Gravity ab Initio

Part I

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Abstract

A simple theory is put forward that unifies Newton's law of gravity and Coulomb's law for charged particles. An equation with its solutions is presented and is the mathematical framework that connects both laws. An underlying principle on which the derivation of the equation was based on is proposed. The result is that a simple underlying physical principle of two densities trying to reach equilibrium, combined with a few equations, yields both Newton's and Coulombs' laws. This work tries to sum up the current state of this theory, which is still in its very beginning stages.

Keywords

Newton's law, Coulomb's law, gravity, electrostatics, unification, density

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1. Introduction

This work tries to put forward a theory that unifies Newton's law of gravity and Coulomb's law for charged particles. For now it is only applicable to static elementary particles. In this part I the mathematical framework for this unification is presented. The underlying principle on which the derivation of this framework was based on is also described, but this hypothesis is further contemplated in other publications [1].

2. The Equation

The equation presented here is in the form F(X,Y), where F is the force that particle X exerts on particle Y.

$$F(X,Y) = \frac{(X_r - X_v) \cdot Y_r + (X_b - X_v) \cdot Y_b}{2 \cdot r^2} \tag{1}$$

Let's put this equation and its variables in proper context. Here it is presumed that instead of mass and electric charge, every particle P is described with three properties P_r, P_b and P_v. For now it would be easiest if we think of these properties as three special charges: red, blue and violet, because charges are what we are most familiar with in physics today.

We see that violet charge is a bit special, because all interactions are proportional to the difference between other two charges (red and blue) to the violet charge. Equation 1 could also be written with three terms, the third term being $(X_v\text{-}X_v)\cdot Y_v$, but this term is of course always zero.

For now this equation is just a bunch of letters and numbers. How do we know that it really represents and unifies both Newton's and Coulomb's law? We need to find a solution and determine the values for the red, blue and violet charges of elementary particles, so that the equation 1 satisfies both laws. And these values are as follows:

$$P_r = P_m + \sqrt{k_e} \cdot P_q \tag{2}$$

$$P_b = P_m - \sqrt{k_e} \cdot P_q \tag{3}$$

$$P_v = P_m + G \cdot P_m \tag{4}$$

Here P_m is the mass of the elementary particle P, and P_q is its electric charge. G is gravitational constant and k_e is Coulomb constant $k_e=1/4\pi\varepsilon_0$.

Let's now insert equations 2, 3, 4 into the equation 1 and compare it to the original equation 5 of Newton's and Coulomb's law.

$$F(X,Y) = k_e \cdot \frac{X_q \cdot Y_q}{r^2} - G \cdot \frac{X_m \cdot Y_m}{r^2} \tag{5}$$

2.1 Example

For the general example we can now insert relations 2, 3, 4 into the equation 1.

$$F(X,Y) = \frac{(X_m + \sqrt{k_e} \cdot X_q - X_m - G \cdot X_m) \cdot (Y_m + \sqrt{k_e} \cdot Y_q) + (X_m - \sqrt{k_e} \cdot X_q - X_m - G \cdot X_m) \cdot (Y_m - \sqrt{k_e} \cdot Y_q)}{2 \cdot r^2}$$

$$= \frac{(\sqrt{k_e} \cdot X_q - G \cdot X_m) \cdot (Y_m + \sqrt{k_e} \cdot Y_q) + (-\sqrt{k_e} \cdot X_q - G \cdot X_m) \cdot (Y_m - \sqrt{k_e} \cdot Y_q)}{2 \cdot r^2}$$

$$= \frac{\sqrt{k_e} \cdot X_q \cdot Y_m + k_e \cdot X_q \cdot Y_q - G \cdot X_m \cdot Y_m - G \cdot X_m \cdot \sqrt{k_e} \cdot Y_q - \sqrt{k_e} \cdot X_q \cdot Y_m + k_e \cdot X_q \cdot Y_q - G \cdot X_m \cdot Y_m + G \cdot X_m \cdot \sqrt{k_e} \cdot Y_q}{2 \cdot r^2}$$

