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Number Theoretic Structural Approach to Dimensionless Physics Forms

M. A. Thomas ¹

Abstract

Physics parameters in a near quadratic structural form demonstrates invariance in respect to the symmetry of the Monster group across a slight vacuum energy change. Five parameters needed in the structure are the Planck mass, the electron mass the charged pion mass, the gravitational coupling constant and the electromagnetic fine structure constant. The gravitational coupling constant along with the electromagnetic fine structure constant are reduced to a near unity value, which responds to changing gravitational and vacuum energy conditions thus reflecting the amount of space-time curvature. The entire parameter set changes are invariant due to an overall symmetry as the special case of a baryonic star system or vacuum field changing from a near Minkowski like space-time to a more extremal space-time curvature of a neutron star or black hole. This involves the quark flavor change in a baryon of going from uud to udd, which is the isospin symmetry action of the SU(2) group on the strong force dynamics of the proton-neutron nuclear fields. In addition, a number theoretic equivalent of the structural form shows nearly the same dimensionless ratio values on a one to one basis to the physics form. The number theoretic forms are based on computer constructions of closed forms utilizing constants involving the complex plane and suppressions of powers of π and e . The number theoretic formula values for dimensionless mass ratios nearly match the Codata 2014 set. That the structural features of the physics forms and number theoretic forms match suggests that the main structural form has a nontrivial solution(s) consisting of the Standard Model physics forms and possibly its dual number theoretic forms. The near quadratic form using a near unity value to produce an integer is not a simple encoding machine.

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Introduction

In physics there are dimensionless constants obtained by using like dimensioned values of parameters that can be canceled when used in ratio form. In general, these are parameters taken from the Standard Model of physics with an example being the proton mass electron mass ratio being the (approximate) dimensionless number 1836.152. Since most of these parameters are empirically derived, the pure number will always have an uncertainty as to what its possible absolute value is. This is dissatisfying, as pure numbers obtained should have a reflection in pure mathematics as to its actual value. That is the simple theory, which

if true would be a royal road to physics being a pure mathematics or language of nature where many things could be computed without anthropogenic influence. It would follow from such a theory a strong completeness and measure of rationality of how the World works in the context of a universal language. As of today no such royal road has been found and there exist many schemas (by both nonprofessionals and physicists) purporting to approach or achieve the realization of having pure numbers represent physics in extant or made up calculator structures. Most approaches utilize the irrationals e , π in some combination to calculate close to a target value i.e. Codata by the NIST. While intriguing most of this is play and patterning, which itself does not have much explanatory power. It is realized in mathematics that many numbers can be approximated very close by using either one of these constants or both in combination. An example is $6\pi^5 = 1836.1181..$ which values the proton mass electron mass ratio close to prior Codata years. That it is compact and simple might be something. However, π^5 is messy and odd powers how to interpret that? Wylers constant suffers from such an odd power of π . If instead, an expression involved π^2 or a similar quadratic of a constant then it could be more believable. A feature of the computer constructions below is simply that powers of the constants π and e should not be large and at the most should only be even powers of 2 say 4 at the most. The precision and accuracy of the Codata proton and electron masses are very good to 10 significant figures and this value (1836.1181...) is definitely off the mark. It is suggested that most approaches (are guesses and plays) are similar and will exhibit a chunky thrown together character that suggests that they are just numerical approximations that the author has created. In addition, one has to consider how close to a Codata value the expression is to consider if there may be truth to it. In many cases if the value matches the latest value in the Codata, it highly conceivable that the author manipulated the expression to the extent that it matches exactly. This makes the expression of a dubious nature. Some Codata values might change drastically at the next cycle however; this is becoming less of a problem. A large portion of the Codata values are very well determined empirically with the example of proton, neutron electron masses out to 10 significant figures. The last three digits (the uncertainty tail) are generally, what will change from cycle to cycle unless the methods are better which could extend the significant figures past 10 digits. Other methods to improve the overall value system are the 'least squares adjustment'. So actually calculating a parameter exactly does not necessarily mean anything. It is probably better to obtain a 'near miss'. A drastic change in a Codata value can occur (dataset fluctuation) and the primary example is the gravitational constant since 'systematic errors' have not been totally eliminated or accounted for in the empirical search for this value [1] [2].

In physics the Standard Model (SM) consists of its particle descriptions and three gauge forces, the electromagnetic, weak and strong force. The gravitational coupling constant is not well defined in the physics literature and is generally ignored. Apart from the SM it is also dimensionless but is exponentially very much weaker than the SM forces. For the reader who is new to this the gravitational coupling constant (dimensionless) is not the same as the Newton constant (gravitational constant) which has dimensions. The Newton

constant is a coupler of force between masses in Newtonian gravity and is a coupler between mass/energy distributions due to the geometry of space-time according to General Relativity. Currently, a repeated definition of the gravitational coupling constant (dimensionless) incurs the attractive potential between the mass of the proton and electron 'because they are stable' and they both have charge (?). Also, because the inverse of this arrangement suggests a 10^{38} power of the electromagnetic force to the very weak gravitational force. It is suggested that this is a repeated folklore arrangement (proton-electron) or (electron-electron) that needs to be toned down or eliminated. However, one thing stays the same in that whatever particle arrangement is used the power number will be 10^{38} to 10^{44} showing that the gravitational force is indeed exponentially very weak compared to the three gauge forces.

