Gravity as the cause for nuclear force and cosmological acceleration

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Abstract

The origin of the force holding protons and neutrons together in the nucleus has been one of the daunting puzzles of physics, regardless of the Standard Model explanation. One possible consideration is the force of gravity as responsible for the stability of the nucleus. However, this idea will be immediately dismissed because gravitational force as we know it is weaker than electromagnetic force by a factor of about 8×10^{-37} . This is the very reason that gravity has eluded the attention of physicists as a possible explanation of nuclear force. Nature has hidden its mystery for almost a century by looking ridiculous. We know gravitation as introduced by Newton and have been stuck with that for centuries. This paper reveals a drastically different law of gravitation that ultimately resolves the mystery of nuclear force. This theory also successfully explains the phenomenon of cosmological acceleration and the Pioneer Anomaly.

Introduction

The reason why the nucleus doesn't fly apart under the electrostatic repulsion forces of its protons, packed within an extremely small space (the diameter of the nucleus is of the order of $1\text{x}10^{-14}$ m) , was one of the long standing mysteries of physics. The origin of the force holding protons and neutrons together in the nucleus is explained in the Standard Model by the interaction of elementary particles called Quarks and Gluons. In this paper, we propose that both the stability of the nucleus and cosmological acceleration phenomenon may be due to the force of gravitation.

Gravity

In a previous paper[1] I have proposed that gravity is a difference between electrostatic attraction and repulsion forces. This idea was also supported by a compelling theory (Apparent Source Theory) and experimental and observational evidences[1].

The idea that gravity is a difference between electrostatic attraction and repulsion forces is a very compelling one. Since all neutral and charged objects contain both positive and negative charges, there will be both attractive and repulsive force between any two physical objects. The more massive an object is the larger number of positive and negative charges it contains and hence the greater the gravitational force.

The question follows: how can the attractive and repulsive forces be different ? The immediate idea that would come to mind is that the free space permittivity is different for attractive and repulsive forces.

Therefore, I restated Coulomb's law as [1]:

$$F_{att} = \frac{1}{4\pi\varepsilon_{att}} \frac{Q1 \, . \, Q2}{r^2}$$

$$F_{rep} = \frac{1}{4\pi\varepsilon_{rep}} \frac{Q1 \, . \, Q2}{r^2}$$

where ε_{att} is the permittivity of free space for opposite charges and ε_{rep} is for similar charges. However, I was never comfortable with the idea of different space permittivities for attractive and for repulsive forces. The conceptual problem I faced was this: which of the two permittivities will we use in Maxwell's equations? Or do I have to assume yet another permittivity to be applied in Maxwell's equations ?

However, regardless of the above problem, the idea that gravity is a difference between electrostatic attraction and repulsion forces was/is a very compelling one.

It was when I finally discovered the new theory of nuclear force in the present research that I also solved the above problem of 'different permittivities'. I discovered that the difference in attraction and repulsion forces should be thought as resulting from difference in *expressions* (formulas) for the two forces! and not as being due to difference in free space permittivities for attractive and repulsive forces.

Nuclear force

The mystery regarding nuclear force can be stated as:
Why does the nucleus not fly apart under the electrostatic repulsion force of the protons?
And what <u>*holds*</u> *the protons and neutrons together in the nucleus ? i.e. the protons and neutrons would drift away from each other if there is no some kind of binding force ?*

We propose here that nuclear force is in fact gravitational. Since gravitational force as we know it cannot account for nuclear stability, we have to re-write our understanding of it.

The force of gravity is a difference between the attractive and repulsive electrostatic forces[1]. This difference results from different expressions (formulas) for attractive and repulsive electrostatic forces.

$$F_{att} = f\,(\,r\,) \qquad \text{and} \qquad F_{rep} = g\,(\,r\,)$$

where

F_{att} is the electrostatic attraction force,
F_{rep} is the electrostatic repulsion force,
$f(r)$ is the expression for distance dependence of electrostatic attractive force,
$g(r)$ is the expression for distance dependence of electrostatic repulsive force and
r is the distance between the two charges

