Monster Symmetry, a Mini Computational Workshop *
CODATA Invariants in a Symmetry Operation

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Mathematica programs utilizing the NIST 2022 CODATA are presented in a format whereby the reader may directly relate the LaTex math relations to its Mathematica program. This enables the reader to verify with precision and accuracy the veracity of the presented math symmetry relations. Hopefully, the reader will take away from this peculiar workshop a sense of *Beauty* and *Mystery*.

It is necessary to have some definition before we begin and from the NIST webpage the following summary of 'CODATA values of the fundamental physical constants' are stated;

"Every four years, the Committee on Data for Science and Technology (CODATA) issues recommended values of the fundamental physical constants. The values are determined by a least-squares adjustment, based on all the available theoretical and experimental information. The selection and assessment of data is done under the auspices of the CODATA Task Group on Fundamental Constants."

It is noted that CODATA fundamental values are adjusted on a four-year cycle and published with the accepted input data and analysis in a review article. The NIST[1.] retains the newly published values along with their uncertainty (along with past records of values) which is made available on their website. BIPM[2] is also active in the consistent use of the latest CODATA recommended values of the basic constants and the SI system of units. CODATA is an acronym for Committee on Data for Science and Technology. Today it should be noted that CODATA is a technological jewel of Science and Metrology. Particularly this paper is interested in a symmetry operation using particle mass values and physics constants relayed in the Standard Model and Newton's constant *G*. On this, CODATA has excelled in establishing many of these values very precisely, some out to 9 significant figures or more. An example is the 'fine structure constant, which is precisely determined to 11 significant figures. Similarly, the proton and neutron masses are determined to 12 significant figures. Yes there are uncertainties but they are relatively negligible. However, there is a stubborn constant which refuses to stabilize to a precise value with a decent amount of significant figures. That said the various experimentation done by different parties to determine this constant do not agree on what the precise value should be past well established three significant figures. That constant is big G (Newton constant). This paper is short and hopefully quick to a point. The point is there is a calculable structure involving Standard Model particles, constants and the Monster group symmetry's number of elements and that CODATA is consistent in showing stability and veracity of the calculation. It appears the result is not a lucky accident.

*** This is meant to portray this short paper as a virtual workshop, therefore not existing in any particular time or place. In a sense this is for fun, as it makes it <u>easy</u> for the reader to verify the mathematical relations to their satisfaction.**

1. NIST is the National Institute of Standards and Technology, Gaithersburg, MD

2. BIPM is the Bureau international des poids et mesures, Saint-Cloud, Paris France

The Monster group is a very large symmetry group having a large integer number of elements.

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This integer value is approximately 8×10^{53}. The Reader will find each calculation to have a Mathematica program by which the Reader may verify the numbers presented or the case where the Reader may place their own or past CODATA Values. The form to investigate is,

$$16\left(\sqrt[2048]{\frac{1}{\sqrt[65536]{\frac{hc}{2\pi G m_p m_n}\frac{\sqrt{2}\,M_{pl}^2}{\alpha}}-1}}\right)^5 \frac{M_{pl}^2}{m_{e^+e^-}^2}\frac{m_{\pi^{+-}}^2}{m_{e^+e^-}^2}\frac{m_{\pi^{+-}}^2}{m_{e^+e^-}^2} = \dot{M} \qquad \textbf{(1)}$$

and its equivalent,

$$16\left(\sqrt[2048]{\frac{1}{\sqrt[65536]{2^4\sqrt{\frac{e}{2}}\,e^{\pi/4\alpha}\,\alpha^3\,\frac{\sqrt{2}\,M_{pl}^2}{2}}-1}}\right)^5 \frac{M_{pl}^2}{m_{e^+e^-}^2}\frac{m_{\pi^{+-}}^2}{m_{e^+e^-}^2}\frac{m_{\pi^{+-}}^2}{m_{e^+e^-}^2} = \dot{M} \qquad \textbf{(2)}$$