In the paper two primary gravitational coupling constants will be developed. One gravitational coupling constant will be defined for the ordinary baryonic conglomerates of the proton-neutron nuclear matter fields, which exist in the near flat Minkowski like space-time. This covers ordinary matter configurations such as planets, stars and their chemistries as we know it. The neutron is included since its presence in the atomic nucleus of many elements is an integral part of nuclear chemistries. The other gravitational coupling constant is defined for neutronic matter fields near the extremal curvature of a neutron star or a black hole of similar mass. These two different gravitational coupling constants occur at close vacuum energies that are only slightly different. That difference is due to the change in the gravitational field from the near flat (Minkowski type) space-time curvature of normal solar system masses and Newtonian dynamics to that of gravitational collapses in these systems involving the extremal space-time curvatures of compact neutron stars or black holes. That would mean that the gravitational coupling constant is dynamical under field energy changes and this is indicative of a violation of the Einstein Equivalency Principle. The violation is slight such that General Relativity retains its rigidity and robustness. A key feature is the large uncertainty of Newton gravitational constant in the Codata sets such that it is assumed that the other values i.e. Planck's constant the baryon masses are not problematic which enables an isolation of the Newton constant value to good measure (prediction). The current 2014 Codata Newton's gravitational constant is not utilized in this paper due to its current large uncertainty and systematic errors [2], [3]. After the gravitational coupling constant section a mathematical structure that exhibits Monster group symmetry order is introduced and a discussion of its triviality is discussed. A physics solution for each parameter placement is replicated for the physics form and the number theoretic form and the full equation is developed for both the near flat solution and the extremal solution.

Starting with the extremal case there is a pure number theoretic form [4], which involves the best 'near integer', value in CM as a quadratic and the 70^2 related to a solution of a particular Diophantine equation (Edouard Lucas' cannonball problem).

$$e^{2\pi\sqrt{163}} 70^2 = 337736875876935471466319632506024463200.0000008023...$$

It is close to a physics form, which is also a quadratic.

$$\frac{hc}{\pi G m_n^2} = 3.37709(16) \times 10^{38}$$

$$\frac{hc}{\pi G m_n^2} = \frac{m_p^2}{m_n^2}$$

Where m_p is the Planck mass and m_n is the neutron mass. It will turn out that the neutron mass at the neutronic fields of a neutron star will be slightly larger in mass than its Codata counterpart and that the pure math form reflects this and not what the Codata value calculates. Dividing the pure math form by 2 and inverting gives the weak gravitational coupling constant for neutronic fields at or near the surface of a neutron star.

$$\frac{2}{e^{2\pi\sqrt{163}} 70^2} = 5.921769705505 \dots \times 10^{-39} \text{ (dimensionless)}$$

This value is unique in that the square root of its inverse is a number theoretic value of the Planck mass (similar to the Planck mass-neutron mass ratio).

$$\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} = 1.299493893554208802281939914 \dots \times 10^{19}$$

This turns out to be the hierarchal gap value between the Standard Model (using the neutron as the baseline) and the Planck scale energetic domain. This implies that for our number theoretic approach the neutron mass value existing at the neutron star vacuum and gravitational fields is normalized to the number value 1. For the physics approach this neutron mass will be slightly larger than the 2014 Codata mass.

Using the 2014 Codata utilizing the proton and neutron masses a large dimensionless number is generated.

$$\frac{hc}{\pi G m_p m_n} = 3.38175(16) \times 10^{38}$$

This a fluctuation due to the current use of the 2014 Codata value of the Newton constant. In the past the number has been around 3.38202... This can be remedied by fixing the

gravitational constant to $6.6735414268 \times 10^{-11} m^3 kg^{-1} s^{-2}$. There are some reasons as to why this may be the case. In that the gravitational constant will be larger at a stronger field strength (more energetic vacuum) the neutronic field gravitational coupling constant will be slightly larger in strength compared to the lower energetic field value of the regular proton-neutron gravitational coupling constant. A good number theoretic candidate for the neutron mass proton mass ratio is found that can be used to calculate the regular proton-neutron gravitational coupling constant. The sixth root form and the associated Riemann Zeta functions will be seen to fit in very well with the final number theory form.

$$\sqrt[6]{\frac{26 \zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}} = 1.00137841550143 \dots$$

Compare to the 2014 Codata value,

$$\frac{m_n}{m_p} = 1.00137841898(51)$$

A candidate for the number theoretic proton-neutron gravitational coupling constant form,

$$e^{2\pi\sqrt{163}} 70^2 \sqrt[6]{\frac{26 \zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}} = 3.3820241762205037126 \dots \times 10^{38}$$

Using the fixed gravitational constant and 2014 Codata will match the number theoretic value at 9-10 significant figures.

$$\frac{hc}{\pi G m_p m_n} = 3.38202417622 \times 10^{38}$$

The proton-neutron gravitational coupling constant is,

$$2 \left(e^{2\pi\sqrt{163}} 70^2 \sqrt[6]{\frac{26 \zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}} \right)^{-1} = 5.913618282396 \dots \times 10^{-39}$$

There is a dimensionless form utilizing e and α which is a modified relation taken from Damour where A and B are of natural unity and 't Hooft suggested that $B = \pi/4$ [5].