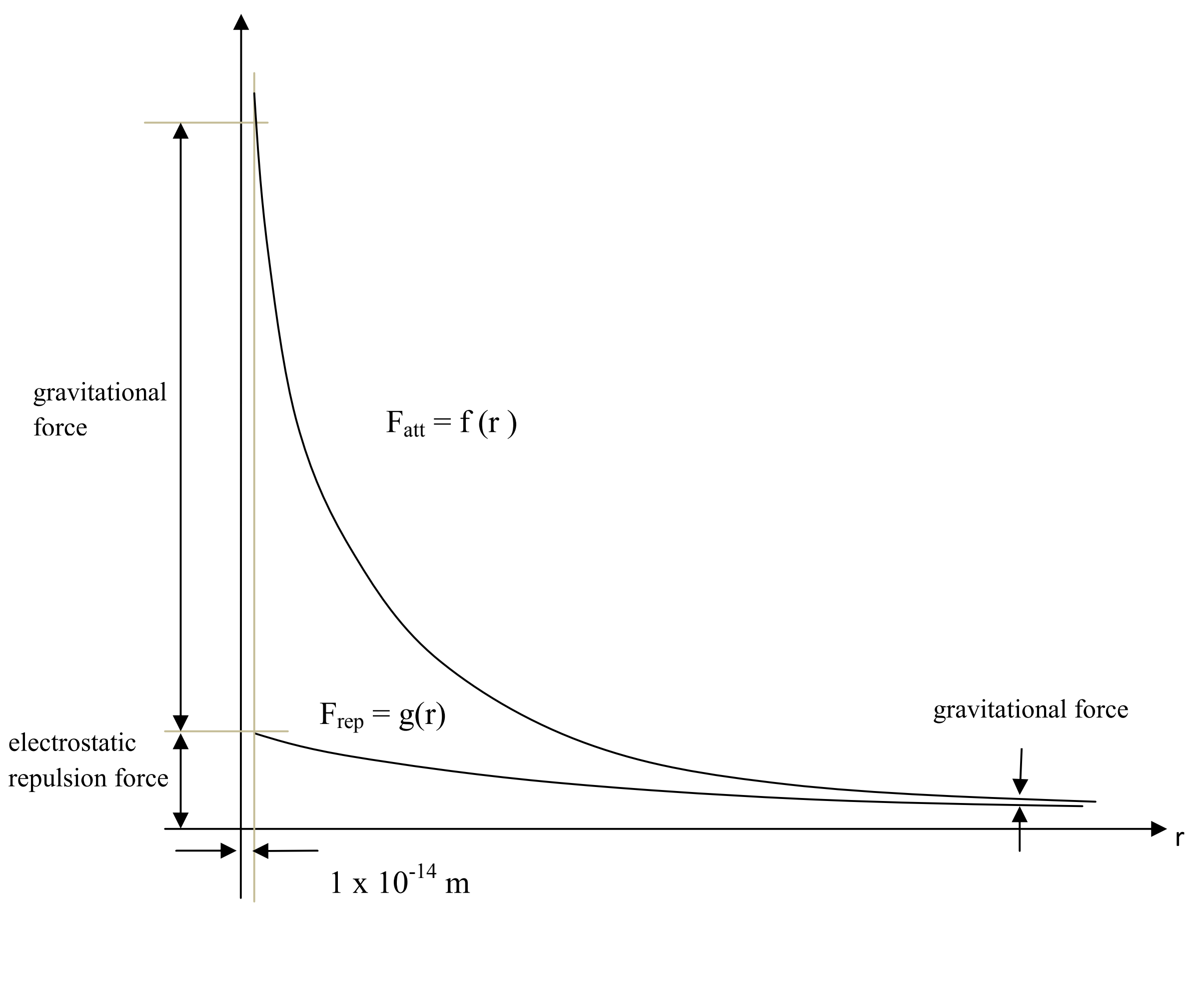
For centuries, we have been stuck with the inverse squared distance Newton's law of gravitational force and that may have been the root problem.

Now we put down the requirements for the new formulas for electrostatic attraction, electrostatic repulsion and gravitational forces.

