

# Electrical Moonshine

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**Abstract.** The electrical constant  $a$  and its Eddington approximation 137 are both 10 ppb connected with the dimension  $d = 26$  of bosonic string theory and the Witten 'moonshine entropy'  $\ln D$ , with  $D = 196883 = 59(59^2 - 12^2)$ . The involved pi-approximations implies a 0.3 ppb formula for  $a$ , and, using the first Mathieu group order, this confirms the Coherent Cosmology value  $G \approx 6.67544 \times 10^{-11} \text{ kg}^{-1} \text{ m}^3 \text{ s}^{-2}$ , compatible with the BIPM measurement, but at 4 sigma from the controversial tabulated one. Direct connection between  $a$ , 137,  $d$  and  $D$ , implies the string central number 496, very close to the 20<sup>th</sup> root of the Monster order, whose square corresponds to 125.6 GeV (BEH Boson), directly tied to the Monster order entropy via the tau and muon masses. The Monster order correlates with canonical economic numbers, leading to a value for the tau mass, from its approximation  $59^2 m_e$ , so directly tied to  $D$ , and compatible with the Koide relation in the 10 ppb range, confirming again the BIPM value for  $G$ . The fifth power of the Monster order is directly connected to  $D$  and  $d$  via the number 24 of transverse dimensions, involving the economic number  $3^{(24^2+1)}$ . This confirms the arithmetical character of Physical laws.

A bridge was established between two very different mathematical domains: the group theory and the conformal field one, which is related to the string theory [1]. The starting common point is the dimension of the Monster group  $D = 196883$ . In its treatment of the bosonic string theory, of dimension  $d = 26$ , Witten [2] considers the corresponding entropy  $\ln D$ , and compare it with the natural term  $4\pi$ . But there are two  $10^{-8}$  precise relations implying 137 and the electric constant [3]  $a \approx 137.035999138(31)$ .

$$6d \ln D \approx (137/\pi_1)^2 \approx (a/\pi)^2 - 1$$

$\pi_1$  being the classical approximation  $355/113$ , *confirming the arithmetical character* of Physics revealed by the Monster Group [4], Topological Axis [5], and the Eddington number 137 [6][7]. *As predicted [8] the physical constants are tied to rational approximations of  $\pi$* . Indeed, with  $6\pi^5$ , the Lenz-Wyler approximation for  $p$  the proton/electron mass ratio and  $H$  the Hydrogen/electron mass ratio, the computer shows, *in the measurement ppb range:*

$$\sqrt{(6\pi^5 H)/p} \approx (\pi_1/\pi)(a/137)$$

Moreover, writing  $a^2 = 137^2 + \pi_a^2$ , one finds a value corresponding, in the Lenz-Wyler [9] formula to the whole number  $1834 \approx 6\pi_a^5$ . This corresponds to the value :

$$a_{1834} \approx 137.035999098$$

at  $-3.0 \times 10^{-10}$  ( $-1.3 \sigma$ ) from the above measured value [3]. In the measured 30 ppm range, the main strange mesons are given by :

$$\begin{aligned} a/(\pi_a - 3) &\approx 972.80 \approx K_0 - 1 \\ a/(\pi' - 3) &\approx 966.10 \approx K_{\pm} \end{aligned}$$

where  $\pi' = 443/141$ , corresponding to  $\sqrt{(Hn/d_e)}$  within 0.3 ppm, where  $H$  and  $n$  are the Hydrogen/electron and neutron/electron mass ratio, and  $d_e \approx 1.001159652$  is the electron magnetic factor [3]. With  $u \approx 0.23129(5)$  the weak-mixing angle, one observes that

$$7 + 2u^2 \approx (\pi_u - 3)^{-1}$$

induces a value  $\pi_u$  compatible with  $p_G + 2$  where  $p_G = P/2^{127/2}$ , with  $P$  the canonical mass ratio Planck/electron. Introducing the order of the first Mathieu group  $O_1 = 7920$ , one observes :

$$(p_G + 1)/O_1 \approx 0.23138 \approx e/\sqrt{(\sqrt{137a}) + 1}$$

This is a 1 ppm connexion between electricity and gravitation, corresponding to  $G \approx 6.675441 \times 10^{-11} \text{ kg}^{-1}\text{m}^3\text{s}^{-2}$ , at 2 ppm from the Coherent Cosmology value, confirming the BIPM  $G$  measurement [10], at  $4 \sigma$  the controversial tabulated value (200 ppm). Introducing the neutron mass, the above gravitational  $G$  value is confirmed to 0.2 ppm and 1.3 ppm by :

$$\sqrt{(pH)} \approx p_G (n/6\pi^5)^2 \approx \sqrt{(p_G^2 + a^2)}$$

Moreover, at 5 ppm :

$$(\pi - 3)^{-2}/(1 + \pi/a) \approx 4 \ln(D)$$

Detailed analysis shows that, in the ppb range :

$$D = 12d(136 + 496 - 1) + 11 \approx 12d(a + 496 - 2) - u \approx H(8H/a - 1/12)$$

where 496 the third perfect number, central in string theory [11], whose square is very close to  $s$ , the 10<sup>th</sup> root of the Monster order, corresponding, by respect to the electron energy, to 125.6 GeV, nearly compatible with the BEH mass 125.09(24) GeV [3].