Where $\dot{M}$ = Number of elements of symmetry of the Monster

The nomenclature used in the forms is as follows using the 2022 CODATA,

$M_{pl} = 2.176434\ \times 10^{-8} kg \quad (Planck\ mass)$
$G = 6.67430\ \times 10^{-11} \quad (Newton\ constant)$
$h = 6.62607015\ \times 10^{-34} \quad (Planck\ constant)$
$c = 299792458\ cm/s\ \ (speed\ of\ light\ in\ vacuum)$
$m_{e^+e^-} = 1.82187674278 \times 10^{-30} kg\ \ (combined\ mass\ of\ electron\ positron\ pair)$
$m_p = 1.67262192595\ \times 10^{-27} kg\ \ (proton\ mass)$
$m_n = 1.67492750056\ \times 10^{-27} kg\ \ (neutron\ mass)$
$\alpha = 0.0072973525643\ (fine\ structure\ constant)$

$m_{\pi^{+-}} = 2.4880682 \times\ 10^{-28} kg\ (charged\ pion\ mass)$ translated from 2022 PDG[3] value
$= 139.57039(18)\ MeV/c^2$
$e = 2.718281828 \ldots\ \ (Euler's\ number)$

3. PDG is the Particle Data Group

This first form 1. rendered in Mathematica utilizing 2022 CODATA,

A.
16 ((1/((((6.62607015 10^-34 299792458)/((2 Pi) 6.67430 10^-11 1.67262192595 10^-27 1.67492750056 10^-27)) Sqrt[2] (2.176434 10^-8^2/0.0072973525643))^(1/65536) - 1))^(1/2048))^5 (2.176434 10^-8^2/1.8218767427 10^-30^2) (2.4880682 10^-28^2/1.8218767427 10^-30^2) (2.4880682 10^-28^2/1.8218767427 10^-30^2)

The value obtained to 7 significant figures, = 8.079777×10^{53}

The second form 2. in Mathematica utilizing 2022 CODATA,

B.
16 ((1/((2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2) 2.176434 10^-8^2)^(1/65536) - 1))^(1/2048))^5 (2.176434 10^-8^2/1.8218767427 10^-30^2) (2.4880682 10^-28^2/1.8218767427 10^-30^2) (2.4880682 10^-28^2/1.8218767427 10^-30^2)

The value obtained to 7 significant figures, = 8.079777×10^{53}

<u>IS THERE AN EQUIVALENCE BETWEEN DISPARATE RELATIONS ?</u>

$$\frac{hc}{\pi G m_p m_n} = 3.38164 \times 10^{38} \; (dimensionless) \qquad \mathbf{(3)}$$

Relation number **3.** in Mathematica utilizing 2022 CODATA

C.
(6.62607015 10^-34 299792458)/(Pi 6.67430 10^-11 1.67262192595 10^-27 1.67492750056 10^-27)

The value obtained to 6 significant figures, = 3.38164×10^{38}

$$2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\;\alpha^4 = 3.3820238042 \times 10^{38} \; (dimensionless) \qquad \mathbf{(4)}$$

Relation number **4.** in Mathematica utilizing 2022 CODATA,

D.
2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^4

The value obtained to 11 significant figures, = $3.3820238042 \times 10^{38}$

Since all the CODATA values (used) besides G and Planck mass are good to 9 or more significant figures we replace G in relation **3.** with an unknown x and set relation **3. =** relation **4.**

$$\frac{hc}{\pi\, x m_p m_n} = 2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\ \alpha^4 \qquad (\mathbf{5})$$

Relation number **5.** In Mathematica utilizing 2022 CODATA to solve for unknown x,

E.
((6.62607015 10^-34 299792458)/(Pi x 1.67262192595 10^-27 1.67492750056 10^-27)) (Sqrt[2]/2) (1/0.0072973525643) == 2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2)

The value obtained to 9 significant figures, $x = 6.67354204 \times 10^{-11} m^3 kg^{-1} s^{-2}$
This will redefine the Planck mass, $= 2.17642551\ 10^{-8}\ kg$. Using the new determined G relations **3.** and **4.** are thus equal to each other (or appear to $= 3.3820238041 \times 10^{38}\ vs.\ 3.3820238054 \times\ 10^{38}$).