1. At extremely small distances, as in the distance between protons in the nucleus, the attractive force should be greater than the repulsive force in such a way that the gravitational force, which is F_{att} - F_{rep} , should be greater than the repulsion force F_{rep} , by a factor of about 137 because it is known that the strong nuclear force of the Standard Model is greater than electromagnetic force by this factor.

2. This gravitational force should diminish to nearly zero at distances of the order of the diameter of atoms and beyond. At macroscopic distances, the attraction and repulsion forces should essentially follow inverse squared distance dependence of Coulomb's law.

Graphically, the attractive and repulsive electrostatic forces look like as follows, qualitatively.



We see from the above curves that, at a distance of 1×10^{-14} m , the difference between the attractive and repulsive electrostatic forces, which is the gravitational force, is greater than the electrostatic repulsion force. At large distances, the two formulas essentially follow the inverse squared distance law with which we are familiar, but with very small difference between them to give rise to the gravitational force we already know at macroscopic distances.

The above is just a qualitative graphical representation of the forces. The exact formulae for the electrostatic attraction and repulsion forces and for the gravitational force should be revealed by further research. We simply make a heuristic attempt in this paper, and not attempt to derive the formulae from some principles.

Coulomb's law is given by:

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\frac{Q1\,.\,Q2}{r^2}$$

We introduce an additional multiplying factor in each formula that will make the electrostatic attraction force greater than the electrostatic repulsion force at distances of the order of the diameter of the nucleus and essentially reduce to 1 at distances comparable to the diameter of the atom. Note that we are just trying to find an example of a factor that fulfills this requirement. We don't mean that this is the exact, the real expression.

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{att0}}{r^2}\right)\frac{Q1\,.\,Q2}{r^2}$$
$$F_{rep} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{rep0}}{r^2}\right)\frac{Q1\,.\,Q2}{r^2}$$

For the factors to diminish to nearly 1 for distances of about 10^{-10} m (the diameter of atoms) , the constants K_{att0} and K_{rep0} should be extremely small numbers.

For example, if $r = 10^{-11}\ m$, the factor K_{rep0} should be about 10^{-30} for the multiplying factor of the repulsive force to be 1.00000001.

Now let us estimate the values of K_{att0} and K_{rep0} so that gravitational force in the nucleus is about 137 times the electrostatic repulsion force. i.e.

$$\frac{F_{att} - F_{rep}}{F_{rep}} = 137 \quad \Rightarrow \quad \frac{\frac{K_{att0}}{r^2} - \frac{K_{rep0}}{r^2}}{1 + \frac{K_{rep0}}{r^2}} = 137 \quad \Rightarrow \quad \frac{K_{att0} - K_{rep0}}{r^2 + K_{rep0}} = 137$$

For example, if we assume $K_{rep0} = 10^{-30}$, $r = 10^{-14}$ m , then $K_{att0} = 1.3838 \times 10^{-26}$.

