curvature of the field lines.
- Equation (7) is a unification of electrostatic and gravitational forces between two electric charges and equation (18) is the force of gravity between two neutral bodies.
- The results of this paper put to question the notion of four-dimensional space-time continuum which explains gravity as a result of curvature, distortion or warping of space-time continuum in the presence of matter.
- If an electric charge is to assume any configuration, it is most likely to be a spherical shell of radius a, with mass $m = \mu_o Q^2/4\pi a$ and intrinsic energy $E_n = Q^2/8\pi\varepsilon_o a = ½\ mc^2$. Such a particle should exist as an indivisible negative charge (electron) or positive charge (positron), joining to form a "unitron" at center separation of $2a$, with potential energy-$Q^2/8\pi\varepsilon_o a$, mass $m = \mu_o Q^2/4\pi a$ and intrinsic energy $2E_n$.
- In this paper curvature appears in the electric field lines of force for an electric charge, to account for force of repulsion or attraction between charges, gravitational force of attraction between masses and the inertia of an accelerated body.
- A new physical constant χ, "magneto-gravity constant", is introduced, of value:

- $\chi = G(\mu_o/4\pi a)^2 = 8.410x10^4$ *newton-(meter)^2 per (coulomb)^4.G* is the gravitational constant, μ_o the permeability and *a* is the radius of the electron.

Conclusions

- Gravitation is a pulling force of attraction between two neutral bodies in space, each composed of equal numbers of positive and negative electric charges, and a result of force of repulsion between like charges being slightly reduced and force of attraction between unlike charges similarly increased.
- Space is not empty but consists of electric fields emanating from electric charges in a body, in accordance with Coulomb's law, to constitute the aether as a medium for light propagation. In a neutral body the sum of electrical charges and the resultant of their fields are zero but the sum of square of the charges remain to account for mass of the body and the gravitational force of attraction between bodies.

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