As to the current status of G in CODATA there seems to be no stable consensus after 3 significant figures of where a value with a nice set of significant figures and small uncertainty should lie. This is not to say that there is no zeroing in on where the value lies, but to a precise and accurate value with a small uncertainty is a golden goal of the ongoing experimentation efforts. Currently the spread of values over the years is around 500 parts per million. As no theory as to the relations are not presented this paper's purpose is to only give the Reader a way to simply and quickly use Mathematica programs to verify the calculations presented. Of course it is up to the Reader to decide if there is worth to this work. These calculations are the iterative results of many years of 'on the paper' and computational verification (perhaps 600 to ~1000 calculations over a 20 year period).

If true (an application) the calculations have an apparent ability to bring the PDG determined charged pion mass $m_{\pi^{+-}}$ in line with the CODATA using symmetry.

Using current CODATA adjust charge pion mass $m_{\pi^{+-}}$ using symmetry using form **1.** and setting to the first 6 digits of the Monster integer to solve for unknown x.

F.
16 ((1/((((6.62607015 10^-34 299792458)/((2 Pi) 6.67430 10^-11 1.67262192595 10^-27 1.67492750056 10^-27)) Sqrt[2] (2.176434 10^-8^2/0.0072973525643))^(1/65536) - 1))^(1/2048))^5 (2.176434 10^-8^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) == 8.08017 10^53

$x = 2.48810 \times 10^{-28} kg \qquad 139.572\ MeV/c^2$

Using the fine structure radical using form **2.**, and setting to first 7 digits of the Monster integer to solve for unknown x.

G.

16 ((1/((2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2) 2.176434 10^-8^2)^(1/65536) - 1))^(1/2048))^5 ((2.176434 10^-8^2/1.8218767427 10^-30^2) (((x)^2 (x)^2)/(1.8218767427 10^-30^2 1.8218767427 10^-30^2))) == 8.080174 10^53

$x = 2.488099 \times 10^{-28} kg \quad 139.5721 \ MeV/c^2$

It appears possible using symmetry that the charged pion mass can be computed to 9 significant figures using the new values computed,

$$G = 6.67354204 \times 10^{-11} m^3 kg^{-1} s^{-2} \ , \ M_{pl} = 2.17642551 \ 10^{-8} \ kg$$

Using the first form **1.** with the dimensionless physics radical,

H.

16 ((1/((((6.62607015 10^-34 299792458)/((2 Pi) 6.67354204 10^-11 1.67262192595 10^-27 1.67492750056 10^-27)) Sqrt[2] (2.17642551 10^-8^2/0.0072973525643))^(1/65536) - 1))^(1/2048))^5 (2.17642551 10^-8^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) == 8.08017425 10^53

$x = 2.48810367 \times 10^{-28} \ kg \quad 139.5723780 \ MeV/c^2$

Using the first form **2.** with the fine structure constant radical,

I.

16 ((1/((2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2) 2.17642551 10^-8^2)^(1/65536) - 1))^(1/2048))^5 (2.17642551 10^-8^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) (x^2/1.8218767427 10^-30^2) == 8.08017425 10^53

$x = 2.48810368 \times 10^{-28} \ kg \quad 139.572381 \ MeV/c^2$

With the new symmetry determined pion mass $m_{\pi^{+-}}$, G and M_{pl} the agreement with the Monster symmetry integer is very good to 9 significant figures using Form **2.** .

J.

16 ((1/((2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2) 2.17642551 10^-8^2)^(1/65536) - 1))^(1/2048))^5 (2.17642551 10^-8^2/1.8218767427 10^-30^2) (2.48810367 10^-28^2/1.8218767427 10^-30^2) (2.48810367 10^-28^2/1.8218767427 10^-30^2)

$$== 8.08017422 \times 10^{53}$$

Thus is finished the workshop. In the spirit of the *Friendly Giant*, "Have a Nice Day".[4]

4. It is important to note the use of Codata and PDG values in the calculation minimizes conscious or unconscious bias to obtain target value or a predetermined solution. The anthropomorphic nature of Codata, PDG and SI units is eliminated as a consequence of unit cancel to dimensionless ratios. The discoverers of the Monster Group were Bernd Fischer and Robert Greiss with Greiss providing the first

construction of the Monster in 1980. Greiss originally named the Monster the "Friendly Giant" when shortened to the FG group also meant the Fischer-Greiss group. It should be noted that the Codata NIST values used in these calculations were not truncated.

