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Nuclear Force is Gravitation.
Was Einstein Right?

By Shantilal G. Goradia
Copyright © By Shantilal G. Goradia, October 20, 2000
3003 Royal Huntsman Court
South Bend, IN 46637-5044

Abstract: I combine the effects of Planck length, general relativity and Newtonian gravity in one equation, to come up with a semi-classical model of gravity in the form of deviation from Newtonian gravity. Einstein explained nuclear forces in terms of gravity (Ref. 2). This reference is explicit in expressing Einsteins attempts and describes them as misguided. My model shows Einstein was not misguided in his attempts to explain nuclear forces in terms of gravity. My model shows just the opposite. I use Planck length as what it is: minimum distance that makes any sense. I make a subatomic distinction between mass and space, a lesson learned from general relativity. General relativity is about mass telling space how to curve and space telling mass how to move. Unlike string theory, I use no imaginary dimensions. My model predicts maximum nuclear force as the limit of gravitation and clearly yields Newtonian gravity at a macroscopic scale in an unprecedented and consistent manner: Good-bye to quantum gravity.

I am combining Newton, Planck and Einstein and to predict a limit of gravity as Chandrashekhar did to predict his limit.

Introduction: The fact that mass has an effect on surrounding space is the first essential element of general relativity. This paper unifies this mass/space distinction of general relativity with Newtonian gravity at a subatomic scale and with reported experimental findings of the last century. The subatomic distinction of mass concentration mainly in nucleons surrounded by empty space as we know it now was not known when the general relativity was written. The author uses this distinction to set forth a consistent classical equation of gravity valid to the Planck length and peeps into the quantum world.

It is difficult to exaggerate the importance of fundamental nuclear theory for satisfying Einstein's dream of expressing all four forces of nature in one equation.

See equations **(1)** and **(2)**. The notation **D** in the denominator in Newtons equation **(1)** of the gravitational force denotes the separating distance between the centers of mass of the particles in question. Validity of equation **(1)** has been verified for distances as low as few centimeters. Its validity is not verified when subatomic separating distance between nuclei of atoms is a few femtometers (**fm's**). Newtons equation is an approximation that explains macroscopic observations. It does not express the measured force of attraction between nucleons at short range. My assertion is that its failure is a result of implicit assumption in Newtonian gravitys formation: that gravity originates at a point. Newtonian physics implies point masses and action between points. A point has no mass. I am asserting that, instead, the gravitation field originates at the surfaces of elementary particles, not at a central point within the elementary particles. The associated deviation from inverse square logic is insignificant and consistent with general relativity. The consequences of this distinction are enormous and unexplored. Newtons equation needs replacement by equation **(2)** for all microscopic distances. The correction is the injection of $\mathbf{d_n}$. The notation $\mathbf{d_n}$ in Equation **(2)** is the diameter of the nucleons in question. Equation **(2)** is good for all distances greater than Planck Length (**10^{-35} meters = 10^{-20} fms**). I require the Planck length as a lower bound so as to include the dominant, first order, quantum effect in this semi-classical model.

Newtonian $\quad \mathbf{F_N = G m_1 x m_2 / D^2} \quad$ **(1)**

Proposed $\quad \mathbf{F_P = G m_1 x m_2 / (D - d_n)^2} \quad$ **(2)**

The relative strength of the proposed equation is (2) divided by (1)

The Ratio $\quad \mathbf{F_P / F_N = D^2 / (D - d_n)^2}$

Strength of Gravity at Short Range per equation (2)

When **D** is very large compared to $\mathbf{d_n}$, $\mathbf{D^2}$ is almost equal to $\mathbf{(D\text{-}d_n)^2}$. The diameter of atoms is hundreds of millions of times greater than the diameter of nucleons located at the center of atoms. The force of gravitation calculated by these two equations between the nucleons of two adjoining atoms is practically the same, because the ratio $\mathbf{D^2 / (D\text{-}d_n)^2}$ is almost equal to one. When **D** is small compared to $\mathbf{d_n}$, the force of attraction calculated by equation **(2)** will be significantly greater than that calculated by equation **(1)**. The following results bring home the concept.

If we call the force of gravitation calculated by equation **(1) "g"**, the force of gravitation calculated by equation **(2)** would be higher by the ratio $\mathbf{D^2 / (D - d_n)^2}$. When **D** exceeds $\mathbf{d_n}$, by Planck length (**10^{-20} fms**), the ratio:

$$D^2/(D-d_n)^2 = (d_n + \text{Planck length})^2/(\text{Planck length})^2$$ (All lengths in femtometers)

$$= (1 + 10^{-20})^2 / (10^{-20})^2$$ **(d_n = 1 femtometer)**

$$= 10^{40}$$

Multiplying this by "**g**" to get the force of attraction between two nucleons per equation **(2),** we get $\mathbf{F_P = 10^{40}\ g}$

Natures Intervention at Planck Length

Nature guards against conversion of physical quantity to either zero or infinity in ways hard to verbalize. Accordingly, before the force of gravitational attraction between nucleon masses increases to infinity, Nature must be intervening at Planck length with its mysterious and quantum mechanical tools.

Classical Unification

If equation **(2)** is correct, then the nuclear force between nucleons which is recognized as the secondary effect of color force between the quarks is clearly at unity with gravity semi-classical way.

Observations/Predictions

Yukawa used a range of nuclear force as one fm to predict pion. Ref 3 claims the range as 4 fms. Ref 4 claims the measurable range as high as 10 fms. The point is: our ability to measure miniscule forces between nucleons is limited. The force between two nucleons as calculated by Newtons equation (equation 1) is 0.77 x 10^{-35} Newtons at surface-to-surface separation of 4 fms. Force between them calculated per my equation (equation 2) is 1.2 x 10^{-35} Newtons. The difference between these two is too small to measure accurately. For atomic size distances and larger, both formulas are practically identical as they should be expected in order for the proposed model not to challenge well established Newtons formula for macroscopic distances. The order of magnitude of the maximum force between two coupled nucleons is so high that our ability to measure the maximum force between two coupled nucleons is reliable. An easy way to check a proposed equation is to check its boundary values at upper limit and lower limit, not its intermediate values, especially, when the intermediate values are immeasurable.

Nobel Prize Winner Dr. Leon Lederman gave a speech at IMSA High School auditorium in Illinois on October 17, 2000. He advised to the effect that one should make concrete predictions with a focus on avoiding changes later on. Having said that, I make the following prediction:

My prediction is that the limiting value of the nuclear force is of the order of 10^{40} g. The deformation of the nucleons, not accounted for in the proposed equation would somewhat change its equivalent effective diameter. It is not possible to account for the deformation of the nucleon. It is assumed that the effect of such deformation and such inaccuracies (for example, the Planck length is 1.62 times higher than the one used in deriving the proposed equation) is negligible considering the order of magnitude of the limiting value of the force between two coupled nucleons. It should be noted that there is no feature of nuclear force that distinguishes it from gravitation. They have different intensities like solar gravitation and lunar gravitation have different intensities, but no distinguishing feature.

Please note that unlike Yukawa potential, the reported experimental values in many books are close to my prediction anyway. The books do not always list their sources.

Conclusion

Newtons equation of gravitation is a macroscopic approximation. Equation **(2)** in the above text must be the general semi-classical equation of gravity for distances greater than Planck lengths.

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I invite your creative comments at Shantilalg@juno.com. Whatever this paper implies does not stand tall, unless your comments are looked at.

Shantilal G. Goradia

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