$$\text{Gravitational coupling constant} \simeq A e^{\frac{-B}{\alpha}}$$

The following identity calculates the fine structure constant close to the 2014 Codata value [6].

$$\sqrt[4]{\frac{e}{2}} 2\alpha^4 e^{\pi/4\alpha} = e^{2\pi\sqrt{163}} 70^2 \sqrt[6]{\frac{26\zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}}$$

$$\alpha = 0.00729735255655 \dots$$

The 2014 Codata value,

$$\alpha = 0.0072973525664 \quad (17)$$

The two Riemann Zeta functions $\zeta(3)$ (a.k.a. Apéry's constant) and $\zeta(5)$ are the first two odd functions of the nontrivial zeros on the critical line. The π constant is not at obscure odd powers or large powers.

By itself the relations above suggests that in the low energy domain of the regular proton neutron fields /chemistries which we are familiar with that the fine structure constant and Newton gravitational constant values should be,

$$\alpha = 0.00729735255655 \dots$$

$$G = 6.6735414268 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

While these could be correctly obtained or derived in calculation and they look quite good at the low energy level they represent there is an issue with the final theoretical form. The following shows that there is probably some missing information in the forms that otherwise could present a full correct number theoretical calculation. This is a paradox and the resolution is related to obtaining the complete correct theoretical form and or the spatial distribution of dark matter. In the forms that follow, Newton's gravitational constant will be fixed for the proton-neutron gravitational coupling constant. The large form is then,

$$\frac{hc}{\pi G m_p m_n} = 3.382227403 \times 10^{38}$$

Newton's gravitational constant is then,

$$G = 6.6731404355 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

This is a smaller Newton's constant than the previous calculation. Then the fine structure constant should be slightly smaller as well.

$$\sqrt[4]{\frac{e}{2}} 2\alpha^4 e^{\frac{\pi}{4\alpha}} = 3.382227403 \times 10^{38} \quad (\text{dimensionless})$$

Solving for α ,
$$\alpha = 0.00729734832518$$

Not quite as close as the previous result to the 2014 Codata. This generates a slightly smaller gravitational coupling constant.

$$5.91326295276 \dots \times 10^{-39}$$

The ratio between both gravitational coupling constants is

$$1.0000300446 \dots^2$$

for which no number theoretic form or closed compact form is yet determined. However, it is possibly related to energy contributions from the vacuum and or the density of dark matter. If dark matter the speculation would be that, there are three gravitational coupling constants instead of two with each gravitational coupling constant having its unique strength dictated by its placement in relation to the galactic plane and halo to deep interstellar space outside of galactic halos. From deep interstellar space (where it is weakest) and outside of any galactic halo there is the regular proton-neutron flavor because there is little local gravitational influence of astrophysical objects. Traveling into the galactic halo and plane again there is the proton-neutron flavor in the lesser solar system and star system gravities to the neutron-neutron flavor near the galactic center at or near compact objects such as neutron stars and black holes. This suggests that the gravitational coupling constants are not constants but are dynamical and if the number theoretic forms or physics forms are true those constants represent in step what the other constants would be in that particular computation due to astrophysical properties at a particular location. This would mean that the Einstein Equivalency Principle is violated as expressed by the equations. The Newton gravitational constant in our low energy realm could vary between

$$G = 6.6731404355 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

and

$$G = 6.6735414268 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

It is more likely that within the visible matter filled galactic plane that Newton's gravitational constant will hover around the larger value because the fine structure constant in the expression is close to the 2014 Codata.

$$G = 6.6735414268 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

An inference would be that the lesser value of Newton's gravitational constant and the fine structure constant resides outside the halo of galaxies in interstellar space.

The Trivial Expression

There is an interesting form, which is the basis for all that follows.

$$\frac{1}{4} a^2 \frac{b^4}{c^6} \left(\frac{1451520 5^{4/5} 11^{2/5} 26^{3/5} \sqrt[5]{377381116575491} c^{6/5}}{a^{2/5} b^{4/5}} \right)^5 =$$

808017424794512875886459904961710757005754368000000000

This is the number of elements in the symmetry of the Monster group, which is a number close to 10^{54} . This number consists of the supersingular primes having order,

$$2^{46}, 3^{20}, 5^9, 7^6, 11^2, 13^3, 17, 19, 23, 29, 31, 41, 47, 59, 71$$

All integers in the expression are constructed using the supersingular primes. Its triviality is apparent in that all variables a, b, and c will cancel leaving the integers to calculate exactly the Monster group number. The variables a, b and c represent an infinite number of solutions from the number line. In the forms that follow the fifth power expression and its 5th root will represent a constant Z_{pn} that is almost a unity value.

$$\frac{1451520 5^{4/5} 11^{2/5} 26^{3/5} \sqrt[5]{377381116575491} c^{6/5}}{a^{2/5} b^{4/5}} = \sqrt[2048]{\frac{1}{\sqrt[65536]{a^2 d^4 \frac{1}{\pi} - 1}}}$$

Define the variables,

a = Planck mass, b= charged pi meson, c = electron mass, d = fine structure constant

This form defines Z_{pn} with an interesting root expression involving the fine structure constant and the constant π . For the physics, low energy form the following expression will be an identity to a number theoretic form.