Appendix A

<u>Results using 2018 CODATA and 2022 PDG</u>

Form **1.** Mathematica **A.** $\d{M} = 8.079777 \times 10^{53}$ - 7 significant figures

Form **2.** Mathematica **B.** $\d{M} = 8.079777 \times 10^{53}$ - 7 significant figures

Form **3.** Mathematica **C.** $= 3.38164 \times 10^{38}$ - 6 significant figures

Form **4.** Mathematica **D.** $= 3.3820235640 \times 10^{38}$ - 11 significant figures

Form **5.** Mathematica **E.** $\mathrm{x} = 6.67354254 \times 10^{-11} m^3 kg^{-1} s^{-1}$ - 9 significant figures
$M_{pl} = 2.17655778\ 10^{-8}\ kg$ - 9 significant figures

Form **1.** Mathematica **F.** $x = 2.48810 \times 10^{-28} kg$ - 6 significant figures
$m_{\pi^{+-}} = 139.572\ \ MeV/c^2$

Form **2.** Mathematica **G.** $x = 2.488099 \times 10^{-28} kg$ - 7 significant figures
$m_{\pi^{+-}} = 139.5721\ \ MeV/c^2$

Form **1.** Mathematica **H.** $x = 2.48802807 \times 10^{-28}\ kg$ - 9 significant figures
$m_{\pi^{+-}} = 139.568139\, MeV/c^2$

Form **2.** Mathematica **I.** $x = 2.48802807 \times 10^{-28}\ kg$ - 9 significant figures
$m_{\pi^{+-}} = 139.568139\, MeV/c^2$

Form **2.** Mathematica **J.** $\d{M} = 8.08017427 \times 10^{53}$ - 9 significant figures

Appendix B

<u>Using the Heegner number 163,compare to the Planck mass result in E. using 2022 CODATA</u>

$$Sqrt2\ 35\ e^{Pi\ Sqrt163}\ m_n = \ M_{pl}$$

Sqrt[2] 35 Exp[Pi Sqrt[163]] 1.67492750056 10^-27 == x

Where, $m_n = 1.67492750056 \times 10^{-27} kg$, then $\boldsymbol{M_{pl} = 2.17655805912 \times 10^{-8}\ kg}$

Appendix C

<u>Consequence of setting the radical to unity</u>

$$\sqrt[2048]{\frac{1}{\sqrt[65536]{x}-1}} = 1 \qquad x = 2^{65536}$$

(1/(x^(1/65536) - 1))^(1/2048) == 1

Compare to, $$x = 2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\, \alpha^3 \frac{\sqrt{2}}{2}\, M_{pl}^2 = 1.5523296 \times 10^{25}$$

2 (E/2)^(1/4) Exp[Pi/(4 0.0072973525643)] 0.0072973525643^3 (Sqrt[2]/2) 2.17642551 10^-8^2 ==x

[1.] National Institute of Standards and Technology (NIST), The NIST Reference on Constants, Units and Uncertainty, Fundamental Physical Constants, *CODATA* Internationally recommended 2018 and 2022 values of the Fundamental Physical Constants, Gaithersburg, MD https://www.nist.gov/programs-projects/codata-values-fundamental-physical-constants and https://physics.nist.gov/cuu/Constants/

[2.] BIPM is the Bureau international des poids et mesures, Saint-Cloud, Paris France https://www.bipm.org/en/

[3.] Particle Data Group (PDG), R.L. Workman et al. (Particle Data Group) Prog. Theor. Exp. Phys. 2022, 083C01 (2022) , https://pdg.lbl.gov/

[4.] Wolfram Research, Inc., Mathematica, Version 13.1, Champaign, IL (2022). URL: https://www.wolfram.com/mathematica

[5.] Thomas, M.A. (2021) 'Monster Symmetry and Scalar Theory, Conformal Gravities: Birth of Symmetries from Euclidean Space' v2, *viXra* [Power Point PDF].

[6.] Thomas Mark (2022) 'The Quantum Vacuum is Everywhere and Possibly the Monster Group is Hiding There' Predict (Internet Magazine)

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