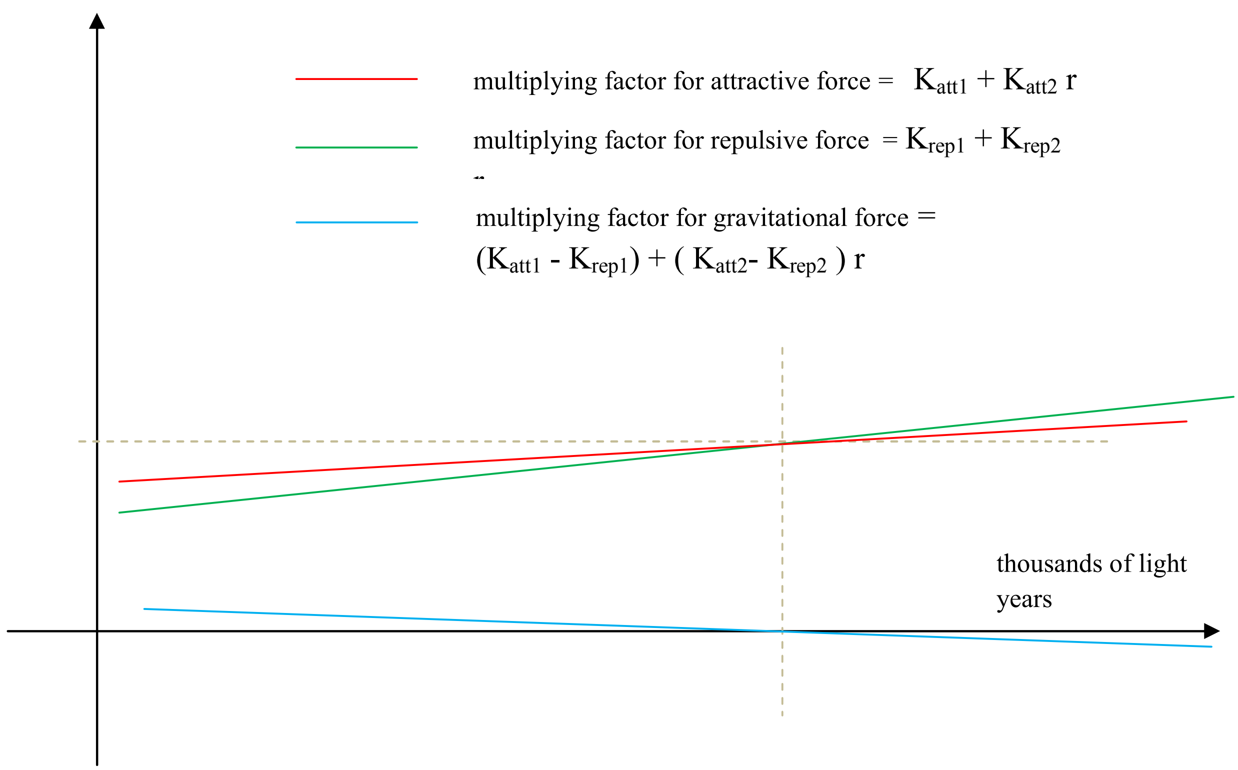
The nucleus as a quantum system

Since gravitational force in the nucleus is greater than the repulsion force of the protons, the protons and the neutrons will be attracted to the center of the nucleus, in the same way that an electron in an atom is attracted towards its nucleus. Therefore, the protons and neutrons should revolve around the center of the nucleus to avoid falling into the center. From this follows allowable orbitals of quantum mechanics in the nucleus. Therefore, a nucleus, like the atom, is a quantum system and will have only discrete states.

Cosmological acceleration

We can even add another requirement for the formulas expressing the two forces. That is, the formulas should also be such that the electrostatic repulsion force becomes greater than the electrostatic attraction force beyond some astronomical distance, so that gravity turns from an attractive force into a repulsive force beyond a certain astronomical distance. This may explain why the universe doesn't collapse and why galaxies are moving away from us and from each other ('expanding universe').

All we need is introduce yet another factor. Graphically the forces look like as follows in astronomical scales, qualitatively.



The complete expression for the attraction and repulsion electrostatic forces will be:

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{att0}}{r^2}\right)(K_{att1} + K_{att2}r)\ \frac{Q1\,.\,Q2}{r^2}$$

$$F_{rep} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{rep0}}{r^2}\right)(K_{rep1} + K_{rep2}r)\ \frac{Q1\,.\,Q2}{r^2}$$

K_{att1} , K_{att2} , K_{rep1} and K_{rep2} are constants to be calculated from astronomical observations.

Note again that the real multiplying factors satisfying the stated requirements may be different in form from the above factors.

The last linear multiplying factor is not correct because it can't explain outstanding problems in cosmology: cosmological acceleration and the Pioneer anomaly. In the following discussion we present a better form of the complete gravitational force formula.

What if we assume a quadratic form instead of a linear form for the second factor ?

