On the possible mathematical connections between some Ramanujan equations concerning p(n) and τ(n), several equations concerning Modular Forms in Theoretical Physics, various parameters concerning Particle Physics, ϕ and ζ(2). VI

Michele Nardelli[1], **Antonio Nardelli**[2]

Abstract

In this paper (part VI), we describe and analyze further new mathematical connections between some Ramanujan formulas concerning p(n) and τ(n), several equations concerning Modular Forms in Theoretical Phyisics, various parameters concerning Particle Physics, ϕ and ζ(2).

[1] M.Nardelli studied at Dipartimento di Scienze della Terra Università degli Studi di Napoli Federico II, Largo S. Marcellino, 10 - 80138 Napoli, Dipartimento di Matematica ed Applicazioni "R. Caccioppoli" - Università degli Studi di Napoli "Federico II" – Polo delle Scienze e delle Tecnologie Monte S. Angelo, Via Cintia (Fuorigrotta), 80126 Napoli, Italy

[2] A. Nardelli studies at the Università degli Studi di Napoli Federico II - Dipartimento di Studi Umanistici – **Sezione Filosofia - scholar of Theoretical Philosophy**



https://trinitycollegelibrarycambridge.wordpress.com/2020/04/24/remembering-ramanujan/

FOR THE READER

We want to highlight that the development of the various equations was carried out according an our possible logical and original interpretation

For more information on the data entered for the development of the various equations, see the "Observations" section.

On recreational mathematics

"Penrose tiles are a marvelous example of how a discovery made solely for the fun of it can turn out to have an unexpected practical use. A few years later a 3-D form of Penrose tiling became the basis for constructing a previously unknown type of molecular structure called a quasicrystal. Since then, physicists have written hundreds of research papers on quasicrystals and their unique thermal and vibrational properties. Although Penrose's idea started as a strictly recreational pursuit, it paved the way for an entirely new branch of solid-state physics." (https://blogs.scientificamerican.com/observations/a-quarter-century-of-recreational-m-2010-05-26/)

From:

https://web.archive.org/web/20020207051215/http://anduin.eldar.org/~problemi/singmast/ecmutil.html

THE UNREASONABLE UTILITY OF RECREATIONAL MATHEMATICS
by Prof. David Singmaster

WHY IS RECREATIONAL MATHEMATICS SO USEFUL?

"As I said earlier, I have only a tentative answer to this, but it also partly answers Wigner's question. Mathematics has been described as a search for pattern - and that certainly describes much of what we do and also much of what most scientists do. But how do we find patterns? The real world is messy and patterns are difficult to see. As we begin to see a pattern, we tend to remove all the inessential details and get to an ideal or model situation. These models may be so removed from reality that they become fanciful or even recreational. E.g. physicists deal with frictionless perfectly elastic particles, weightless strings, ideal gases, etc. Then such models get modified and adapted into a large variety of models. Now one of the ways in which a science progresses is by seeing analogies between reality and simpler situations. E.g. the idea of the circulation of the blood could not be developed until the idea of a pump was known and somewhat understood. The behaviour of a real system cannot be developed until one can see simpler models within it. But what are these simpler models? They are generally among the large variety of models which have been created in the past, often recreational or fanciful. Perhaps the clearest example is graph theory, where Euler made a simple model of the reality that he was studying, then later workers found that model useful in other situations. Thus recreational mathematics helps as a major source of mathematical models, which are the raw material for mathematical research"

We, in our papers, through the use of “recreational number theory”, obtain possible new matematical connections between various sectors of Ramanujan's mathematics and various physical parameters concerning several topics of physics and cosmology.

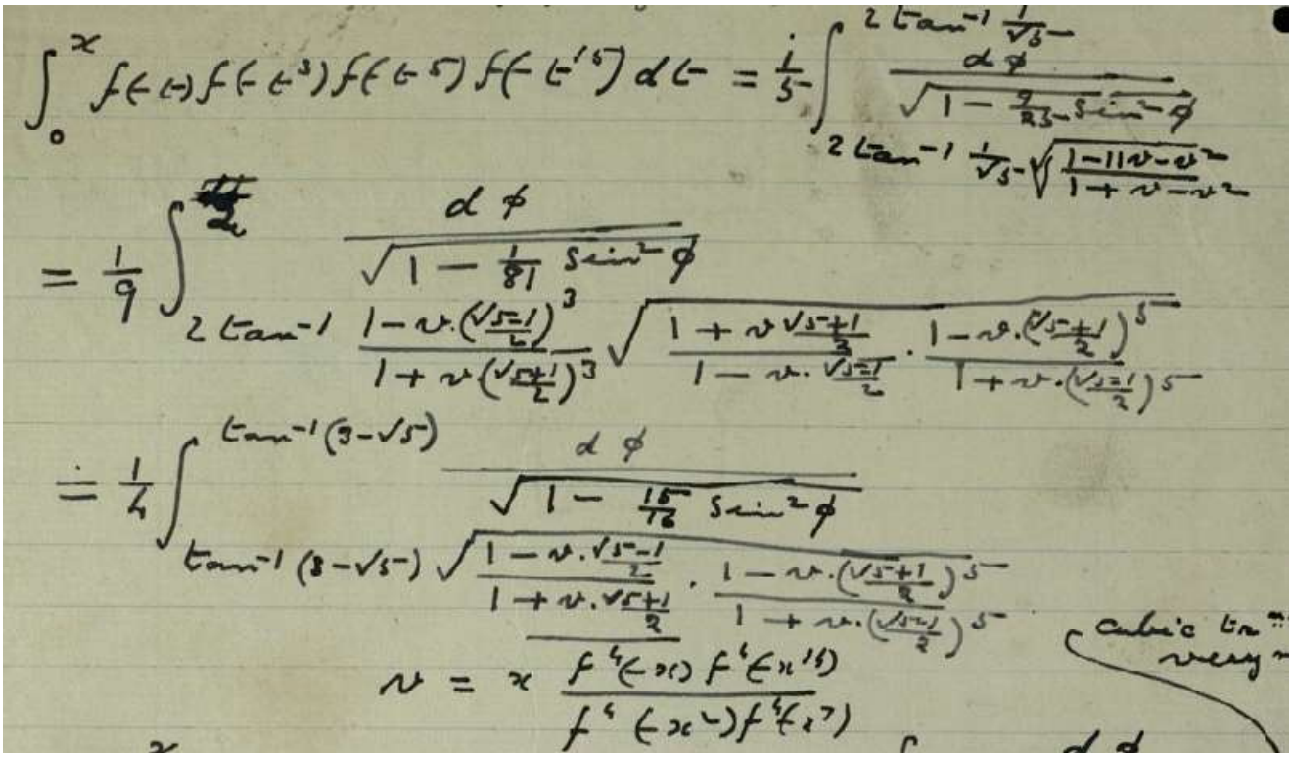
From:

https://www.trin.cam.ac.uk/library/wren-digital-library/modern-manuscripts/ramanujan/

https://archives.trin.cam.ac.uk/index.php/papers-of-srinivasa-ramanujan

https://mss-cat.trin.cam.ac.uk/manuscripts/uv/view.php?n=Add.Ms.a.94.15#?c=0&m=0&s=0&cv=112&xywh=-1423%2C1735%2C7282%2C4541

We have that:



We put $\alpha = \pi$; $\phi = x$ and obtain:

tan^-1(3-sqrt5)

Input:

$$\tan^{-1}\left(3-\sqrt{5}\right)$$

$\tan^{-1}(x)$ is the inverse tangent function

Exact Result:

$$\tan^{-1}\left(3-\sqrt{5}\right)$$

(result in radians)

Decimal approximation:

0.652358139784368185995390631643822574365307919962979741794...