$$Z_{pn} = \sqrt[2048]{\frac{1}{\sqrt[65536]{\sqrt[4]{8e} \alpha^4 e^{\frac{\pi}{4\alpha}} \frac{\alpha^4}{2\pi} - 1}}}$$

If the fine structure constant is

$$\alpha = 0.00729734832518$$

which is weaker than the 2014 Codata value then

$$Z_{pn} = 1.00336610183888$$

The number theoretic equivalent is,

$$Z_{pn} = \frac{1}{11^5} 2^{10} 3^{10} 5^5 7^2 \sqrt[10]{2} (5 \times 7 \times 13)^{\frac{3}{5}}$$

$$\sqrt[5]{17 \ 19 \ 23 \ 29 \ 31 \ 41 \ 47 \ 59 \ 71} e^{-\sqrt{163}\pi} \zeta(3)^{\frac{12}{5}} \left(\frac{\log(2\pi)}{\gamma \log(2) \log(\pi)} \right)^{\frac{6}{5}}$$

$$= 1.003366101838877211038830667680 \dots$$

These are two theoretic expressions defining a constant Z_{pn} ; one physics the other number theoretic. Rewriting the trivial expression,

$$\frac{1}{4} a^2 \frac{b^4}{c^6} Z_{pn}^5$$

$$= 808017424794512875886459904961710757005754368000000000$$

That the fine structure constant appears in our near unity constant Z_{pn} and that there is a rewrite of that constant in number theoretical form would mean that variables or constants a, b and c will have to calculate a number relatively close to the number of Monster group elements pushing the equation to have nontrivial solution(s) as well. A key part of determining how the values will change in response to changing gravitational and vacuum fields is that the dimensional ratio,

$$\frac{h}{G}$$

or its inverse remains invariant throughout the proton-neutron to neutron-neutron flavor field energetic vacuum changes. This also means that the Planck mass remains invariant.

$$m_P = \sqrt{\frac{hc}{2\pi G}}$$

Since G was fixed and h/G is considered invariant the Planck mass is fixed and invariant.

$$m_P = \sqrt{\frac{hc}{2\pi G}} = 2.176623411508 \times 10^{-8} \text{ kg}$$

$$\text{Codata 2014: } 2.176470(51) \times 10^{-8} \text{ kg}$$

Replacing a, b and c with the physics parameters Planck mass, charged pion mass and electron mass,

$$\frac{1}{4} \frac{m_p^2}{m_e^6} (\pi^{+-})^4 Z_{pn}^5 = 8.0801742476 \times 10^{53}$$

The value is good to 9 significant figures and calculates those digits matching the Monster integer order [7]. The only parameters using 2014 Codata are m_e and h . The Planck mass m_p , Newton constant G and charged pion mass π^{+-} are structurally fixed in the theory and are not published values. The charged pi meson π^{+-} is fixed but is also close to the PDG 2014 value [8]. From the equation, an approximation to the charged pion mass π^{+-} can be determined.

$$\pi^{+-} =$$

$$\sqrt[4]{\text{Number of symmetry elements of the Monster Group} \times \left(\frac{1}{4} \frac{m_p^2}{m_e^6} Z_{pn}^5 \right)^{-1}}$$

$$\pi^{+-} = 2.4882140269 \times 10^{-28} \text{ kg}$$

$$\pi^{+-} = 139.57857 \text{ MeV}$$

The Particle Data Group (PDG) value is,

$$\pi^{+-} = 139.57018(35) \text{ MeV}$$

The Proton-Neutron Flavor Fields

The comparison will be made between the physics form and the number theoretic form on a one to one basis from this proton-neutron flavor representation.

$$\frac{1}{4} \frac{m_p^2}{m_e^6} (Z_{pn} \pi^{+-})^2 (Z_{pn} \pi^{+-})^2 Z_{pn} = 8.0801742476 \times 10^{53}$$

$$\frac{1}{4} \frac{a^2}{c^6} (Z_{pn} b)^2 (Z_{pn} b)^2 Z_{pn} = \text{Monster group integer}$$

The Planck mass a is structurally fixed.

$$a = m_p = \sqrt{\frac{hc}{2\pi G}} = 2.176623411508 \times 10^{-8} \text{ kg}$$

The pure number form of the Planck mass was established earlier.

$$a = m_p = \sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} = 1.299493893554208802281939914 \dots \times 10^{19}$$

The charged pion mass value b is structurally fixed.

$$b = \pi^{+-} = 2.4882140269 \times 10^{-28} \text{ kg}$$

This can be replaced with a pure number representation.

$$b = \pi^{+-} = \sqrt[4]{\frac{13^2}{2^{13} (1 + 5e - 5\pi + \log(2048))^2}} = 0.148558755972458 \dots$$

Compare to the charged pi-meson ratio to neutron mass ratio (using 2014 Codata) and the charged pi-meson to the neutron mass ratio corrected ($m_{n_{nn}}$) at the neutron star field level.

$$\frac{\pi^{+-}}{m_n} = 0.14855652379 \quad \frac{\pi^{+-}}{m_{n_{nn}}} = 0.14855206080$$