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{att0}}{r^2}\right)(K_{att1} + K_{att2}r^2)\ \frac{Q1\,.\,Q2}{r^2}$$

$$F_{rep} = \frac{1}{4\pi\varepsilon_0}\left(1 + \frac{K_{rep0}}{r^2}\right)(K_{rep1} + K_{rep2}r^2)\ \frac{Q1\,.\,Q2}{r^2}$$

In this case the gravitational force at astronomical scales will be (the first factor is significant only at the nuclear scale) :

$$F_{grav} = F_{att} - F_{rep} =$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{Q1\,.\,Q2}{r^2}\left(K_{att1} - K_{rep1} + (K_{att2} - K_{rep2})\,r^2\right)$$

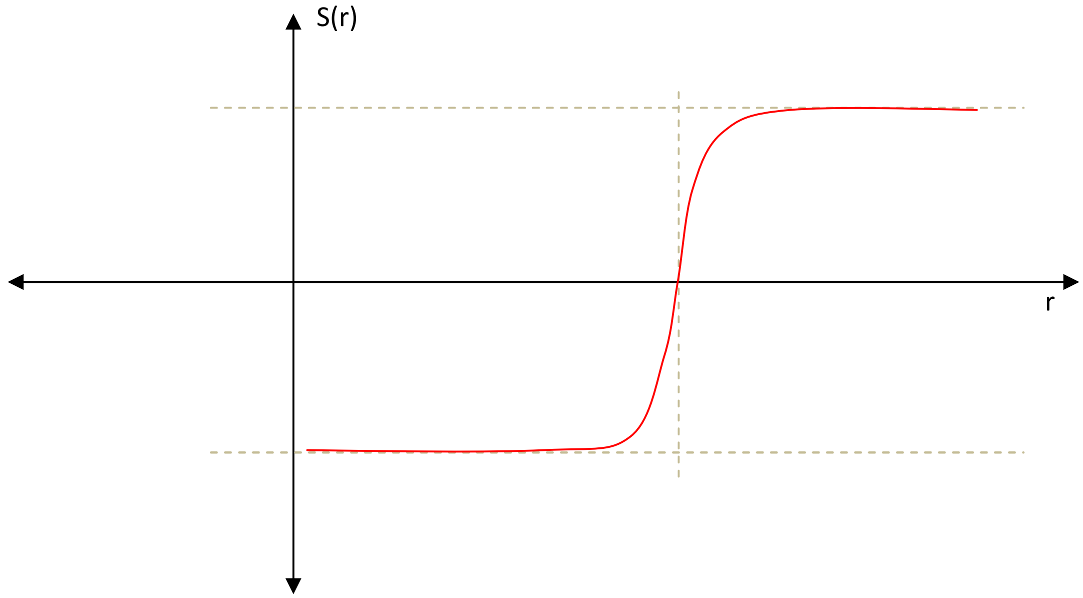
$$= \frac{1}{4\pi\varepsilon_0}\frac{Q1\,.\,Q2}{r^2}\left(K_{att1} - K_{rep1}\right) + \frac{1}{4\pi\varepsilon_0}\,Q1\,.\,Q2\,(K_{att2} - K_{rep2})$$

Therefore, the gravitational force will have two components. The first term represents the familiar inverse squared distance law (Newton's law) and vanishes with distance. The second term is constant independent of distance ! This may be the origin of cosmological acceleration!

The first term is attractive, so K_{att1} should be greater than K_{rep1}. The second term is repulsive (beyond some astronomical distance), so K_{att2} should be less than K_{rep2}.

The Pioneer Anomaly

There is still another problem. We know the 'coincidence' between the anomalous acceleration of the Pioneer space craft and the cosmological acceleration. The problem here is that the direction of the acceleration is towards the Sun, not away from it, but we know that cosmological acceleration is away from the Sun. The magnitude of the acceleration of the Pioneer space craft coincides with the magnitude of cosmological acceleration, but the sign doesn't. Therefore, we need to introduce an additional term multiplying the second factor. This additional term, S(r) , is a constant changing signs at some astronomical distance. Therefore, the second component of the gravitational force is repulsive only beyond some astronomical distance, but attractive up to that distance.



