Gravity as the cause for cosmic acceleration, Pioneer anomaly and nuclear force

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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 has the potential to explain the phenomenon of cosmological acceleration and the Pioneer anomaly. Gravity is a force that behaves differently at vastly different distance scales: nuclear scale, macroscopic scale and astronomical scale.

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 1×10^{-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 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 amount of *total* (NOT net) 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 free space permittivity may be 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. One of the conceptual problems I faced was this: which of the two permittivities will we use in Maxwell's equations? Or do I have to invent 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 electrostatic attraction and repulsion forces should be thought of as resulting from difference in the *expressions* (formulas) for distance dependence of 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 its 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 isn't 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 what we know about 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 between two charges Q_1 and Q_2.

$$F_{att} = \frac{1}{4\pi\varepsilon_o} \frac{Q_1 \, Q_2}{r^2} \; f(r) \qquad and \qquad F_{rep} = \frac{1}{4\pi\varepsilon_o} \frac{Q_1 \, Q_2}{r^2} \; g(r)$$

where

F_{att} is the electrostatic attraction force,
F_{rep} is the electrostatic repulsion force,
$f(r)$ is the new factor for the law of electrostatic attractive force,
$g(r)$ is the new factor for the law 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 formulas for electrostatic attraction, electrostatic repulsion and gravitational forces.

1. The gravitational force will have two components: nuclear gravitational force and Newton's gravitational force (later we introduce a third component: astronomical gravitational force)

2. At extremely small distances, as in the case of 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.

3. The nuclear gravitational force should essentially decrease to zero at distances of the order of the diameter of atoms and beyond. At macroscopic distances, the total attraction and repulsion forces should essentially follow inverse squared distance dependence of Coulomb's law and their difference should result in Newton's inverse squared distance law of gravitation.

Graphically, the attractive and repulsive electrostatic forces look like as in fig.1, qualitatively.

We see from the 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.

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:

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1\,Q_2}{r^2}$$

We introduce a 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 Coulomb's formula at distances much greater than the diameter of the nucleus.

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\,\frac{Q_1\,Q_2}{r^2}\left(\frac{K_{att0}}{r^2} + K_{att1}\right) = \frac{1}{4\pi\varepsilon_0}\,\frac{Q_1\,Q_2}{r^2}\;f(r) \qquad (K_{att1} \cong 1)$$

$$F_{rep} = \frac{1}{4\pi\varepsilon_0}\,\frac{Q_1\,Q_2}{r^2}\left(\frac{K_{rep0}}{r^2} + K_{rep1}\right) = \frac{1}{4\pi\varepsilon_0}\,\frac{Q_1\,Q_2}{r^2}\;g(r) \qquad (K_{rep1} \cong 1)$$

K_{att1} and K_{rep1} are constants both very close to 1 (to be in accordance with conventional Coulomb's law) but with an extremely small difference between them that will give rise to the conventional Newton's inverse squared distance law of gravitation.