$$= \frac{2 \cdot k_e \cdot X_q \cdot Y_q - 2 \cdot G \cdot X_m \cdot Y_m}{2 \cdot r^2}$$

$$= k_e \cdot \frac{X_q \cdot Y_q}{r^2} - G \cdot \frac{X_m \cdot Y_m}{r^2}$$

The equation 1 and relations 2, 3, 4 hold, and we get the same result as with Newton's and Coulomb's law! Particles are now described with three properties (red, blue and violet charge) instead of just two (mass and electric charge), but we don't need any constants. The force equation needs five variables (violet charge for Y particle is not in the equation 1) instead of just four variables in the classical equation. I think a couple more variables is a reasonable price for unification of gravitational and electrical force. We are not invoking higher dimensions or any other strange phenomena. Note that this is true unification in a sense that equation 1 is the more general and basic one, from which gravitational and electrical force come as emergent one. We have just one principle (the difference between red, blue charges and the violet charge) from which two familiar principles of gravitational and electrical force emerge. The blue and red terms contribute both to gravitational and electrical force, it is not like one is for gravitational and the other is for electrical force. Also note that we get the correct negative sign for gravitational force. There is no need to assert in the equation that gravity is attractive force as we do in Newton's law. Here it just comes out naturally.

If this example is too general, you can calculate various interactions between electron, proton and neutron with the help of the following relations.

	Electron	**Proton**	**Neutron**
Red	$E_m + \sqrt{k_e} \cdot E_q$	$P_m + \sqrt{k_e} \cdot P_q$	N_m
Blue	$E_m - \sqrt{k_e} \cdot E_q$	$P_m - \sqrt{k_e} \cdot P_q$	N_m
Violet	$E_m + G \cdot E_m$	$P_m + G \cdot P_m$	$N_m + G \cdot N_m$

2.2 Second form

We can rewrite equations 2, 3, 4 by noticing that on the right hand we have only three different terms: P_m,$\sqrt{k_e}\cdot P_q$, $G\cdot P_m$. Let's write them as P, DP and dP. We can now also say that instead of red, blue and violet charges a particle is completely described by these three parameters.

$$P_r = P + DP \tag{6}$$

$$P_b = P - DP \tag{7}$$

$$P_v = P + dP \tag{8}$$

Insert now these relations from equations 6, 7, 8 into equation 1.

$$F(X,Y) = \frac{(X + DX - X - dX)\cdot(Y + DY) + (X - DX - X - dX)\cdot(Y - DY)}{2\cdot r^2}$$

$$= \frac{(DX - dX)\cdot(Y + DY) + (-DX - dX)\cdot(Y - DY)}{2\cdot r^2}$$

$$= \frac{(DX\cdot Y + DX\cdot DY - dX\cdot Y - dX\cdot DY) + \ (-DX\cdot Y + DX\cdot DY - dX\cdot Y + dX\cdot DY)}{2\cdot r^2}$$

$$= \frac{(+2\cdot DX\cdot DY - 2\cdot dX\cdot Y)}{2\cdot r^2}$$

$$= \frac{DX\cdot DY - dX\cdot Y}{r^2} \tag{9}$$

Here we see that the term DX·DY is connected with electrical force and term dX·Y with gravitational force. Electrical force is dependent on parameter DP of both particles, while gravitational force is dependent on dP parameter of the first particle and P parameter of the second particle. Note that DX·DY term can of course also have negative sign.

2.3 Two trivial solutions

In this chapter two trivial solutions to equation 1 are presented. They are trivial in a sense that for both we set violet charge of both particles to zero. The first solution reduces to Newton's and Coulomb's law, and the second is a bit more involved.

