Journal of Applied Mathematics and Physics, 2022, 10, 2499-2507
https://www.scirp.org/journal/jamp
ISSN Online: 2327-4379
ISSN Print: 2327-4352

Unified Equation of Fundamental Forces' Coupling Values, and the Existence of Subsequent, Fifth and Other, Forces

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How to cite this paper: Mozafari, K. (2022) Unified Equation of Fundamental Forces' Coupling Values, and the Existence of Subsequent, Fifth and Other, Forces. *Journal of Applied Mathematics and Physics*, **10**, 2499-2507.
https://doi.org/10.4236/jamp.2022.108168

Received: July 21, 2022
Accepted: August 16, 2022
Published: August 19, 2022

Abstract

This paper provides an equation to entangle all known fundamental forces by employing their coupling constants, *i.e.*, strong (α_s), electromagnetic (α), weak (α_w), and gravitational (α_g) interaction coupling values. The constant coupling formulation is further indicative of many other fundamental forces with significantly weaker coupling values. As an example, the fifth fundamental force, Kashi's Force, is found to have a coupling constant of 10^{-1446}, which is significantly smaller than the smallest known fundamental force, gravitational force, with an approximate coupling constant value of 10^{-38}. Additionally, the paper finds the sum of all fundamental forces based on the equation proposed is equal to 0.0117, which is within the range of effective world value of the strong coupling constant 0.1 $\alpha_s\left(M_z^2\right)$.

Keywords

Fundamental Forces, Coupling Value, Kashi's Force, Unified Equation

1. Introduction

As of now, physics has discovered four known fundamental forces: strong nuclear force, electromagnetism, weak nuclear force, and gravitational interaction. For the author, the phrase "fundamental" could imply a commonality beyond what has been discussed in terms of physical property and origin. That is, a mathematical equation could untangle these forces. Such relation has been obtained arbitrarily through careful observation of the known coupling values. Each of the mentioned fundamental forces has particular properties and ranges. The current paper does not discuss the physical properties of such interaction; instead, it focuses on a few mathematical findings associated with them. Such findings intend to present a unique formulation to bound the forces to a single nature. It appears a mathematical equation can entangle the magnitudes of the four fundamental forces.

The mere existence of such a relationship can have significant implications for our understanding of the universe as a whole. One of the primary outgrowths of such a relationship can shed light on the actuality of other fundamental forces. The current paper insinuates one such formula, in which a single formula presents the relative magnitudes of all the forces. The submitted article focuses on mathematical findings rather than the physical implication of such a formulary. It is imaginable that provided the obtained results are acceptable, many compelling determinations could be made to advance our knowledge of our physical surroundings further. Discussion of such conclusions is beyond the scope of the presented paper, yet the author provides some hints for interested readers.

2. Math and Equations

In order to compare the magnitude of the known fundamental forces and ultimately formulating the relationship between them, the coupling constants are applied. The dimensionless electromagnetic coupling strength, α, is employed and presented as follows [1].

$$\alpha \equiv \frac{2\pi k e^2}{E_{photon}\lambda_{photon}}$$

Provided the energy of a photon with 1 nm wavelength has an experimental value of 1240 eV, the alpha can be calculated as shown.

$$\alpha \equiv \frac{2\pi \times 1.44 \text{ eV}\cdot\text{nm}}{1240 \text{ eV} \times 1 \text{ nm}} = \frac{1}{137}$$

The strength of the dimensionless electromagnetic coupling can increase [2] in specific conditions that are in the focus of the presented paper; however, it would be utilized in proceeding approximation and formulation.

On the same note, the dimensionless coupling value of the strong interaction, α_s, is outlined bellow [3].

$$\alpha_s \approx 1$$

Similarly, the value of weak coupling, α_w, can be circumscribed as follows.

$$\alpha_w \approx 10^{-6}$$

Ultimately, the coupling strength for the gravitational force, α_g, can be determined by the following equation.

$$\alpha_g \equiv \frac{G m_p m_p}{1240 \text{ eV}\cdot\text{nm}} \approx 10^{-38}$$

Table 1 summarizes the obtained value, along with their approximation used in the current paper [1].

Table 1. Coupling strength of the known fundamental forces.

Fundamental Force	Relative Strength (1 GeV)
Strong Force	$\alpha_s \approx 1$
Electromagnetic Force	$\alpha = \frac{1}{137}$
Weak Force	$\alpha_w \approx 10^{-6}$
Gravitational Force	$\alpha_g \approx 10^{-38}$

For a more simplified formulation, the fundamental forces are ranked in an ascending order based on their strength, with the strong force being α_1. Table 2 depicts the approximate relative coupling strength values for the known fundamental forces.