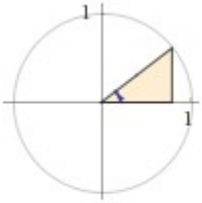
(result in radians)

0.65235813…

Conversion from radians to degrees:

37.38°

Reference triangle for angle 0.6524 radians:



width	$\cos\left(\tan^{-1}\left(3-\sqrt{5}\right)\right) = \frac{1}{\sqrt{1+\left(3-\sqrt{5}\right)^2}} \approx 0.794654$
height	$\sin\left(\tan^{-1}\left(3-\sqrt{5}\right)\right) = \frac{3-\sqrt{5}}{\sqrt{1+\left(3-\sqrt{5}\right)^2}} \approx 0.607062$

Alternate form:

$$\frac{1}{2}\, i \log\left(1 - i\left(3 - \sqrt{5}\right)\right) - \frac{1}{2}\, i \log\left(1 + i\left(3 - \sqrt{5}\right)\right)$$

$\log(x)$ is the natural logarithm

Alternative representations:

$$\tan^{-1}\left(3 - \sqrt{5}\right) = \text{sc}^{-1}\left(3 - \sqrt{5} \;\middle|\; 0\right)$$

$$\tan^{-1}\left(3 - \sqrt{5}\right) = \tan^{-1}\left(1, 3 - \sqrt{5}\right)$$

$$\tan^{-1}\left(3 - \sqrt{5}\right) = \cot^{-1}\left(\frac{1}{3 - \sqrt{5}}\right)$$

Series representations:

$$\tan^{-1}\left(3 - \sqrt{5}\right) = \sum_{k=0}^{\infty} \frac{(-1)^k \left(3 - \sqrt{5}\right)^{1+2k}}{1 + 2k}$$

$$\tan^{-1}\left(3 - \sqrt{5}\right) = \frac{1}{2}\, i \log\left(\frac{1}{2}\, i \left((-3 - i) + \sqrt{5}\right)\right) + \frac{1}{2}\, i \sum_{k=1}^{\infty} \frac{\left(\frac{1}{2}\, i \left((-3 - i) + \sqrt{5}\right)\right)^k}{k}$$

$$\tan^{-1}\left(3 - \sqrt{5}\right) = -\frac{1}{2}\, i \log\left(\frac{1}{2}\left((1 + 3\, i) - i\sqrt{5}\right)\right) - \frac{1}{2}\, i \sum_{k=1}^{\infty} \frac{\left(\frac{1}{2}\left((1 + 3\, i) - i\sqrt{5}\right)\right)^k}{k}$$

Integral representations:

$$\tan^{-1}\left(3 - \sqrt{5}\right) = -\left(-3 + \sqrt{5}\right) \int_0^1 \frac{1}{1 + \left(-3 + \sqrt{5}\right)^2 t^2}\, dt$$

$$\tan^{-1}\left(3-\sqrt{5}\right)=\frac{i\left(-3+\sqrt{5}\right)}{4\pi^{3/2}}\int_{-i\infty+\gamma}^{i\infty+\gamma}\left(15-6\sqrt{5}\right)^{-s}\Gamma\left(\frac{1}{2}-s\right)\Gamma(1-s)\,\Gamma(s)^2\,ds$$

for $0<\gamma<\frac{1}{2}$

$$\tan^{-1}\left(3-\sqrt{5}\right)=\frac{i\left(-3+\sqrt{5}\right)}{4\pi}\int_{-i\infty+\gamma}^{i\infty+\gamma}\frac{\left(3-\sqrt{5}\right)^{-2s}\,\Gamma\left(\frac{1}{2}-s\right)\Gamma(1-s)\,\Gamma(s)}{\Gamma\left(\frac{3}{2}-s\right)}\,ds \quad \text{for } 0<\gamma<\frac{1}{2}$$

Continued fraction representations:

$$\tan^{-1}\left(3-\sqrt{5}\right)=\frac{3-\sqrt{5}}{1+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(-3+\sqrt{5}\right)^2k^2}{1+2k}}=\cfrac{3-\sqrt{5}}{1+\cfrac{\left(-3+\sqrt{5}\right)^2}{3+\cfrac{4\left(-3+\sqrt{5}\right)^2}{5+\cfrac{9\left(-3+\sqrt{5}\right)^2}{7+\cfrac{16\left(-3+\sqrt{5}\right)^2}{9+\ldots}}}}}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)=3-\sqrt{5}+\frac{\left(-3+\sqrt{5}\right)^3}{3+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(-3+\sqrt{5}\right)^2\left(1+(-1)^{1+k}+k\right)^2}{3+2k}}=$$

$$3-\sqrt{5}+\cfrac{\left(-3+\sqrt{5}\right)^3}{3+\cfrac{9\left(-3+\sqrt{5}\right)^2}{5+\cfrac{4\left(-3+\sqrt{5}\right)^2}{7+\cfrac{25\left(-3+\sqrt{5}\right)^2}{9+\cfrac{16\left(-3+\sqrt{5}\right)^2}{11+\ldots}}}}}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)=3-\sqrt{5}-\frac{\left(3-\sqrt{5}\right)^3}{3+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(3-\sqrt{5}\right)^2\left(1+(-1)^{1+k}+k\right)^2}{3+2k}}=$$

$$3-\sqrt{5}-\cfrac{\left(3-\sqrt{5}\right)^3}{3+\cfrac{9\left(3-\sqrt{5}\right)^2}{5+\cfrac{4\left(3-\sqrt{5}\right)^2}{7+\cfrac{25\left(3-\sqrt{5}\right)^2}{9+\cfrac{16\left(3-\sqrt{5}\right)^2}{11+\ldots}}}}}$$

tan^-1(3-sqrt5) sqrt((((1-(1/golden ratio))/(1+(golden ratio)) * (1-(golden ratio)^5)/(1+(1/golden ratio)^5))))

Input:

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{1-\frac{1}{\phi}}{1+\phi}\times\frac{1-\phi^5}{1+\left(\frac{1}{\phi}\right)^5}}$$

$\tan^{-1}(x)$ is the inverse tangent function

ϕ is the golden ratio

Exact Result:

$$i\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(\phi^5-1\right)}{\left(\frac{1}{\phi^5}+1\right)(\phi+1)}}\,\tan^{-1}\left(3-\sqrt{5}\right)$$

(result in radians)

Decimal approximation:

0.75807634211541299164094189951217500362468453376695041975 0... i

(result in radians)

Polar coordinates:

$r \approx 0.758076$ (radius), $\theta = 90°$ (angle)

0.758076

Alternate forms:

$$i\sqrt{\frac{1}{22}\left(23+3\sqrt{5}\right)}\,\tan^{-1}\left(3-\sqrt{5}\right)$$

$$\tan^{-1}\left(3-\sqrt{5}\right) \quad \text{root of } 11x^4+23x^2+11 \text{ near } x = 1.16206\,i$$

$$\frac{i\left(1+\sqrt{5}\right)^2\sqrt{\frac{4+\sqrt{5}}{2\left(7+\sqrt{5}\right)}}\,\tan^{-1}\left(3-\sqrt{5}\right)}{3+\sqrt{5}}$$