First

Let us look at the equation 1 when violet charge is zero for both particles.

$$F(X,Y) = \frac{(X_r)\cdot Y_r + (X_b)\cdot Y_b}{2\cdot r^2} \tag{10}$$

We can see immediately that this equation is very similar to both classical equations. We just ascribe red charge to electrical force and blue charge to gravitational force (it could of course be the other way around), and get the following solution.

$$P_r = \sqrt{2 \cdot k_e \cdot P_q} \tag{11}$$

$$P_b = i \cdot \sqrt{2 \cdot G \cdot P_m} \tag{12}$$

$$P_v = 0 \tag{13}$$

Because our equation 10 doesn't have constants, the gravitational and Coulomb constant must be contained in the values for the red and blue charges. Because equation 10 is divided by 2, we get the √2 factor. Also we cannot just change the sign from plus to minus just because we now have blue charge related to gravity. So we get also the imaginary i factor to take care of the minus sign.

Second

Here both the red and blue charges have imaginary and real component. But not like the previous solution, each charge contributes both to gravitational and electrical force. The advantage of this solution is that we don't need three variables to describe a particle but just two – red and blue charge. It is very similar to solution in equations 2, 3, 4, the only difference being $i \cdot \sqrt{G}$ factor and of course zero violet charge.

$$P_r = i \cdot \sqrt{G} \cdot P_m + \sqrt{k_e} \cdot P_q \tag{14}$$

$$P_b = i \cdot \sqrt{G} \cdot P_m - \sqrt{k_e} \cdot P_q \tag{15}$$

$$P_v = 0 \tag{16}$$

Note that we get the constants $\sqrt{G}$ and $\sqrt{k_e}$ in our solutions, because we want to get the correct results directly from the red and blue charges inserted in equation 1, without additional constants afterwards. Imaginary unit i is there to take care of the negative sign for gravity. As interesting as it might be, this solution won't be further contemplated and developed in this work.

2.4 Other solutions

We can get many (infinitely many) different solutions of the same form as in the equations 2, 3, 4. Why I chose that specific one will be somewhat explained in part two. These are the necessary steps to calculate P, DP and dP for arbitrary elementary particle P.

a. Guess the value P of some neutral particle. There is nothing wrong with guessing, that is how new theories begin. I will choose neutron as my neutral particle and call this value N, but it can be any other neutral particle.
b. Calculate dN out of equation 9 and Newton's law for two neutrons (the inverse square relation is omitted for simplicity).

$$dN \cdot N = G \cdot m_n \cdot m_n => dN = \frac{G \cdot m_n \cdot m_n}{N} \tag{17}$$

c. Calculate dP and P of any arbitrary particle out of equation 9, equation 17 and Newton's law for the arbitrary particle and your neutral particle.

$$dP \cdot N = G \cdot m_p \cdot m_n => dP = G \cdot m_p \cdot \frac{m_n}{N} \tag{18}$$

$$dN \cdot P = G \cdot m_n \cdot m_p => P = \frac{G \cdot m_n \cdot m_p}{dN} = \frac{G \cdot m_n \cdot m_p \cdot N}{G \cdot m_n \cdot m_n} = m_p \cdot \frac{N}{m_n} \tag{19}$$

d. Calculate DP of an arbitrary charged particle out of equation 9 and Coulombs law for two such arbitrary particles.

$$DP \cdot DP = k_e \cdot Q_p \cdot Q_p => DP = \sqrt{k_e} \cdot Q_p \tag{20}$$

You can easily get the relations in table 1 if your "guess" for the value N is $N=m_n$. Also you get the simplest terms this way.