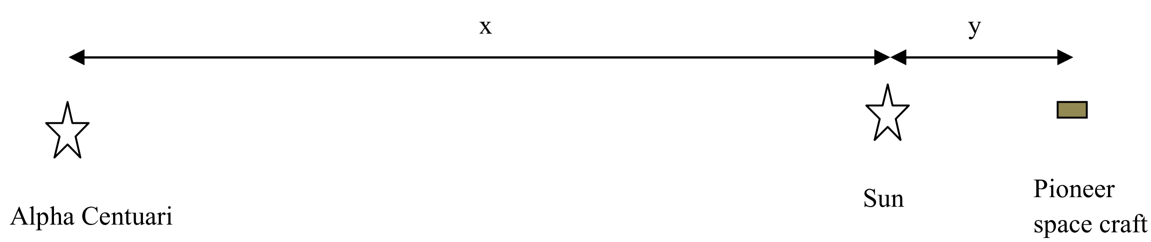
Therefore, the complete formula of gravitational force at astronomical scales is proposed as:

$$F_{grav} = \frac{1}{4\pi\varepsilon_0}\frac{Q1\,.\,Q2}{r^2}\left(K_{att1} - K_{rep1}\right) + S(r)\,\frac{1}{4\pi\varepsilon_0}\,Q1\,.\,Q2\,(K_{att2} - K_{rep2}\quad)$$

From the above analysis, cosmological acceleration is the acceleration caused by the Sun (the Solar System) on stars and galaxies and it depends only on the mass (on the number of positive and negative charges) of the Sun. This is analogous to the gravitational acceleration on Earth (9.81 m/s^2) being due to the mass of the Earth. However, unlike the gravitational acceleration on the Earth, it is constant independent of distance. Therefore, the amount of cosmological acceleration (cosmological red shift) scientists observe from Earth only applies to the Sun (the Solar System). The cosmological acceleration will be different if observed from Alpha Centuari, for example, because its mass is different from the mass of the Sun. Just as gravitational acceleration on the Moon is different from that on Earth, cosmological acceleration observed from Alpha Centuari will be different from that observed from the Sun (from Earth).

In the above analyses of cosmological acceleration we considered only the force acting on one cosmic body by another cosmic body. For example, do we have to consider also the gravitational forces from billions of galaxies on the Pioneer spacecraft in the universe or not ?

Let us consider the Pioneer space craft, the Sun and Alpha Centuary. Does Alpha Centuary affect the anomalous acceleration of Pioneer anomaly as seen from the Sun (the Earth?)



If both the Sun and the Pioneer have the same acceleration as observed from Alpha Centuari (which is the cosmological acceleration observed from Alpha Centuari), then it is easy to show that the Sun and the Pioneer space craft cannot be accelerating relative to each other.

$$\frac{d^2x}{dt^2} = \frac{d^2}{dt^2}(x+y) \quad \square \quad \frac{d^2x}{dt^2} = \frac{d^2x}{dt^2} + \frac{d^2y}{dt^2} \Rightarrow \frac{d^2y}{dt^2} = 0$$

Conversely, this means that if the Pioneer is accelerating as observed from Earth, both the Sun and the space craft cannot have the same acceleration as observed from Alpha Centuari. So does this mean that our theory is wrong ? No. This is because cosmological acceleration is not the acceleration of specific galaxies, but the *general*, *common* outward acceleration of all galaxies in every direction as seen from a Cosmic object (from the Sun or from Alpha Centuari) . The average (common, general) outward acceleration (cosmological red shift) observed from Earth in every direction is due to the mass of the Sun only !

Van der Waals force and Casimir effect

The nuclear component of gravitational force may be significant even beyond the nuclear scale, at the atomic scale, but much smaller than the electrostatic force. The Van der Waals force and Casimir effect may be residue of nuclear gravitational force.

Conclusion

In this paper, the mystery of nuclear force has been revealed. The nuclear force is basically a gravitational force, but not gravitational force as we know it. The laws of electrostatic force and gravitation have been modified to explain nuclear force. We have seen that gravity is a force that acts differently across vastly different scales in the universe: nuclear scale, macroscopic scale and astronomical scale. We have successfully explained the phenomenon of cosmological acceleration and the Pioneer anomaly. Cosmological acceleration as observed from Earth is due to the mass of the Sun. At astronomical distances gravity exists as a constant force independent of distance. If both nuclear and gravitational forces are electrostatic, then there is only one fundamental force in the universe: the electromagnetic force.

Thanks to God and His Mother Our Lady Saint Virgin Mary

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