Provided the approximated relative coupling values, Equation (1) can be appropriated to connect the values.

$$\alpha_{n+1} \approx 10^{-\left(x_n^2+2\right)} \tag{1}$$

where x_n is the approximate power of the n^{th} coupling value, provided $x_1 = 0$ (Figure 1).

$$x_n = -\left(x_{n-1}^2 + 2\right) \tag{2}$$

That is, the following calculations can be interpreted for the coupling values. Note the n can only take integer values, and for its similarities with quanta concept, it can be called "Quanta Fo".

The strong force coupling value can be retrieved using the following equation.

$$\alpha_1 \approx 10^0$$

As $x_1 = 0$, α_2, the electromagnetic force coupling value, can be obtained utilizing Equation (1).

$$\alpha_2 \approx 10^{-\left(0^2+2\right)} = 10^{-2}$$

Similarly, since $x_2 = -2$, α_3, the weak force coupling value, can be calculated by utilizing Equation (1).

$$\alpha_3 \approx 10^{-\left((-2)^2+2\right)} = 10^{-6}$$

Finally, α_4, the gravitational force coupling value, can be obtained substituting $x_3 = -6$ in Equation (1).

$$\alpha_4 \approx 10^{-\left((-6)^2+2\right)} = 10^{-38}$$

The next reasonable move would be to find the sum of coupling values where x is not equal to zero even though the x equals zero point integral would not affect the overall result. Accordingly, the integral of Equation (1) is assessed and presented in the following.

$$\int_{-\infty}^{\infty} 10^{-\left(x^2+2\right)} \mathrm{d}x = \lim_{t\to\infty}\left(\frac{1}{200}\sqrt{\frac{\pi}{\log 10}}\,\mathrm{erf}\left(t\sqrt{\log 10}\right)\right)\Bigg|_{-t}^{t}$$

Table 2. Approximate relative coupling strength of the known fundamental forces.

Fundamental Force	Approximation of Relative Strength
Strong Force	$\alpha_1 \approx 10^0 = 1$
Electromagnetic Force	$\alpha_2 \approx 10^{-2}$
Weak Force	$\alpha_3 \approx 10^{-6}$
Gravitational Force	$\alpha_4 \approx 10^{-38}$

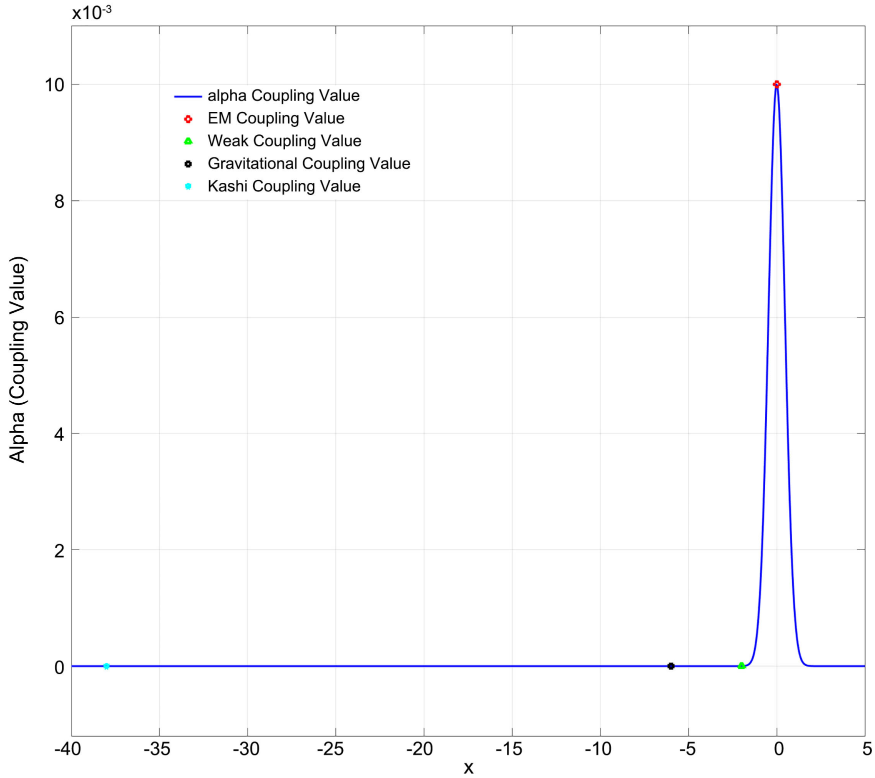

Figure 1. The figure coupling value versus as a function of x, where x is not equal to zero. The figure was prepared by utilizing the Matlab 2022 application.