2.5 Units

So far I have said nothing about the units of our red, blue and violet charge. Let's apply some dimensional analysis to our equations. We presume that all three charges have the same units. From equation 1 one can see that a product of two charges divided by length squared should yield dimension of force or Newton.

$$\frac{x \cdot x}{m^2} = N => x = \sqrt{N} \cdot m = \frac{\sqrt{kg \cdot m^3}}{s} \tag{21}$$

From equation 9 we know that gravitational force is dependent on dP parameter of the first (active) particle and P parameter of the second (passive) particle. Since P parameter is equal to mass of the second particle, and only active particle should contribute to gravitational acceleration, we get the following relation:

$$\frac{x}{m^2} = \frac{m}{s^2} => x = \frac{m^3}{s^2} \tag{22}$$

Now we have two different units for our charges, but they should be the same. If we now solve for kilograms we get:

$$\frac{\sqrt{kg \cdot m^3}}{s} = \frac{m^3}{s^2} => kg = \frac{m^3}{s^2} \tag{23}$$

This is quite interesting but not really a new result in physics. Others have suggested that the unit of mass should be m^3/s^2.

In equations 2, 3 and 4, I was only trying to get the correct numerical values for red, blue and violet charges, so that the equation 1 would hold. But if we use the $kg= m^3/s^2$ relation the units also hold, which is quite interesting in itself.

$$\sqrt{k_e} \cdot P_q => \sqrt{\frac{N \cdot m^2}{C^2}} \cdot C = \sqrt{N} \cdot m = \frac{m^3}{s^2} \tag{24}$$

$$G \cdot P_m => \frac{m^3}{kg \cdot s^2} \cdot kg = \frac{m^3}{s^2} \quad (25)$$

So the conclusion is that our charges have units or dimensions if you wish of m^3/s^2 which is also the dimension of mass. There is no need for a new name for this m^3/s^2 unit. But if there is one, then I in my infinite vanity of vanities propose the name Kopac or Kp.

3. Two densities

In chapter two, we presumed that each particle is described by or possesses three chargers: red, blue and violet. This was just for the sake of simplicity, because these three properties are necessary according to equation 1. There was no explanation about physical reality beneath such proposition. This can still be one of possible explanations, but here I propose a different explanation. Derivation of equation 1 was based on this "two densities" physical principle. Note that there are practically no equations here as this is just an intuitive hypothesis.

Here we propose that the universe as we know it and everything within it is composed of two kinds of small particles. We will call them red and blue atto particles. The prefix atto just implies that they are very small subatomic particles and does not describe their actual size. For particles like electron, proton and neutron we will use the term elementary particle.

The vacuum is composed of fixed density of both red and blue atto particles. The density of both particles in vacuum is exactly the same.

Elementary particles like electron, proton and neutron have different densities of these atto particles than vacuum. They can have higher or lower densities than vacuum, and can also have different densities of blue and red atto particles (remember vacuum has exactly the same density of both).

The forces that are exerted between elementary particles arise, because the nature wants to equalize these different densities in the vacuum and the elementary particles, and bring them to equilibrium.

Red atto particles can only interact with red atto particles, and blue ones only with blue ones.

Let us now put the properties that we called red, blue and violet charge in equations 2, 3 and 4 in the context of this explanation of physical reality behind these equations.

- P_r represents the number, or better yet the quantity of red atto particles inside an elementary particle. It is not the density, but the actual quantity, so density times volume.
- P_b represents the quantity of blue atto particles inside an elementary particle.
- P_v represents the quantity of red and blue atto particles, that would be present if instead of elementary particle, there would be vacuum in place of the elementary particle in question.

The simple explanation would be that because an elementary particle has less (or more) atto particles than surrounding vacuum, the atto particles in surrounding vacuum are attracted (or repelled) by this elementary particle. The force is proportional to this difference.

These atto particles in the surrounding vacuum then interact with atto particles in the second elementary particle. The more atto particles there are in the second elementary particle, the stronger the interaction (simply because more atto particles means there is a greater chance for vacuum atto particles to interact with them) and hence the force is proportional to the quantity of atto particles in the second elementary particle.