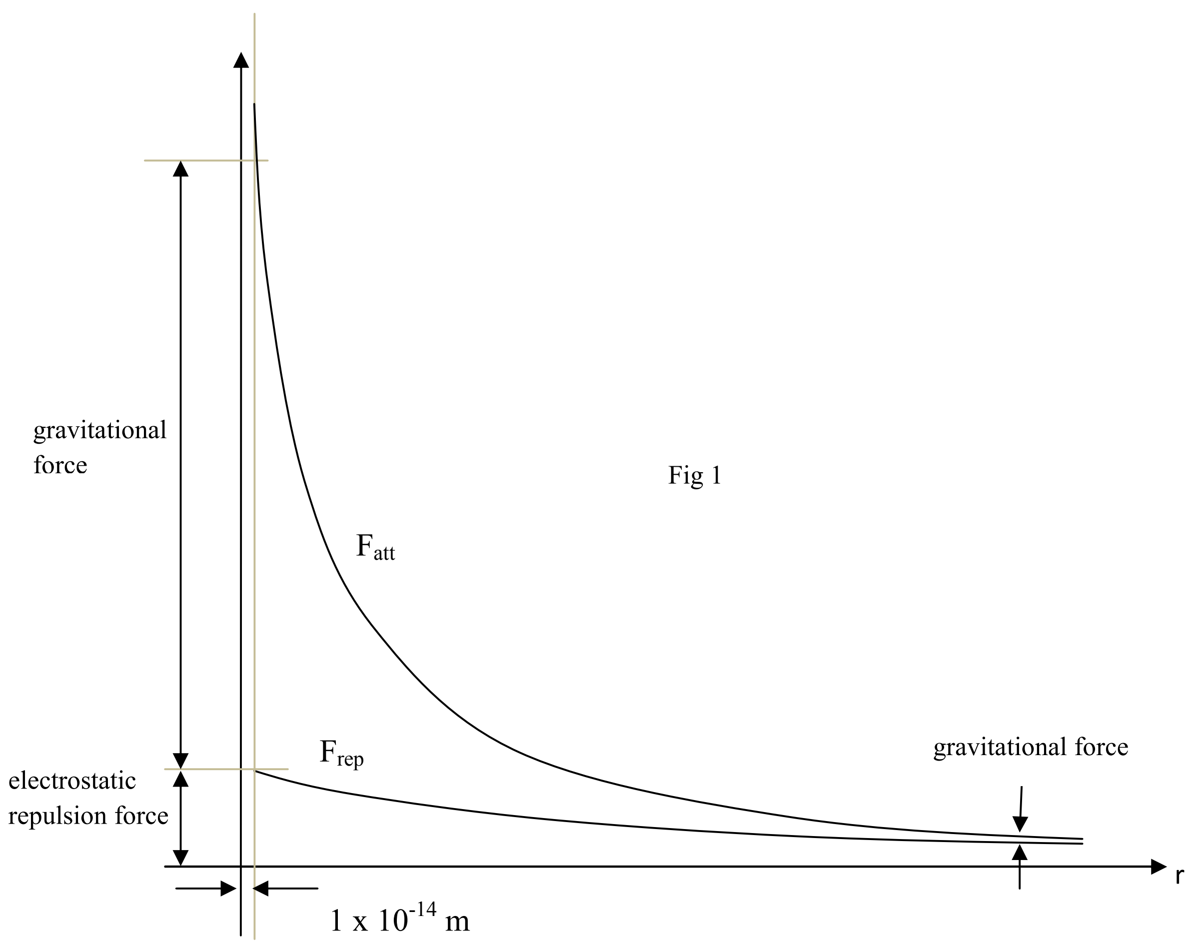


Fig 1

For the factors f(r) and g(r) 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 g(r) to be 1.00000001.

Let us roughly 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.

$$\frac{F_{att} - F_{rep}}{F_{rep}} = 137 \quad \Rightarrow$$

$$\frac{\frac{K_{att0}}{r^2} - \frac{K_{rep0}}{r^2} + K_{att1} - K_{rep1}}{\frac{K_{rep0}}{r^2} + K_{rep1}} \approx \frac{\frac{K_{att0}}{r^2} - \frac{K_{rep0}}{r^2}}{\frac{K_{rep0}}{r^2} + K_{rep1}} = 137 \quad (\text{ since } K_{att1} - K_{rep1} \cong 0\ )$$

$$\Rightarrow \quad \frac{K_{att0} - K_{rep0}}{K_{rep0} + r^2} = 137 \quad (\text{ since } K_{rep1} \cong 1\ )$$

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

Actually we should have used only K_{rep1} in the denominator because 137 is known as the factor by which the strong nuclear force (nuclear gravitational force) is greater than the conventional Coulomb's repulsive force. However, I have checked that there isn't much difference in the result.

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

From the observed phenomenon of cosmological red-shift and the slight deviation from Hubble's law, we conclude that the electrostatic repulsion force should become 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 ?, i.e. 'expanding universe').

The formula of gravitational force for astronomical distances should explain the phenomenon of cosmological acceleration.

The complete formula for electrostatic attractive and repulsive forces is proposed as:

$$F_{att} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1\,Q_2}{r^2}\left(\frac{K_{att0}}{r^2} + K_{att1} + K_{att2}r^2\right)$$

$$F_{rep} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1\,Q_2}{r^2}\left(\frac{K_{rep0}}{r^2} + K_{rep1} + K_{rep2}r^2\right)$$

The gravitational force will be:

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

$$= \frac{1}{4\pi\varepsilon_0}\frac{Q_1\,Q_2}{r^2}\left(\left(\frac{K_{att0} - K_{rep0}}{r^2}\right) + (K_{att1} - K_{rep1}) + (K_{att2} - K_{rep2})\,r^2\right)$$

The first term is the *nuclear gravitational force* and diminishes to zero much beyond the nuclear scale. The second term represents the familiar inverse squared distance law (*Newton's law of gravitation*) and vanishes at astronomical distances. The third term, which we will call *astronomical gravity*, is constant independent of distance ! This may be the origin of cosmological acceleration!