Alternative representations:

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=\sec^{-1}\left(3-\sqrt{5}\;\middle|\;0\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(1-\phi^5\right)}{(1+\phi)\left(1+\left(\frac{1}{\phi}\right)^5\right)}}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=\tan^{-1}\left(1,\,3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(1-\phi^5\right)}{(1+\phi)\left(1+\left(\frac{1}{\phi}\right)^5\right)}}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=\cot^{-1}\left(\frac{1}{3-\sqrt{5}}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(1-\phi^5\right)}{(1+\phi)\left(1+\left(\frac{1}{\phi}\right)^5\right)}}$$

Series representations:

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=i\sqrt{\frac{1}{22}\left(23+3\sqrt{5}\right)}\sum_{k=0}^{\infty}\frac{(-1)^k\left(3-\sqrt{5}\right)^{1+2k}}{1+2k}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=i\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}\sum_{k=0}^{\infty}\frac{(-1)^k\left(3-\sqrt{5}\right)^{1+2k}}{1+2k}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}}=$$

$$-\frac{1}{2}\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}\left(\log(2)-\log\left(i\left((3-i)-\sqrt{5}\right)\right)-\sum_{k=1}^{\infty}\frac{\left(\frac{i}{2}\right)^k\left((3-i)-\sqrt{5}\right)^k}{k}\right)$$

Integral representations:

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} = i\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}\int_0^1 \frac{1}{1+\left(3-\sqrt{5}\right)^2 t^2}\,dt$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} = \frac{\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}}{4\pi^{3/2}} \int_{-i\infty+\gamma}^{i\infty+\gamma}\left(1+\left(3-\sqrt{5}\right)^2\right)^{-s}\Gamma\left(\frac{1}{2}-s\right)\Gamma(1-s)\,\Gamma(s)^2\,ds \quad \text{for } 0<\gamma<\frac{1}{2}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} = \frac{\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}}{4\pi}\int_{-i\infty+\gamma}^{i\infty+\gamma}\frac{\left(3-\sqrt{5}\right)^{-2s}\Gamma\left(\frac{1}{2}-s\right)\Gamma(1-s)\,\Gamma(s)}{\Gamma\left(\frac{3}{2}-s\right)}\,ds \quad \text{for } 0<\gamma<\frac{1}{2}$$

Continued fraction representations:

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} = \frac{2i\sqrt{\frac{2}{11}\left(23+3\sqrt{5}\right)}}{\left(3+\sqrt{5}\right)\left(1+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(-3+\sqrt{5}\right)^2k^2}{1+2k}\right)} = \frac{2i\sqrt{\frac{2}{11}\left(23+3\sqrt{5}\right)}}{\left(3+\sqrt{5}\right)\left(1+\cfrac{\left(-3+\sqrt{5}\right)^2}{3+\cfrac{4\left(-3+\sqrt{5}\right)^2}{5+\cfrac{9\left(-3+\sqrt{5}\right)^2}{7+\cfrac{16\left(-3+\sqrt{5}\right)^2}{9+\ldots}}}}\right)}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} =$$

$$\frac{i\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}}{1+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(3-\sqrt{5}\right)^2k^2}{1+2k}} = \frac{i\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\frac{1}{\phi}\right)\left(-1+\phi^5\right)}{\left(1+\frac{1}{\phi^5}\right)(1+\phi)}}}{1+\cfrac{\left(3-\sqrt{5}\right)^2}{3+\cfrac{4\left(3-\sqrt{5}\right)^2}{5+\cfrac{9\left(3-\sqrt{5}\right)^2}{7+\cfrac{16\left(3-\sqrt{5}\right)^2}{9+\ldots}}}}}$$

$$\tan^{-1}\left(3-\sqrt{5}\right)\sqrt{\frac{\left(1-\phi^5\right)\left(1-\frac{1}{\phi}\right)}{\left(1+\left(\frac{1}{\phi}\right)^5\right)(1+\phi)}} =$$

$$\frac{2i\sqrt{\frac{2}{11}\left(23+3\sqrt{5}\right)}}{\left(3+\sqrt{5}\right)\left(1+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{\left(-3+\sqrt{5}\right)^2(1-2k)^2}{15-6\sqrt{5}+2\left(-13+6\sqrt{5}\right)k}\right)} = \left(2i\sqrt{\frac{2}{11}\left(23+3\sqrt{5}\right)}\right)\Big/$$

$$\left(\left(3+\sqrt{5}\right)\left(1+\left(-3+\sqrt{5}\right)^2\Big/\left(15-6\sqrt{5}+2\left(-13+6\sqrt{5}\right)+\left(9\left(-3+\sqrt{5}\right)^2\right)\Big/\left(15-6\sqrt{5}+4\left(-13+6\sqrt{5}\right)+\frac{25\left(-3+\sqrt{5}\right)^2}{15-6\sqrt{5}+6\left(-13+6\sqrt{5}\right)+\frac{49\left(-3+\sqrt{5}\right)^2}{15-6\sqrt{5}+8\left(-13+6\sqrt{5}\right)+\ldots}}\right)\right)\right)\right)$$

0.652358139784368185995390631643822574365307919962979741794...

(result in radians)

0.758076342115412991640941899512175003624684533766950419750... i

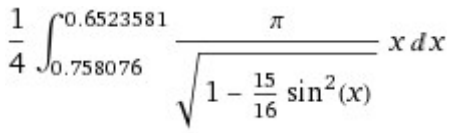
(result in radians)

$r \approx 0.758076$ (radius), $\theta = 90°$ (angle)

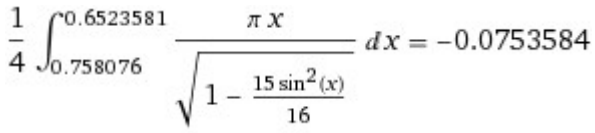
0.758076

1/4 * integrate (Pi/(sqrt(1-15/16 (sin^2(x))))) x,(0.758076 to 0.6523581)

Input interpretation:



Computation result:



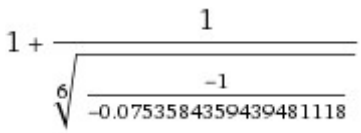
Result:

−0.075358435943948111801849692785421781689531005874108823 26...

-0.075358435…

1+1/(-1 / -0.0753584359439481118)^1/6

Input interpretation:

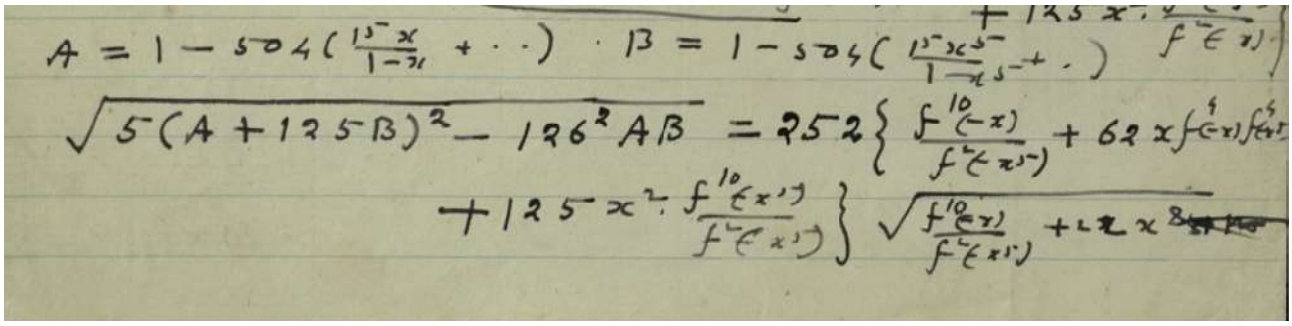


Result:

1.649913132564748613...