where erf is defined as the error function.

$$\int_{-\infty}^{\infty} 10^{-\left(x^2+2\right)} \mathrm{d}x \approx 0.0117 \tag{3}$$

The value obtained in Equation (3) is very close to the experimental value of the effective coupling constant of strong force $0.1\,\alpha_s\left(M_z^2\right)$. This fact is depicted in Table 3 [4]-[16].

That is, the sum of all possible forces found in Equation (3) is within the range of most accurate experimental effective strong interaction coupling constant of $0.1\,\alpha_s\left(M_z^2\right)$ [16] [17].

It is also possible to find x_0 by extracting the x_n from Equation (2) as presented in the following line.

$$x_n = -\left(x_{n-1}^2 + 2\right)$$

Since x_1 is equal to 0, then the following can be concluded (Figure 2).

Table 3. Selected world average values for $\alpha_s\left(M_z^2\right)$ since 1989 [10], with current value of 0.1185 ± 0.0006 [16].

Year	$\alpha_s\left(M_z^2\right)$ value and error
1989 [10]	0.11 ± 0.01
1992 [11]	0.1134 ± 0.0035
1995 [12]	0.118 ± 0.003
1997 [13]	0.118 ± 0.003
2000 [14]	0.1184 ± 0.0031
2006 [15]	0.1189 ± 0.0010
2008 [18]	0.1198 ± 0.0032
2009 [6]	0.1171 ± 0.0024
2012 [7]	0.1173 ± 0.0011
2013 [16]	0.1185 ± 0.0006