Also the mass ratio Muon/Electron  $\mu$  and Tau/Electron  $\tau$  appear in the entropy of the Monster order  $O_M$ :

$$\ln O_M/137 \approx e/3 \approx \ln \tau/9 \approx 10\mu \ln D/8\tau$$

involving  $\ln O_M/10 = \ln s$  :

$$137/8 \approx \tau \ln s/\mu \ln D$$

So  $\tau$  is tied to the cube of the 'economic number'  $e^{(2)} = e^e$ . In fact the measured value 3477.22(23) is compatible with the following values, involving :  $e^{(3)} = e^{(e^e)}$  :

$$\tau \approx 137^2 e^{(3)}/(2a)^3 \approx 3477.439674 \approx e^{3e}(137/a)(p/H)(H-p)^{-1/2}$$

implying, that the square root of  $r_H/\lambda_e = aH/p$ , the ratio of the Bohr radius to the electron wavelength is close, to (4 ppm) :

$$\sqrt{(r_H/\lambda_e)} = (2e^{(2)}\sqrt{a})^3/e^{(3)}$$

Moreover  $\tau \approx 59^2$  shows a direct 2 ppm connexion with  $D = 59(59^2 - 12^2)$ :

$$(1 + 1/\sqrt{a}) D^2 \approx \tau^3 (H/p)$$

where  $1+1/p \approx H/p$  is the above effective mass correction and  $\sqrt{a}$  is the Feynman's Quantum Electrodynamics constant. This value is compatible with the  $2.2 \times 10^{-8}$  precise  $\mu$  value  $\approx 206.7682836(47)$ , in the Koide relation [12], prolonged with the term  $4\pi(apH)^{1/4}$  :

$$(1+\mu+\tau)/2 \approx (1+\sqrt{\mu}+\sqrt{\tau})^2/3 \approx 4\pi(apH)^{1/4}$$

It is significant that the best easily determined particle mass is that of the tau, whose existence and correct order of magnitude was predicted by Eddington [6], 35 years before its surprising discovery. Albeit the Koide formula have already corrected a 3 sigma error for tau mass measurement, it is *always not taken seriously*. This shows how the

particle standard model is disconnected from the profound physics behind. In fact, there is a 1.2 ppm holographic relation tying  $\tau$  and  $\mu$ :

$$(\pi/3)(\mu/ad_e)^3 \approx \tau^2/pH$$

specifying an already noted relation, found from the forgotten Eddington's symmetry tau-proton [13].

Also, within 40 ppb, where  $f \approx 8.434467749$  is the Bizouard strong coupling [4]:  $\tau \approx ae^{(3)/e^{(2)}}fpD\ln D\sqrt{(a-136)}\sqrt{(H-p)} \approx 3477.43954$ , implying the following relation:

$$8(a^2/137)^2 e^{(3)}/e^{(2)} \approx fpD\ln D\sqrt{(a-136)}\sqrt{(H-p)}$$

illustrating the importance of 136, the first Eddington's approximation for  $a$  [6]. Indeed, the computer shows that:

$$a/(a-136)(a-137) \approx 2H$$

precise to 19 ppm, and, moreover,

The economic numbers play also a decisive role in the *incredible* connexion (0.2 ppm) of the Monster group order with that of the pariah group  $J_3$  [4] :

$$O_M \approx J_3^7 d_e \sqrt{(p/6\pi^5)}$$

Also, the economic numbers appears in :

$$e^{(4)/4} \approx (4a^2/3\pi^2)P^{(a-1)^2} \approx (\pi/6) (4n/\pi d_e^2)^{s/2} \approx (6/\pi)^{(e^{(2)})^2} (a/d_e)^{3/2}$$

$$e^{(3)}/(2e^{(2)})^3 \approx 137$$

$$e^7/2^3 \approx a^2/137$$

$$e^{(3)}/e^{(2)} \approx a\sqrt{(pH)} \approx \sqrt{(\pi/3)} sa/137 \approx \sqrt{(a^d d_e (H-p))}/P$$

where  $P$  is the mass ratio Planck/electron. The last relation corresponds again, as above, with  $d = 26$ , to a value for  $G$  both compatible with the Coherent Cosmology one and BIPM measurement.

The following relation may be useful, since 24 is the number of transverse dimensions, and  $D+1$  appears in the moonshine

correlation :

$$(D+1)^{2 \times 26} \approx 3^{24^2 + 1} \approx (e^3 O_M / \sqrt{2})^5$$

precise to  $5 \times 10^{-5}$  and  $9 \times 10^{-6}$  on a number of 275 decimal digits. The term  $O_M / \sqrt{2}$  appears directly in c-free dimensional analysis [4], as well in the relation :

$$O_M / \sqrt{2} \approx (a/137)^{3aW^2/4\pi F}$$

inside the imprecision on  $W$ , the charged weak boson mass, by respect to the electron one, while  $F$  is the Fermi mass, while in the ppb range :

$$a/137 \approx 3^{a/F} \approx (P\sqrt{(3/2)})^{1/(D+11)}$$

This confirms that  $a/137$  is a mathematical ratio.

As well as mathematicians take profit of computer, they could be guided also by those formula, obtained by the *physical approach method* i.e. to look for direct connexions between pertinent numbers.

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