1.6499131325…. $\approx \zeta(2) = \frac{\pi^2}{6} = 1.644934$ ...

Now, we have that:



For x = 2 , we obtain:

A = 1 – 504(2/(1-2)) = 1009; B = 1 – 504(2^5/(1-2^5)) = 521.2580645

sqrt(((5(1009+125*521.2580645)^2-126^2(1009*521.2580645)))

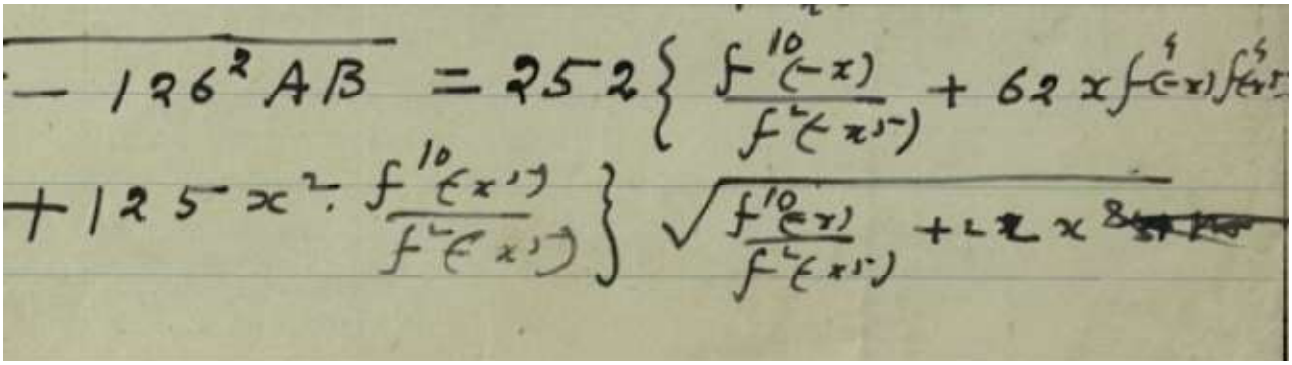
Input interpretation:

$$\sqrt{5\,(1009 + 125\times521.2580645)^2 - 126^2\,(1009\times521.2580645)}$$

Result:

116361.0590...

116361.0590….



252((1+62*2*1+125*2^2))*sqrt(((1+22*2^8))

Input:

$$252\,(1 + 62\times2\times1 + 125\times2^2)\,\sqrt{1 + 22\times2^8}$$

Result:

$157500\sqrt{5633}$

Decimal approximation:

$1.18208970154552991943476762725026733899936754543715949\ldots \times 10^7$

11820897.015455

101.5880838*sqrt(((5(1009+125*521.2580645)^2-126^2(1009*521.2580645))))

Input interpretation:

$101.5880838\sqrt{5\,(1009+125\times521.2580645)^2-126^2\,(1009\times521.2580645)}$

Result:

$1.182089702\ldots \times 10^7$

1.182089702…*10^7

1/2(((252((1+62*2*1+125*2^2))*sqrt(((1+22*2^8))))))^1/2+10

Input:

$\frac{1}{2}\sqrt{252\,(1+62\times2\times1+125\times2^2)\sqrt{1+22\times2^8}}+10$

Result:

$10+75\sqrt{7}\sqrt[4]{5633}$

Decimal approximation:

1729.07657009914040611265216883314474700098184675427172517 0…

1729.07657009…

This result is very near to the mass of candidate glueball **f_0(1710) scalar meson.** Furthermore, 1728 occurs in the algebraic formula for the j-invariant of an elliptic curve. The number 1728 is one less than the Hardy–Ramanujan number 1729 (taxicab number)

Alternate form:

$$5\left(2+15\sqrt{7}\,\sqrt[4]{5633}\right)$$

Minimal polynomial:

$$x^4-40x^3+600x^2-4000x-8\,733\,350\,380\,625$$

1/2(((252((1+62*2*1+125*2^2))*sqrt(((1+22*2^8))))))^1/3+29-Pi

Input:

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times2\times1+125\times2^2\right)\sqrt{1+22\times2^8}}+29-\pi$$

Result:

$$29+\frac{5\times3^{2/3}\,\sqrt[3]{35}\,\sqrt[6]{5633}}{\sqrt[3]{2}}-\pi$$

Decimal approximation:

139.75746971240662290011371417834680636207280452528494860 66...

139.757469712… result practically equal to the rest mass of Pion meson 139.57 MeV

Property:

$$29+\frac{5\times3^{2/3}\,\sqrt[3]{35}\,\sqrt[6]{5633}}{\sqrt[3]{2}}-\pi \text{ is a transcendental number}$$

Alternate forms:

$$\frac{1}{2}\left(5\times6^{2/3}\,\sqrt[3]{35}\,\sqrt[6]{5633}+58-2\pi\right)$$

$$\frac{1}{2}\left(58+5\times6^{2/3}\,\sqrt[3]{35}\,\sqrt[6]{5633}\right)-\pi$$

$$-\frac{-29\sqrt[3]{2}-5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}+\sqrt[3]{2}\,\pi}{\sqrt[3]{2}}$$

Series representations:

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}-4\sum_{k=0}^{\infty}\frac{(-1)^k}{1+2k}$$

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}+\sum_{k=0}^{\infty}\frac{4(-1)^k\,1195^{-1-2k}\left(5^{1+2k}-4\times 239^{1+2k}\right)}{1+2k}$$

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}-\sum_{k=0}^{\infty}\left(-\frac{1}{4}\right)^k\left(\frac{2}{1+4k}+\frac{2}{2+4k}+\frac{1}{3+4k}\right)$$

Integral representations:

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}-4\int_0^1\sqrt{1-t^2}\,dt$$

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}-2\int_0^1\frac{1}{\sqrt{1-t^2}}\,dt$$

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2+125\times 2^2\right)\sqrt{1+22\times 2^8}}+29-\pi=$$
$$29+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}-2\int_0^{\infty}\frac{1}{1+t^2}\,dt$$

1/2(((252((1+62*2*1+125*2^2))*sqrt(((1+22*2^8))))))^1/3+11+1/2

Input:

$$\frac{1}{2}\sqrt[3]{252\left(1+62\times 2\times 1+125\times 2^2\right)\sqrt{1+22\times 2^8}}+11+\frac{1}{2}$$

Result:

$$\frac{23}{2}+\frac{5\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{\sqrt[3]{2}}$$

Decimal approximation:

125.399062365996416138576357561626309246269973924660054427 5...