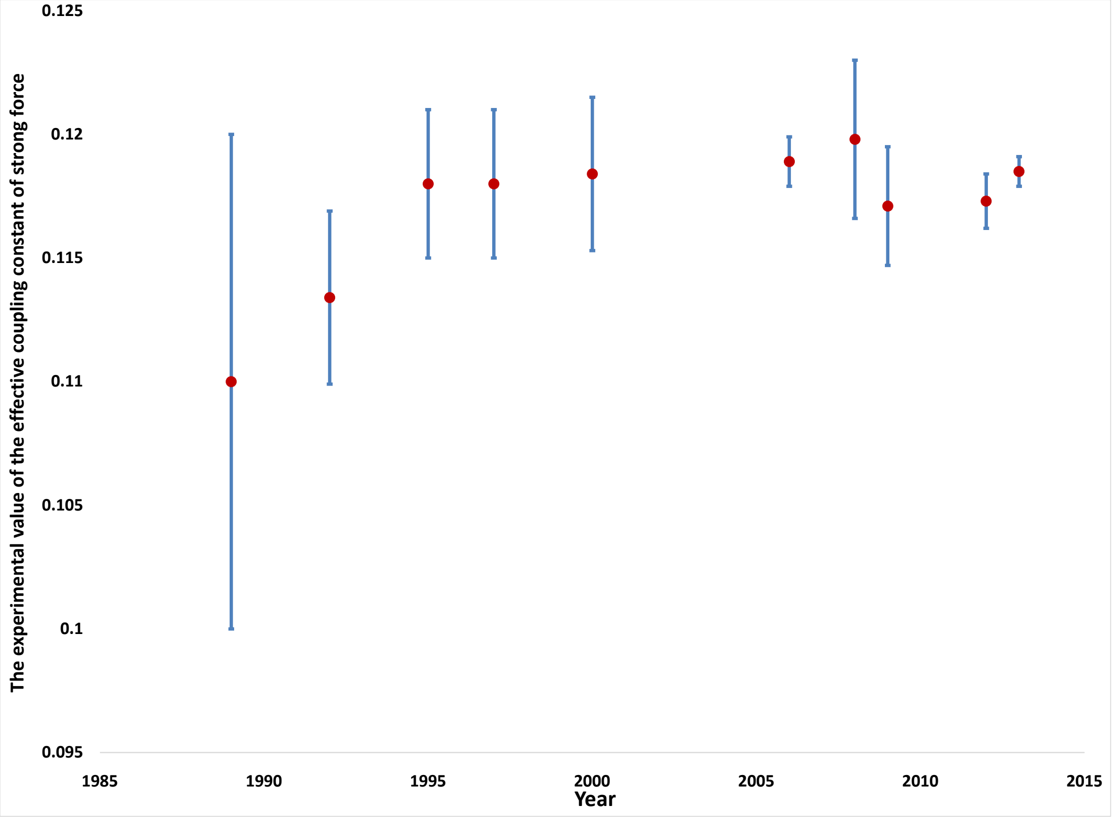

Figure 2. Selected world average values for $\alpha_s\left(M_z^2\right)$ as a function of time, with current value of 0.1185 ± 0.0006. The figure was prepared by utilizing the Microsoft Excel application.

$$x_1 = -\left(x_0^2 + 2\right)$$

$$0 = -\left(x_0^2 + 2\right)$$

$$\sqrt{-2} = x_0$$

$$\therefore \; x_0 = \pm i\sqrt{2}$$

Therefore, the quanta fo that generates the strong coupling interaction value is $\pm i\sqrt{2}$.

3. Discussion

The methods of ascertaining values of coupling constants are subject to a lot of complexion; hence, variation [7] [19] [20]. Moreover, these values are restricted to specific conditions and physical properties. Therefore, a coherent conclusion is not the most logical approach, yet ignoring the findings is illogical.

The concept of formulation of coupling constants represented in Equation (1) indicates the possibility of other fundamental forces that are far weaker in nature than the proceeding known fundamental forces. As an example, provided the quanta fo, n, value is equal to 5, the coupling constant of the fifth force, Kashi's Force, can be achieved by utilizing Equation (1), which is an entirely different concept from other proposed fifth forces [21].

$$\alpha_5 \approx 10^{-\left(x_4^2+2\right)} = 10^{-\left(-38^2+2\right)} = 10^{-1446}$$

Even though the proposed fifth force and subsequent forces have significantly smaller coupling constant; however, their value can be measurable and even significant on massive scales. The uncovered fundamental forces can be the answers to some of the demanding concepts in physics, such as dark matter and dark energy.

The other point worth noting, which requires more extensive research, is the origin of all fundamental forces. As all the presently recognized fundamental forces have been tied to a single equation (Equation (1)) and the sum of their constant coupling value is within the most precise estimations of 0.1 $\alpha_s\left(M_z^2\right)$ it can be inferred the other fundamental forces could be originated from the strong force. Such a claim asks for more extensive research and discussion to prove noble.

Another possible exciting finding that requires more detailed attention is the fact that Equation (1) resembles a normal curve. The normal nature of the curve has considerable implications, which are beyond the scope of the provided paper; however, it seems to be an intriguing topic for further research.

Moreover, the fact that **Figure 1** resembles both positive and negative forces can imply the possibility of counter-forces, Ka Forces, for all existing fundamental forces. Such a finding requires more attention and could lead to more solutions and questions in the physical universe. It appears a mathematical equation can entangle the magnitudes of the four fundamental forces.

The mere existence of such a relationship can have significant implications for our understanding of the universe. One of the primary outgrowths of such a relationship can shed light on the actuality of other fundamental forces. The current paper insinuates one such formula: a single formula presents the relative magnitudes of all the forces. The submitted article focuses on mathematical findings rather than the physical implication of such a formulary. It is imaginable that provided the obtained results are acceptable, many compelling determinations could be made to advance our knowledge of our physical surroundings further. Discussion of such conclusions is beyond the scope of the presented paper, yet the author provides some hints for interested readers.

4. Conclusion

The purpose of the presented article was to seek a possible mathematical formulation between the known fundamental forces coupling values. Such formulation was achieved by approximating the already known values. The delivered equation explained the coupling values for the know fundamental forces. Additionally, the extrapolation of the formula enhances one to embrace possible new fundamental forces. The author decided to dobbed the fifth force as Kashi's force, in memory of the great mathematician Jamshid Kashani. The Kashi's force has an extremely small coupling value compared to the strong force, $\alpha_5 \approx 10^{-1446}$, yet on a large scale, it can have a significant effect on the physical property of the university. Such correlation is beyond the range of the offered paper, yet the curious reader may find some avenue between Kashi's force and large-scale phenomena, such as galactic motion in superclusters, within our know universe. Another interesting correlation could be discovered by overviewing the additional suggested fundamental forces and the proposed dark force in astrophysics.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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