It is considered that the corrected neutron mass $m_{n_{nn}}$ is the baseline as earlier it was stated that the neutron mass at the neutron star gravitational and vacuum fields is normalized to the value 1 not what is measured at the Codata level. However, corrections exists in the number theoretic forms such the ratio using the 2014 Codata neutron mass m_n is the proper comparison. This sets up the calculation so far as,

$$\frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}}\right)^2}{m_e^6} \left(\sqrt[4]{\frac{13^2}{2^{13} (1 + 5e - 5\pi + \log(2048))^2}}\right)^4 Z_{pn}^5$$

= *Monster Integer*

The electron mass (2014 Codata) is,

$$c = m_e = 9.10938356 \times 10^{-31} \text{ kg}$$

The number theoretic form to replace this is,

$$c = m_{e_{pn}} = \frac{\left(\sqrt[3]{\frac{2}{13} (1 + 5e - 5\pi + \log(2048))} \right)^{-1} \frac{3^5 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)}{22 \sqrt[4]{2} e^{\frac{-\sqrt{163} \pi}{2}} \gamma \log(2) \log(\pi)}}{1}$$

$$m_{e_{pn}} = \frac{1}{1838.6836553172 \dots}$$

Again, Apery's constant $\zeta(3)$ makes its appearance along with the Euler-Mascheroni constant. The particle mass ratio comparison is to the 2014 Codata neutron mass and not the corrected neutronic star field mass as the corrections are in the formulation as the later shows the need for a slightly larger electron mass.

$$\frac{m_n}{m_e} = 1838.68366060985 \qquad \frac{m_{n_{nn}}}{m_e} = 1838.73890057166$$

If one prefers the classic proton electron mass ratio within the context of these number theoretic forms this can be done by modifying the form $m_{e_{pn}}$ with the earlier mentioned form to create $m_{e_{pp}}$.

$$\sqrt[6]{\frac{26 \zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}} = 1.00137841550143 \dots$$

Then

$$m_{e_{pp}} =$$

$$\left(\sqrt[3]{\frac{2}{13} (1 + 5e - 5\pi + \log(2048))} \right)^{-1} \frac{3^5 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)}{22 \sqrt[4]{2} e^{\frac{-\sqrt{163} \pi}{2}} \gamma \log(2) \log(\pi)}$$

$$\sqrt[6]{\frac{26 \zeta(3)}{9} + \zeta(5) - \frac{31\pi^2}{54} + \frac{\pi^4}{45}}$$

$$= \frac{1}{1836.152679293 \dots}$$

Although this could be introduced into the equation easily, it changes the baseline value of the neutron from the unity value 1 to a value slightly less than one since the proton becomes the baseline value.

The 2014 Codata proton electron mass ratio value.

$$\frac{m_p}{m_e} = 1836.15267389(17)$$

Placing the number theoretic form of $m_{e_{pn}}$ (keeping the normalized unity value of the neutron) into the equation,

$$\frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}}\right)^2}{\left(\left(\sqrt[3]{\frac{2}{13}}(1+5e-5\pi+\log(2048))\right)^{-1} \frac{3^5 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)}{22 \sqrt[4]{2} e^{-\frac{\sqrt{163}\pi}{2}} \gamma \log(2) \log(\pi)}\right)^6}$$

$$\left(\sqrt[4]{\frac{13^2}{2^{13} (1+5e-5\pi+\log(2048))^2}}\right)^4 Z_{pn}^5 = \text{Monster Integer}$$

The constant Z_{pn} had been defined earlier and the full proton-neutron flavor form is,

$$\frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}}\right)^2}{\left(\left(\sqrt[3]{\frac{2}{13}}(1+5e-5\pi+\log(2048))\right)^{-1} \frac{3^5 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)}{22 \sqrt[4]{2} e^{-\frac{\sqrt{163}\pi}{2}} \gamma \log(2) \log(\pi)}\right)^6}$$

$$\left(\sqrt[4]{\frac{13^2}{2^{13} (1+5e-5\pi+\log(2048))^2}}\right)^4 \left(\frac{1}{11^{4/5}} 2^{10} 3^{10} 5^5 7^2 \sqrt[10]{2} (5 \times 7 \times 13)^{3/5} \sqrt[5]{17 19 23 29 31 41 47 59 71} e^{-\sqrt{163}\pi} \zeta(3)^{12/5} \left(\frac{\log(2\pi)}{\gamma \log(2) \log(\pi)}\right)^{6/5}\right)^5$$

$$= 808017424794512875886459904961710757005754368000000000$$

The equation for the NT proton-neutron flavor fields is precise and exact.

The Neutron-Neutron Flavor Fields

The approach is the same with going to the more extremal gravitational field (and slightly more energetic vacuum) of a neutron star or similar mass black hole. Although the parameters in the equation changes the symmetry remains unchanged. Flavor changes that occur in quarks change properties in larger systems or fields. An example is the proton to neutron conversion, which occurs when an up quark (**u**) changes to a down quark (**d**). this is a composition change from **uud** (proton) to **udd** (neutron). As the proton and neutron can be considered a larger field than its quark ensemble the concept is generalized to proton-neutron (pn) and neutron-neutron (nn) flavor fields. Flavor symmetries are not exact symmetries. It is to be noted that the neutron-neutron (nn) flavor fields have a slightly larger mass (possibly due to vacuum corrections) than the regular 2014 Codata neutron. Also, Planck's constant h and Newton's gravitational constant G are slightly larger.