125.399062365… result very near to the Higgs boson mass 125.18 GeV

Alternate forms:

$$\frac{1}{2}\left(23+5\times 6^{2/3}\sqrt[3]{35}\sqrt[6]{5633}\right)$$

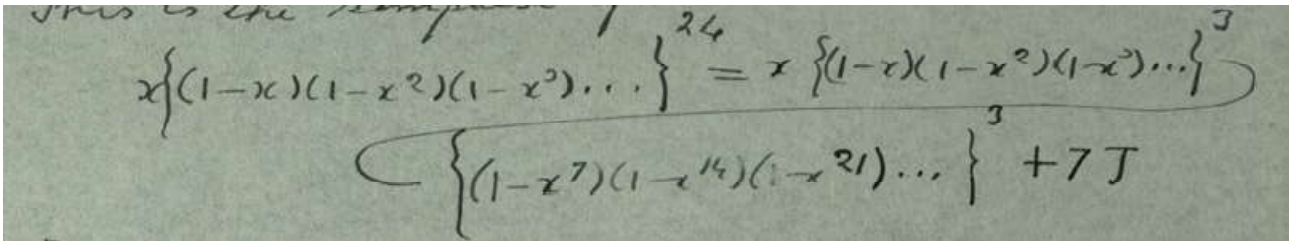
$$\frac{23\sqrt[3]{2}+10\times 3^{2/3}\sqrt[3]{35}\sqrt[6]{5633}}{2\sqrt[3]{2}}$$

Minimal polynomial:

$$64x^6-4416x^5+126\,960x^4-1\,946\,720x^3+16\,790\,460x^2-77\,236\,116x-139\,733\,458\,214\,111$$

https://mss-cat.trin.cam.ac.uk/manuscripts/uv/view.php?n=Add.Ms.a.94.13#?c=0&m=0&s=0&cv=36&xywh=180%2C249%2C5254%2C3276

Now, we have that:



For x = 2 and J = 279.1936 , we obtain:

[2((1-2)(1-2^2)(1-2^3))^24]x = 2((1-2)(1-2^2)(1-2^3))^3*((1-2^7)(1-2^14)(1-2^21))^3+7*279.1936

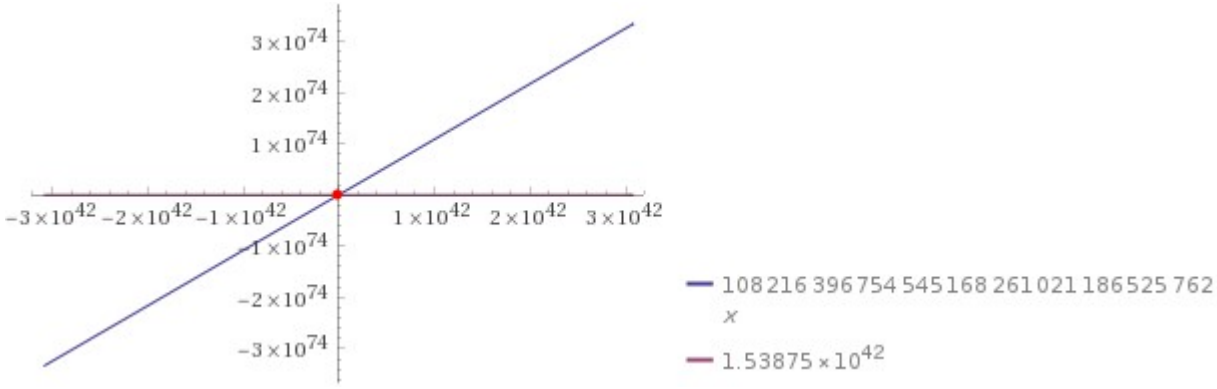
Input interpretation:

$$\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}\right)x = 2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3 + 7\times 279.1936$$

Result:

$$108\,216\,396\,754\,545\,168\,261\,021\,186\,525\,762\,x = 1.53875\times 10^{42}$$

Plot:



Alternate form:

$$108\,216\,396\,754\,545\,168\,261\,021\,186\,525\,762\,x - 1.53875\times 10^{42} = 0$$

Solution:

$x \approx 1.42192 \times 10^{10}$

$1.42192*10^{10}$

Thence:

[2((1-2)(1-2^2)(1-2^3))^24]*1.42192e+10

Input interpretation:

$(2\,((1-2)\,(1-2^2)\,(1-2^3))^{24}) \times 1.42192 \times 10^{10}$

Result:

1 538 750 588 732 228 656 537 112 455 447 115 030 400 000

Scientific notation:

$1.538750588732228656537112455447115030400000 \times 10^{42}$

$1.5387505887\ldots*10^{42}$

2((1-2)(1-2^2)(1-2^3))^3*((1-2^7)(1-2^14)(1-2^21))^3+7*279.1936

Input interpretation:

$2\,((1-2)\,(1-2^2)\,(1-2^3))^3\,((1-2^7)\,(1-2^{14})\,(1-2^{21}))^3 + 7 \times 279.1936$

Result:

$1.538751332658206873986153099189461600454216355 2 \times 10^{42}$

$1.5387513326\ldots*10^{42}$

From which, we obtain:

(e+1/golden ratio)*((2((1-2)(1-2^2)(1-2^3))^3*((1-2^7)(1-2^14)(1-2^21))^3+7*279.1936))

Input interpretation:

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.1936\right)$$

ϕ is the golden ratio

Result:

$5.133760409898911080569295869399622426509340496\ldots \times 10^{42}$

$5.1337604\ldots*10^{42}$ result very near to the angular Planck frequency 5.232458×10^{42} rad·Hz

Indeed:

$$\omega_P = \frac{\theta_P}{t_P} = \sqrt{\frac{c^5}{4\pi\hbar G}}$$

sqrt(299792458^5 / (4*Pi*1.054571817e-34*6.6743e-11))

$$\sqrt{\frac{299\,792\,458^5}{4\,\pi\times 1.054571817\times 10^{-34}\times 6.6743\times 10^{-11}}}$$

$5.232459591019820307162134884298060449265974579876585 3\ldots \times 10^{42}$

$5.232459591\ldots.*10^{42}$

Alternative representations:

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\left(e+-\frac{1}{2\cos(216^\circ)}\right)\left(1954.36+2(-21)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3\right)$$

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\left(e+\frac{1}{2\cos\left(\frac{\pi}{5}\right)}\right)\left(1954.36+2(-21)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3\right)$$

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\left(1954.36+2(-21)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3\right)$$
$$\left(e+\frac{1}{\text{root of } -1-x+x^2 \text{ near } x=1.61803}\right)$$

Series representations:

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\frac{1.53875\times 10^{42}}{\phi}+1.53875\times 10^{42}\sum_{k=0}^{\infty}\frac{1}{k!}$$

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\frac{1.53875\times 10^{42}}{\phi}+7.69376\times 10^{41}\sum_{k=0}^{\infty}\frac{1+k}{k!}$$

$$\left(e+\frac{1}{\phi}\right)\left(2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.194\right)=$$
$$\frac{1.53875\times 10^{42}}{\phi}+\frac{1.53875\times 10^{42}\sum_{k=0}^{\infty}\frac{-1+k+z}{k!}}{z}$$

and also:

[1/((2((1-2)(1-2^2)(1-2^3))^3*((1-2^7)(1-2^14)(1-2^21))^3+7*279.1936))]^1/4096

Input interpretation:

$$\sqrt[4096]{\frac{1}{2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3\left(\left(1-2^7\right)\left(1-2^{14}\right)\left(1-2^{21}\right)\right)^3+7\times 279.1936}}$$

Result:

0.976563298190966408595233723669300579896088992799 42...