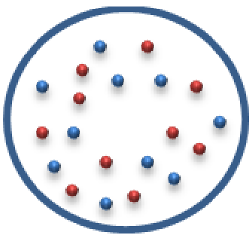
The $1/r^2$ relation is just another case of Gauss law.

3.1 Mass

So what constitutes mass in this "two densities" view of physical reality?

Gravitational mass is simply the absence or lack of atto particles, compared to vacuum. Every elementary particle that exhibits mass has smaller density of atto particles than vacuum.. In terms of equations 6, 7 and 8 this is exactly dP. In original solution this is $G \cdot P_m$ which is gravitational constant times classical mass.

Inertial mass is simply the average quantity of red and blue atto particles inside a given elementary particle - (blue + red)/2. In terms of equations 6, 7 and 8 this is exactly P. In original solution this is P_m which is classical mass. So in this view of physical reality gravitational and inertial mass are not the same but proportional, the constant of proportionality being gravitational constant.



Picture 1: gravitational mass (the emptiness in the middle) and inertial mass (all the red and blue atto particles)

3.2 Photon

What constitutes a photon in this "two densities" view of physical reality?

The proton is simply the emptiness or lack of atto particles which is not bound inside of some elementary particle, but is free in vacuum. When two elementary particles annihilate, their respective emptiness (which is dP) is unbound and freely moves in the vacuum with the speed of light. This is the photon.

4. Two scalar potentials

Here we propose that all the forces in the universe arise from two scalar potentials. We will call them red and blue potential. They are similar to electric potential and we can use a lot of the same math as with electric potential. Let's define these two potentials:

$$V_r = \frac{1}{2} \cdot \frac{P_r - P_v}{r}, V_b = \frac{1}{2} \cdot \frac{P_b - P_v}{r} \tag{26}$$

$$V_e = k_e \cdot \frac{Q}{r} \tag{27}$$

Here P_r, P_b and P_v are the same quantities as in the equations 2, 3 and 4. We called them red, blue and violet charge. V_e is electric potential, just for comparison and to show analogy between them.

Now we can define red and blue vector fields, similar as electric field:

$$E_r = -\nabla V_r, E_b = -\nabla V_b \tag{28}$$

$$E_r = \frac{1}{2} \cdot \frac{P_r - P_v}{r^2}, E_b = \frac{1}{2} \cdot \frac{P_b - P_v}{r^2} \tag{29}$$

$$E_e = -\nabla V_e = k_e \cdot \frac{Q}{r^2} \tag{30}$$

Now we can define the forces that are consequences of these vector fields:

$$F_r = E_r \cdot Y_r, F_b = E_b \cdot Y_b \tag{31}$$

$$F_e = E_e \cdot Y_q \tag{32}$$

Here Y_r, Y_b and Y_q stand for red, blue and electric charge of the "acted upon" particle. If we now write the force that particle X exerts on particle Y we get:

$$F(X,Y) = \frac{(X_r - X_v) \cdot Y_r + (X_b - X_v) \cdot Y_b}{2 \cdot r^2} \tag{33}$$

$$F_e(X,Y) = k_e \cdot \frac{X_q \cdot Y_q}{r^2} \tag{34}$$

The equation 33 is the same as equation 1. We have shown that these two (red and blue) scalar potentials with their respective vector fields are very similar to electric potential and electric field. The only difference is that red and blue scalar potentials are not dependent only on red and blue charges, but on the difference between them and the violet charge.

5. Conclusion

A unified theory gravity and electrostatics is presented. A simple underlying physical principle of two densities trying to reach equilibrium, combined with a few simple equations, yields both Newton's and Coulombs' laws. Such simple unification of gravitational and electrical fields I believe is interesting enough to warrant further investigation and research. This work tries to sum up the current state of this theory, so that others can advance it further. Since it is in its very beginning stages, there are bound to be lots of low hanging fruits, or maybe just a good exercise for young theoretical physicists.

References

[1] Tomaz Kopac, "Gravity ab Initio", Amazon Kindle edition.