Since the Planck mass is kept invariant across energetic vacuum changes the neutron mass can be determined at the nn flavor.

$$\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} = \frac{m_p}{m_{n_{nn}}}$$

$$m_{n_{nn}} = 1.6749777912 \times 10^{-27} \text{ kg}$$

Using the ratio of the nn neutron mass to pn neutron mass and that h/G is invariant the new nn h , new G can be figured.

$$\frac{m_{n_{nn}}}{m_n} = 1.0000300432$$

Since the neutron mass is squared in the large relation,

$$\frac{h}{G} \frac{(1.0000300432)^2}{(1.0000300432)^2}$$

$$h_{nn} = 6.6264681828 \times 10^{-34} \text{ J}$$

$$G_{nn} = 6.6739424219 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

Then,

$$e^{2\pi\sqrt{163}} 70^2 = \frac{h_{nn} c}{\pi G_{nn} m_{n_{nn}}^2}$$

is the correct relation of the pure number form to the newly defined parameters at or near the gravitational and vacuum fields of a neutron star. Compare the relations.

$$\frac{m_p}{m_{nn}} = 1.299493893557 \times 10^{19}$$

$$m_p = \sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} = 1.2994938935542088 \dots \times 10^{19}$$

The neutron-neutron fields will be addressed to the physics form,

$$\frac{1}{4} \frac{m_p^2}{m_{e_{nn}}^6} (Z_{nn} \pi_{nn}^{+-})^2 (Z_{nn} \pi_{nn}^{+-})^2 Z_{nn} = \textit{Monster Integer}$$

$$\frac{1}{4} \frac{a^2}{c^6} (Z_{nn} b)^2 (Z_{nn} b)^2 Z_{nn} = \textit{Monster group integer}$$

The Planck mass stays invariant,

$$a = m_p = \sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} = 1.299493893554208802281939914 \dots \times 10^{19}$$

There are no established/published parameter values at the neutron-neutron flavor fields for a neutron star. The following will be the number theoretic forms that best express the values determined by computer algorithms and patterning use of mathematical constants that is similar to the structural forms found in the proton-neutron structures.

$$b = \pi_{nn}^{+-} = \sqrt{\frac{3 \times 13^2 \sqrt[5]{\frac{3}{22}} \left(\frac{400 - \text{Im}(\rho_1)}{\gamma(-83 + 14 \text{Im}(\rho_1)) \log(2) \log(\pi)} \right)^{6/5}}{2^{14} \times 11(1 + 5e - 5\pi + \log(2048))^2}}$$

$$\pi_{nn}^{+-} = 0.14855875560106 \dots$$

The nn charged pion mass is slightly smaller than the pn charged mass.

$$\pi_{nn}^{+-} = 0.1485587556010 \dots$$

$$\pi_{pn}^{+-} = 0.1485587559724 \dots$$

The SI particle value is

$$\pi_{nn}^{+-} = 2.4882140020 \times 10^{-28} \text{ kg}$$

This is determined from the invariance relation.

$$Z_{pn}\pi_{pn}^{+-} = Z_{nn} \pi_{nn}^{+-} = 140.048407 \text{ MeV}$$

$$\text{or } 2.49658960 \times 10^{-28} \text{ kg}$$

Placing b in the form,

$$\frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}}\right)^2}{m_{e_{nn}}^6} \left(\sqrt[4]{\frac{3 \times 13^2 \sqrt[5]{\frac{3}{22}} \left(\frac{400 - \text{Im}(\rho_1)}{\gamma(-83 + 14 \text{Im}(\rho_1)) \log(2) \log(\pi)}\right)^{6/5}}{2^{14} \times 11(1 + 5e - 5\pi + \log(2048))^2}} \right)^4$$

$$\times Z_{nn}^5 = \text{Monster Integer}$$

$\text{Im}(\rho_1)$ is the imaginary part of the first nontrivial zero of the Riemann zeta function and γ is the Euler-Mascheroni constant. The prime 83 is not a supersingular prime. Its appearance could be related to quantum and gravitational corrections due to the extremal gravitational fields around or near compact astrophysical objects. Another explanation maybe that the expression is not correct.

This nn value is slightly smaller than the pn charged pion value. The strong force should decrease at higher energies in accordance with Grand Unified Theory (*GUT*). The ratio between the two values,

$$1.00000000999993$$

Since there is a fourth power of the pion mass in the symmetry equation,

$$1.00000000999993^4 = 1.00000003999973$$

There is a 6th power of the electron mass in the denominator of the symmetry equation and

$$\sqrt[6]{1.00000003999973} = 1.00000000666662$$

$$m_e 1.00000000666662 = m_{e_{nn}} = 9.109383620 \times 10^{-31} \text{ kg}$$

This is a slightly larger value of the electron mass in the slightly higher energy vacuum as expected as the fine-structure constant has increased slightly in value too. This is due to a slight

decrease of the screening charge surrounding the electron. The fine structure constant at this energy level is defined,

$$\alpha_{nn} = 0.0072974615628$$

The nn electron mass $c = m_{enn}$ is,

$$m_{enn} = \sqrt[3]{\frac{13}{2(1 + 5e - 5\pi + \log(2048))}} \times \left(\frac{2^{9/20} e^{\frac{\sqrt{163}\pi}{2}} \sqrt[5]{\frac{11}{3} \gamma \log(2) \log(\pi)} \left(\frac{400 - \text{Im}(\rho_1)}{14 \text{Im}(\rho_1) - 83} \right)^{4/5}}{3^4 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)} \right)^{-1}$$

$$= \frac{1}{1838.6836430593 \dots}$$

$$m_{enn} = \frac{1}{1838.6836430593 \dots}$$

The particle mass ratio,

$$\frac{m_{nn}}{m_{enn}} = 1838.68366060888$$

The nn electron mass is slightly larger than the pn mass electron mass.