The first term (nuclear force) is attractive, so K_{att0} should be greater than K_{rep0}. The second term is also attractive , so K_{att1} should be greater than K_{rep1} . What about the third term ?

The Pioneer Anomaly

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 I speculate that there is attractive *astronomical* gravity up to some astronomical distance and then repulsive *astronomical* gravity beyond that distance as shown below (fig.2).

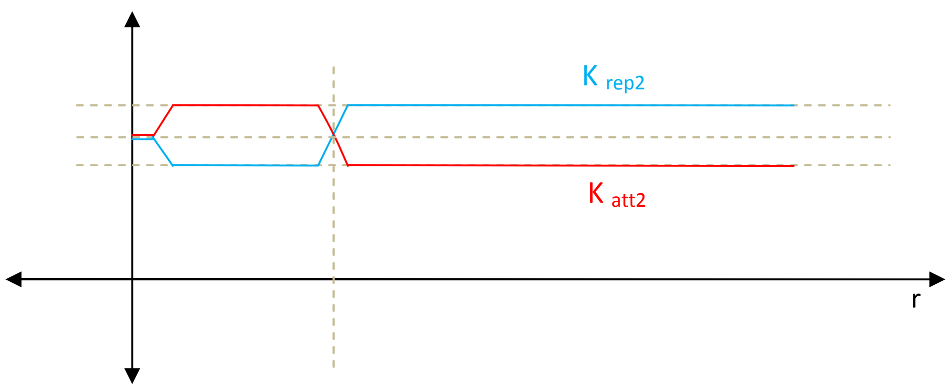


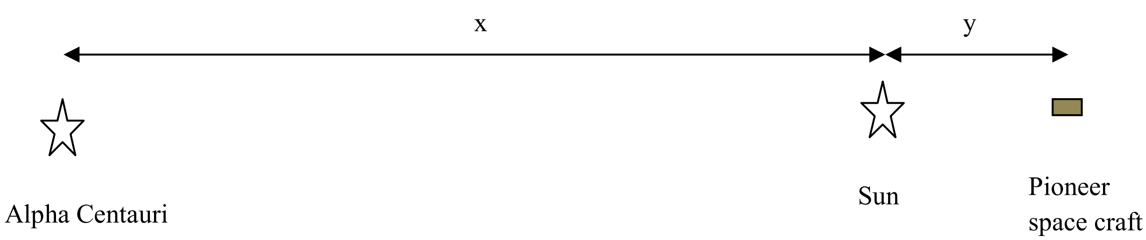
Fig .2

From the above analysis, cosmological acceleration is the acceleration caused by the Sun's astronomical gravitational field (the third component in the general formula) on stars and galaxies and it depends only on the mass (on the amount 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 Centauri, 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 Centauri should be different from that observed from the Sun (from Earth).

But what about Hubble's constant? Is Hubble's constant as observed from Earth (or the Sun) the same as or different from that observed from Alpha Centauri ?

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 Centaury. Does Alpha Centaury 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 Centauri (which is the cosmological acceleration observed from Alpha Centauri), 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 Centauri. 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, average* outward acceleration of all galaxies in every direction as seen from a Cosmic object (from the Sun or from Alpha Centauri) . The average outward acceleration observed from Earth in every direction is due to the mass of the Sun only !

The Sun and the space craft would not be accelerating relative to each other if Alpha Centauri was the only source of gravity. However, since the Sun also has gravity, the acceleration of the space craft due to Alpha Centauri's astronomical gravity is determined by subtracting acceleration of the space craft due to Sun's gravity from total acceleration of the space craft observed from Alpha Centauri. However, this simple analysis assumes that only the Sun and

Alpha Centauri exist in the universe, when in reality there are billions of galaxies in the universe all acting on the space craft with their astronomical gravitational forces. Therefore, the only way of determining cosmological acceleration from a cosmic body (the Sun or Alpha Centauri) is to measure the *average* acceleration of galaxies in every direction.

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 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 and that is the electromagnetic force.

Thanks to God and His Mother Our Lady Saint Virgin Mary

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