$$m_{enn} = \frac{1}{1838.6836430593 \dots}$$

$$m_{epn} = \frac{1}{1838.6836553172 \dots}$$

$$\frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi\sqrt{163}} 70^2}{2}} \right)^2}{\left(\sqrt[3]{\frac{13}{2(1+5e-5\pi+\log(2048))}} \left(\frac{2^{9/20} e^{\frac{\sqrt{163}\pi}{2}} \sqrt[5]{\frac{11}{3}} \gamma \log(2) \log(\pi) \left(\frac{400 - \text{Im}(\rho_1)}{14 \text{Im}(\rho_1) - 83} \right)^{4/5}}{3^4 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)} \right)^{-1} \right)^6} \times \left(\sqrt[4]{\frac{3 \times 13^2 \sqrt[5]{\frac{3}{22}} \left(\frac{400 - \text{Im}(\rho_1)}{\gamma(-83 + 14 \text{Im}(\rho_1)) \log(2) \log(\pi)} \right)^{6/5}}{2^{14} \times 11(1+5e-5\pi+\log(2048))^2}} \right)^4 \times Z_{nn}^5 = \text{Monster Integer}$$

This leaves the constant Z_{nn} to finish out this expression. The physics form is defined as,

$$Z_{nn} = \sqrt[2048]{\frac{1}{\sqrt[65536]{\sqrt{\text{Exp}(2\pi\sqrt{163}) 70^2 \frac{0.0072974615628^4}{2\pi}} - 1}}}$$

Where the fine structure constant is defined at the nn field value,

$$\alpha_{nn} = 0.0072974615628$$

$$Z_{nn} = 1.00336611187247$$

Z_{nn} is defined for extremal space-time curvature in neutron-neutron flavor fields. The number theoretic equivalent is,

$$\begin{aligned} Z_{nn} &= 2^{11} 3^8 5^5 7^2 2^{3/10} 3^{4/5} 11^{2/5} (5 \times 7 \times 13)^{3/5} \\ &\times \sqrt[5]{17 \ 19 \ 23 \ 29 \ 31 \ 41 \ 47 \ 59 \ 71} e^{-\sqrt{163}\pi} \zeta(3)^{12/5} \\ &\times \left(\frac{(\log(2) + \log(\pi))(14 \text{Im}(\rho_1) - 83)}{400 - \text{Im}(\rho_1)} \right)^{6/5} \\ Z_{nn} &= 1.0033661118724720502 \dots \end{aligned}$$

Finishing the physics form with our new parameters in the stronger gravitational field and higher energy vacuum.

$$\frac{1}{4} \frac{m_p^2}{m_{e_{nn}}^6} (Z_{nn} \pi_{nn}^{+-})^2 (Z_{nn} \pi_{nn}^{+-})^2 Z_{nn} = 8.08017400 \times 10^{53}$$

Not as good as the proton-neutron value but because of redefinitions away from Codata and more uncertainty in the calculations in the neutron-neutron regime this is not that bad. The final number theoretic neutron-neutron form is,

$$\begin{aligned} & \frac{1}{4} \frac{\left(\sqrt{\frac{e^{2\pi \sqrt{163}} 70^2}{2}} \right)^2}{\left(\sqrt[3]{\frac{13}{2(1+5e-5\pi+\log(2048))}} \left(\frac{2^{9/20} e^{\frac{\sqrt{163}\pi}{2}} \sqrt[5]{\frac{11}{3}} \gamma \log(2) \log(\pi) \left(\frac{400 - \text{Im}(\rho_1)}{14 \text{Im}(\rho_1) - 83} \right)^{4/5}}{3^4 \times 5^3 \times 7 \sqrt{35} \zeta(3)^2 \log(2\pi)} \right)^{-1} \right)^6} \\ & \times \left(\sqrt[4]{\frac{3 \times 13^2 \sqrt[5]{\frac{3}{22}} \left(\frac{400 - \text{Im}(\rho_1)}{\gamma(-83 + 14 \text{Im}(\rho_1)) \log(2) \log(\pi)} \right)^{6/5}}{2^{14} \times 11(1+5e-5\pi+\log(2048))^2}} \right)^4 \\ & \times \left(2^{11} 3^8 5^5 7^2 2^{3/10} 3^{4/5} 11^{2/5} (5 \times \right. \\ & \left. \times 13)^{3/5} \sqrt[5]{17 19 23 29 31 41 47 59 71} e^{-\sqrt{163}\pi} \zeta(3)^{12/5} \left(\frac{(\log(2) + \log(\pi))(14 \text{Im}(\rho_1) - 83)}{400 - \text{Im}(\rho_1)} \right)^{6/5} \right)^5 \\ & = 808017424794512875886459904961710757005754368000000000 \end{aligned}$$

The equation for the NT neutron-neutron flavor fields is precise and exact.

If the theory is correct,

$$\frac{1}{4} \frac{m_p^2}{m_e^6} (Z_{pn} \pi^{+-})^2 (Z_{pn} \pi^{+-})^2 Z_{pn}$$

=

$$\frac{1}{4} \frac{m_p^2}{m_{e_{nn}}^6} (Z_{nn} \pi_{nn}^{+-})^2 (Z_{nn} \pi_{nn}^{+-})^2 Z_{nn}$$

Flavor symmetry while not being an exact symmetry participates in an exact symmetry. Again it should be noted that although there is the flavor change from **uud** to **udd** in the changes of the gravitational and vacuum fields that the resultant neutron mass m_{nn} is slightly larger than its empirical determined mass in the Codata set. The near quadratic nature of these formulas can be exhibited as virtual vacuum activity.

$$\frac{m_p^2}{m_e^2} \frac{2(Z_{pn}\pi^{+-})^2}{m_{e+e-}^2} \frac{2(Z_{pn}\pi^{+-})^2}{m_{e+e-}^2} Z_{pn} = \text{Monster Group Order of Elements}$$

$$\frac{m_p^2}{m_{e_{nn}}^2} \frac{2(Z_{nn}\pi_{nn}^{+-})^2}{m_{e+e-}^2} \frac{2(Z_{nn}\pi_{nn}^{+-})^2}{m_{e+e-}^2} Z_{nn} = \text{Monster Group Order of Elements}$$

Where, $2m_e = m_{e+e-}$ (positron-electron pair mass)

and the charged pion mass π^{+-} is its own antiparticle.

The Nature of Z

It is noted that the dimensionless parameters Z_{pn} and Z_{nn} are near unity values which seem coupled to the bosonic fields of QCD and that of the bosonic quadratic nature of the structural equation. Both parameters contain their vacuum specific very weak gravitational constant coupled to the fourth power of the electromagnetic coupling constant (fine structure constant). These are structurally within exponentially small root values involving an inverse value minus one. As such, it resembles a boson probability distribution equation. It may or may not be a coincidence that the number 2048 is also involved in the number theoretic form defining the charged pi-meson mass. If Z_{xx} is a natural expression for the gravitational coupling constant since Z_{nn} is slightly larger than Z_{pn} then it might be sensible to say that Z_{nn} is the constant defined for extremal space-time curvature in neutron-neutron flavor fields related to a neutron star or similar mass black hole. If Z_{xx} is a curvature parameter then it could be related to the stress-energy tensor of General Relativity.

Conclusion

A structural form using physics constants is demonstrated to show symmetric invariance to slight co-changes in the vacuum energy and the Newton-Einstein weak gravitational fields. The physics forms have dual math form counterparts showing this precise interrelationship to Monster group symmetry. Both types of forms are described from the near flat Minkowski type gentle curving space-time of the regular infrared proton-neutron flavor fields to the more extremal space-time curvature near a neutron (or similar mass

black hole) star in the slightly higher energy vacuum of the neutron-neutron flavor fields. The dynamics involve two maybe three gravitational coupling constants which establish a unity baseline at the (near low-energy) neutron star level from the (exponentially high energy) Planck energy cutoff. The nature of the Equivalence Principle is slightly violated but parameters of the structure exhibit enough rigidity to maintain the robustness of General Relativity. Computationally the gravitational coupling constants should run as the scale to vacuum energy. Flavor physics offers the possibility of an exploitative crack to explore in the form of the slight vacuum energy changes going from the internal Lie algebra changes in a proton to a neutron like particle/field via isospin symmetries due to gravitational collapse of baryonic matter to a neutron star or similar mass black hole. That the invariant changes of the internal symmetry could be related to the Monster Lie algebras is one possibility with external space-time symmetry invariant changes occurring in lockstep. The number theoretic forms are computer constructions chosen based upon having suppressed powers of π and e and expressed at the most as low even powers along with the appearance of supersingular primes. This suppression allows for evolving computational algorithms utilizing Complex constants and supersingular primes to defeat deceptive unconscious manipulation and patterning. It is hard to deny that the computer results or the physics Codata parameters are co-operative in a unique structural form. This demonstrates that the possibility that vacuum energy and gravitational gauges run in an invariant protected slight dynamism from the flat Minkowski space-time (realm of Special Relativity) towards the extremal space-time curvatures of General Relativity at gravitational collapse endpoints in the observable Universe. That the first two odd (3, 5) Riemann zeta functions the Euler-Mascheroni constant and imaginary part of the first nontrivial zero of the Riemann zeta function make appearances in these forms meaning the Complex plane is very much involved seems a natural approach. The number theoretic forms are close in value to the empirically determined dimensionless forms and that they fit the structural formula is an interesting case. It would be nice to have Codata parameters empirically determined precisely and accurately to 15 or more significant figures to increase confidence and directions in form deduction or to rule out the method. Finally, it must be considered that future powerful computational algorithms will go deeper into mathematics (than an individual possibly can) for emergences of powerful theoretical structures relating to the natural World.

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