0.97656329819….. result near to the value of the following Rogers-Ramanujan continued fraction:

$$\frac{e^{-\frac{\pi}{\sqrt{5}}}}{\frac{\sqrt{5}}{1+\sqrt[5]{\sqrt{\varphi^5\sqrt[4]{5^3}}-1}}-\varphi+1}=1-\frac{e^{-\pi\sqrt{5}}}{1+\frac{e^{-2\pi\sqrt{5}}}{1+\frac{e^{-3\pi\sqrt{5}}}{1+\frac{e^{-4\pi\sqrt{5}}}{1+\ldots}}}}\approx 0.9991104684$$

and to the Omega mesons ($\omega/\omega_3 \mid 5+3 \mid m_{u/d}=255-390 \mid 0.988-1.18$) Regge slope value (0.988) connected to the dilaton scalar field $\mathbf{0.989117352243 = \phi}$

A_1^{**} above the two low-lying pseudo-scalars. (bound states of gluons, or 'glueballs').

A_1^{**}	0.943(39) [2.5]	0.988(38)	0.152(53)
A_4	1.03(10) [2.5]	0.999(32)	0.035(21)

(**Glueball Regge trajectories -** *Harvey Byron Meyer*, Lincoln College -Thesis submitted for the degree of Doctor of Philosophy at the University of Oxford Trinity Term, 2004)

We note that

(*Borwein, Jonathan M.* - **A dictionary of real numbers. -** 1. Numbers, Real—Tables. I. Borwein, Peter B. II.Title. -QA47.B625 1989 512'.7 89-22267 ISBN 0-534-12840-8)

erf((((10*(3)^(1/3)/9))))

Input:

$$\text{erf}\left(10\times\frac{\sqrt[3]{3}}{9}\right)$$

$\text{erf}(x)$ is the error function

Exact result:

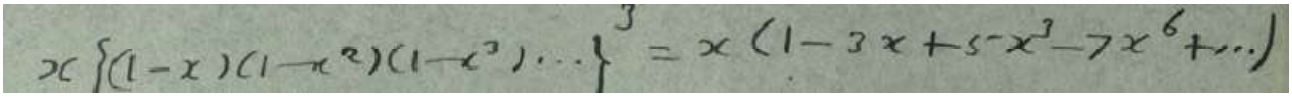
$$\text{erf}\left(\frac{10}{3\times 3^{2/3}}\right)$$

Decimal approximation:

0.976565544256262567840916835205934374977402794151848130716...

0.976565544…. as above

Now, we have that:



$2((1-2)(1-2^2)(1-2^3))^3 = 2((1-3*2+5*2^3-7*2^6))$

$2((1-2)(1-2^2)(1-2^3))^3 = ((2((1-3*2+5*2^3-7*2^6))))x$

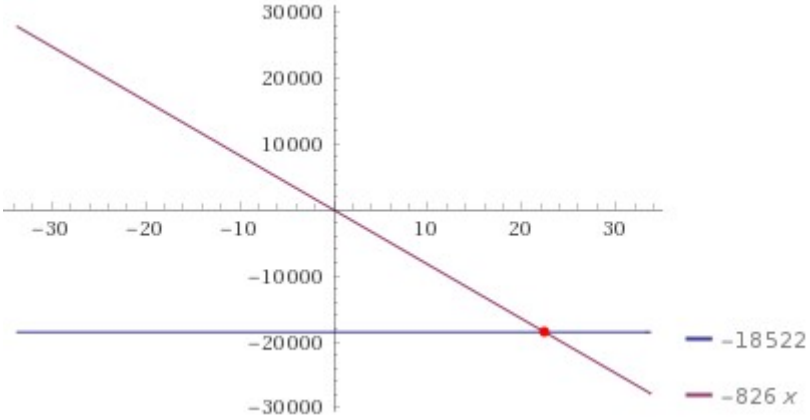
Input:

$$2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3 = \left(2\left(1-3\times 2+5\times 2^3-7\times 2^6\right)\right)x$$

Result:

$$-18522 = -826\,x$$

Plot:



Alternate form:

$$826\,x - 18522 = 0$$

Solution:

$$x \approx 22.424$$

22.424

Thence:

((2((1-3*2+5*2^3-7*2^6))))*22.424

Input interpretation:

$\left(2\left(1-3\times 2+5\times 2^3-7\times 2^6\right)\right)\times 22.424$

Result:

-18522.224

-18522.224

2((1-2)(1-2^2)(1-2^3))^3

Input:

$2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3$

Result:

-18522

-18522

From which:

[-1/((2((1-2)(1-2^2)(1-2^3))^3))]^1/2048

Input:

$\sqrt[2048]{-\frac{1}{2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^3}}$

Result:

$\frac{1}{\sqrt[2048]{2}\ 21^{3/2048}}$

Decimal approximation:

0.995213292538109462227112571063577274185139156382001848927...

0.9952132925…. result very near to the value of the following Rogers-Ramanujan continued fraction:

$$\frac{e^{-\frac{\pi}{\sqrt{5}}}}{\frac{\sqrt{5}}{1+\sqrt[5]{\sqrt{\varphi^5\sqrt[4]{5^3}}-1}}-\varphi+1}=1-\cfrac{e^{-\pi\sqrt{5}}}{1+\cfrac{e^{-2\pi\sqrt{5}}}{1+\cfrac{e^{-3\pi\sqrt{5}}}{1+\cfrac{e^{-4\pi\sqrt{5}}}{1+\ldots}}}}\approx 0.9991104684$$

and to the Omega mesons ($\omega/\omega_3 \mid 5+3 \mid m_{u/d}=255-390 \mid 0.988-1.18$) Regge slope value (0.988) connected to the dilaton scalar field $\mathbf{0.989117352243 = \phi}$

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(**Glueball Regge trajectories -** *Harvey Byron Meyer*, Lincoln College -Thesis submitted for the degree of Doctor of Philosophy at the University of Oxford Trinity Term, 2004)

We note that (see *Borwein, Jonathan M.* - **A dictionary of real numbers.**)

erf((((7*(5)^(1/3)/6))))

Input:

$$\operatorname{erf}\left(7\times\frac{\sqrt[3]{5}}{6}\right)$$

$\operatorname{erf}(x)$ is the error function

Exact result:

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right)$$

Decimal approximation:

0.995217298997852680438691991221699860694414997746032203460...

0.9952172989…. as above

Alternative representations:

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = 1 - \operatorname{erfc}\left(\frac{7\sqrt[3]{5}}{6}\right)$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = \operatorname{erf}\left(0, \frac{7\sqrt[3]{5}}{6}\right)$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = -i \operatorname{erfi}\left(\frac{7i\sqrt[3]{5}}{6}\right)$$

Series representations:

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = \frac{2\sum_{k=0}^{\infty} \frac{(-1)^k 5^{1/3+(2k)/3} 6^{-1-2k} 7^{1+2k}}{(1+2k)k!}}{\sqrt{\pi}}$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = \frac{\sum_{k=0}^{\infty} \frac{(-1)^k 2^{-1/2-3k} H_{1+2k}\left(\frac{7\sqrt[3]{5}}{6}\right)}{(1+2k)k!}}{\sqrt{\pi}}$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right) = 2e^{-49/72\left(-1+2\times 5^{2/3}\right)} \sum_{k=0}^{\infty} I_{\frac{1}{2}+k}\left(\frac{49}{72}\right) T_{1+2k}\left(\sqrt[3]{5}\right)$$

Integral representations:

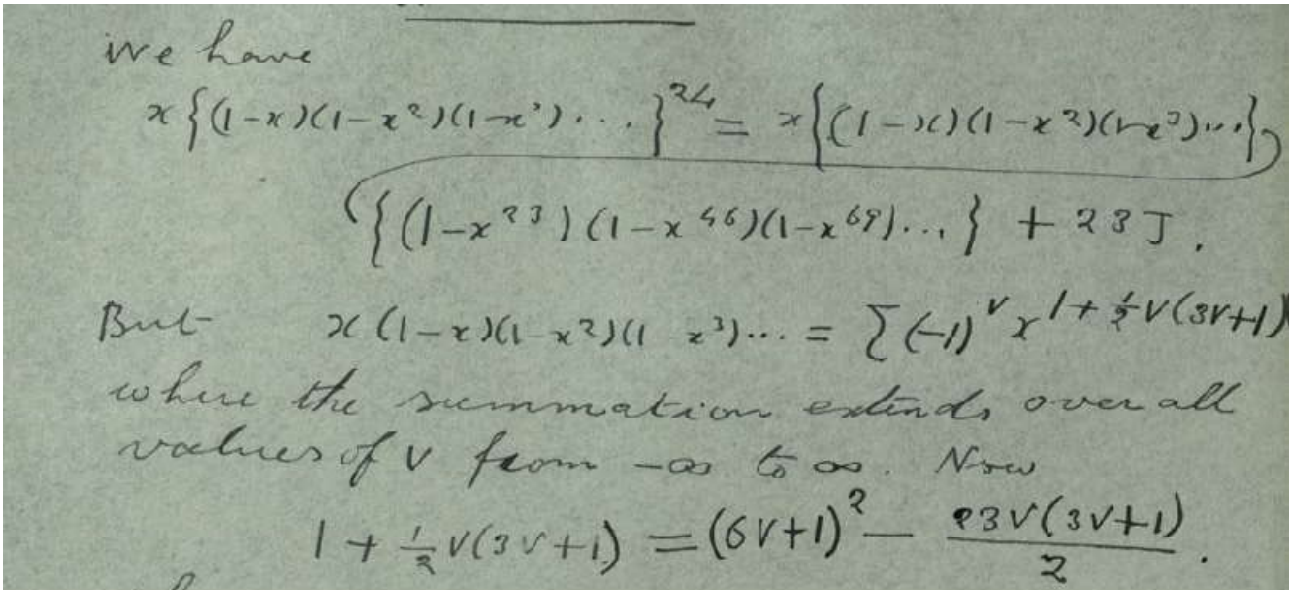
$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right)=\frac{2}{\sqrt{\pi}}\int_0^{\frac{7\sqrt[3]{5}}{6}} e^{-t^2}\,dt$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right)=\frac{2}{\pi}\int_0^{\infty}\frac{e^{-t^2}\sin\left(\frac{7\sqrt[3]{5}\,t}{3}\right)}{t}\,dt$$

$$\operatorname{erf}\left(\frac{7\sqrt[3]{5}}{6}\right)=-\frac{i}{2\pi^{3/2}}\int_{-i\infty+\gamma}^{i\infty+\gamma}\frac{\left(\frac{36}{49}\right)^s 5^{-(2s)/3}\,\Gamma(-s)\,\Gamma\left(\frac{1}{2}+s\right)}{\Gamma(1-s)}\,ds \quad \text{for } -\frac{1}{2}<\gamma<0$$

$\Gamma(x)$ is the gamma function

Now, we have that:



For x = 2, J = 279.1936 and V = 8, we obtain:

(6*8+1)^2 – ((23*8(3*8+1))/2)

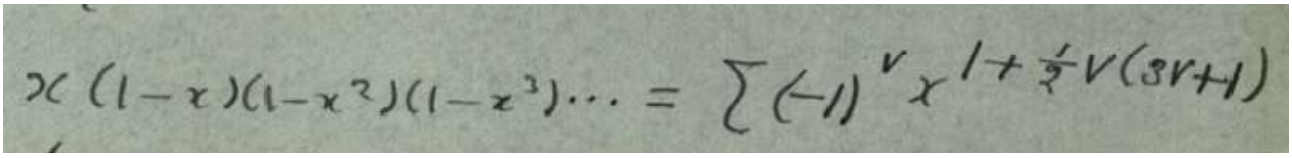
Input:

$$(6\times 8+1)^2-\frac{1}{2}(23\times 8(3\times 8+1))$$

Result:

101

101 result equal to the p(13): p(13) = 101



(-1)^101 * 2^101

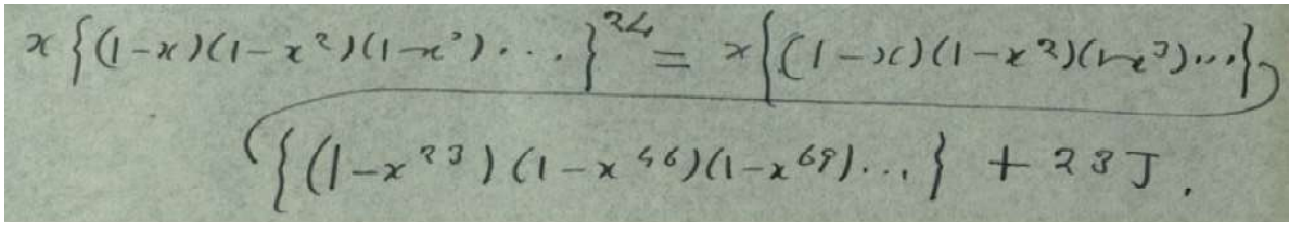
Input:

$$(-1)^{101}\times 2^{101}$$

Result:

$-2\,535\,301\,200\,456\,458\,802\,993\,406\,410\,752$

$-2.535301200456458802993406410752\times 10^{30}$



From:

2((1-2)(1-2^2)(1-2^3))^24 = 2(((1-2)(1-2^2)(1-2^3))*((1-2^23)(1-2^46)(1-2^69)))+23*279.1936

We have:

2((1-2)(1-2^2)(1-2^3))^24

Input:

$2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}$

Result:

108 216 396 754 545 168 261 021 186 525 762

Scientific notation:

$1.082163967545451682610211865257 62 \times 10^{32}$

$1.08216396\ldots*10^{32}$

2(((1-2)(1-2^2)(1-2^3))*((1-2^23)(1-2^46)(1-2^69)))+23*279.1936

Input interpretation:

$2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.1936$

Result:

$1.463486229192376899500413198924802517526756345 28 \times 10^{43}$

$1.4634862\ldots*10^{43}$

From which:

((3/5)^(1/3) π (7/log(π))^(1/6))/(2 sqrt(2)) * ((2(((1-2)(1-2^2)(1-2^3))*((1-2^23)(1-2^46)(1-2^69)))+23*279.1936))

Input interpretation:

$\frac{\sqrt[3]{\frac{3}{5}}\ \pi\ \sqrt[6]{\frac{7}{\log(\pi)}}}{2\sqrt{2}}\left(2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.1936\right)$

$\log(x)$ is the natural logarithm

Result:

$1.85400018314832278918625051505299768223193821 7\ldots \times 10^{43}$

$1.8540001831\ldots*10^{43}$ result practically equal to the value of Planck frequency 1.854858×10^{43} rad/s

$$f_p = \frac{c}{l_P} = \sqrt{\frac{c^5}{\hbar G}}$$

Alternative representations:

$$\frac{(2(((1-2)(1-2^2)(1-2^3))((1-2^{23})(1-2^{46})(1-2^{69})))+23\times 279.194)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$=\frac{\pi(6421.45-42(1-2^{23})(1-2^{46})(1-2^{69}))\sqrt[3]{\frac{3}{5}}\ \sqrt[6]{\frac{7}{\log_e(\pi)}}}{2\sqrt{2}}$$

$$\frac{(2(((1-2)(1-2^2)(1-2^3))((1-2^{23})(1-2^{46})(1-2^{69})))+23\times 279.194)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$=\frac{\pi(6421.45-42(1-2^{23})(1-2^{46})(1-2^{69}))\sqrt[3]{\frac{3}{5}}\ \sqrt[6]{\frac{7}{\log(a)\log_a(\pi)}}}{2\sqrt{2}}$$

$$\frac{(2(((1-2)(1-2^2)(1-2^3))((1-2^{23})(1-2^{46})(1-2^{69})))+23\times 279.194)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$=\frac{\pi(6421.45-42(1-2^{23})(1-2^{46})(1-2^{69}))\sqrt[3]{\frac{3}{5}}\ \sqrt[6]{-\frac{7}{\mathrm{Li}_1(1-\pi)}}}{2\sqrt{2}}$$

Series representations:

$$\frac{\left(2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.194\right)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$= \frac{8.53609\times 10^{42}\ \pi\sqrt[6]{\frac{1}{\log(\pi)}}}{\exp\left(i\pi\left\lfloor\frac{\arg(2-x)}{2\pi}\right\rfloor\right)\sqrt{x}\ \sum_{k=0}^{\infty}\frac{(-1)^k(2-x)^k x^{-k}\left(-\frac{1}{2}\right)_k}{k!}} \quad \text{for } (x\in\mathbb{R} \text{ and } x<0)$$

$$\frac{\left(2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.194\right)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$= \frac{8.53609\times 10^{42}\ \pi\sqrt[6]{\frac{1}{\log(\pi)}}\left(\frac{1}{z_0}\right)^{-1/2\,[\arg(2-z_0)/(2\pi)]} z_0^{-1/2-1/2\,[\arg(2-z_0)/(2\pi)]}}{\sum_{k=0}^{\infty}\frac{(-1)^k\left(-\frac{1}{2}\right)_k(2-z_0)^k z_0^{-k}}{k!}}$$

$$\frac{\left(2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.194\right)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$= \frac{8.53609\times 10^{42}\ \pi\sqrt[6]{\frac{1}{\log(-1+\pi)-\sum_{k=1}^{\infty}\frac{(-1)^k(-1+\pi)^{-k}}{k}}}}{\exp\left(i\pi\left\lfloor\frac{\arg(2-x)}{2\pi}\right\rfloor\right)\sqrt{x}\ \sum_{k=0}^{\infty}\frac{(-1)^k(2-x)^k x^{-k}\left(-\frac{1}{2}\right)_k}{k!}} \quad \text{for } (x\in\mathbb{R} \text{ and } x<0)$$

Integral representations:

$$\frac{\left(2\left(\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)\left(\left(1-2^{23}\right)\left(1-2^{46}\right)\left(1-2^{69}\right)\right)\right)+23\times 279.194\right)\left(\sqrt[3]{\frac{3}{5}}\ \pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$= \frac{8.53609\times 10^{42}\ \pi\sqrt[6]{\frac{1}{\int_1^{\pi}\frac{1}{t}\,dt}}}{\sqrt{2}}$$

$$\frac{(2\,(((1-2)\,(1-2^2)\,(1-2^3))\,((1-2^{23})\,(1-2^{46})\,(1-2^{69})))+23\times 279.194)\left(\sqrt[3]{\frac{3}{5}}\;\pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}}$$

$$= \frac{9.58143\times 10^{42}\,\pi\sqrt[6]{\frac{i\,\pi}{\int_{-i\,\infty+\gamma}^{i\,\infty+\gamma}\frac{(-1+\pi)^{-s}\,\Gamma(-s)^2\,\Gamma(1+s)}{\Gamma(1-s)}\,ds}}}{\sqrt{2}} \quad \text{for } -1<\gamma<0$$

Where

((3/5)^(1/3) π (7/log(π))^(1/6))/(2 sqrt(2))

Input:

$$\frac{\sqrt[3]{\frac{3}{5}}\;\pi\sqrt[6]{\frac{7}{\log(\pi)}}}{2\sqrt{2}}$$

$\log(x)$ is the natural logarithm

Decimal approximation:

1.266838147272113753688893393848716585895739569287221447639...

1.26683814727211….

Alternative representations:

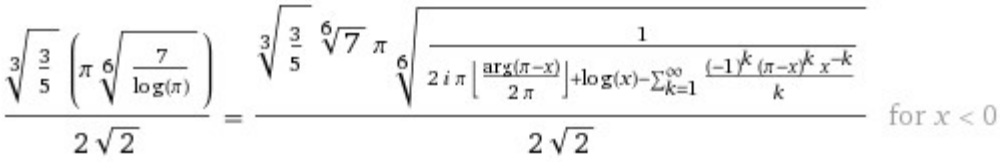
$$\frac{\sqrt[3]{\frac{3}{5}}\left(\pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}} = \frac{\pi\sqrt[3]{\frac{3}{5}}\sqrt[6]{\frac{7}{\log_e(\pi)}}}{2\sqrt{2}}$$

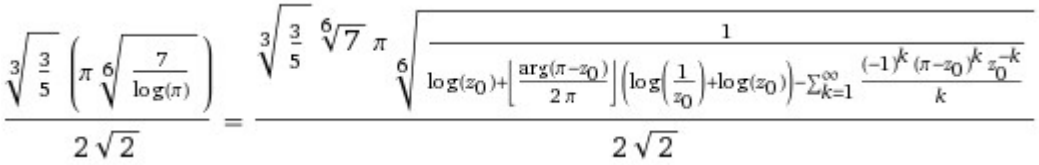
$$\frac{\sqrt[3]{\frac{3}{5}}\left(\pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}} = \frac{\pi\sqrt[3]{\frac{3}{5}}\sqrt[6]{\frac{7}{\log(a)\log_a(\pi)}}}{2\sqrt{2}}$$

$$\frac{\sqrt[3]{\frac{3}{5}}\left(\pi\sqrt[6]{\frac{7}{\log(\pi)}}\right)}{2\sqrt{2}} = \frac{\pi\sqrt[3]{\frac{3}{5}}\sqrt[6]{-\frac{7}{\text{Li}_1(1-\pi)}}}{2\sqrt{2}}$$

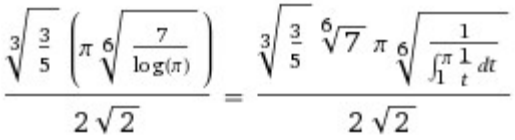
Series representations:

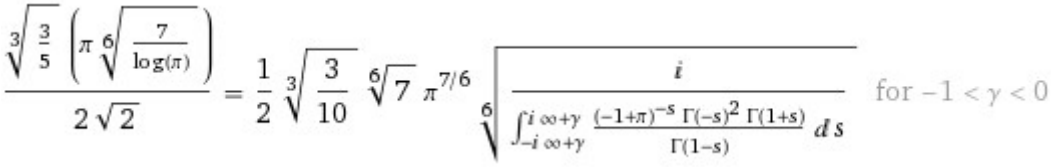






Integral representations:

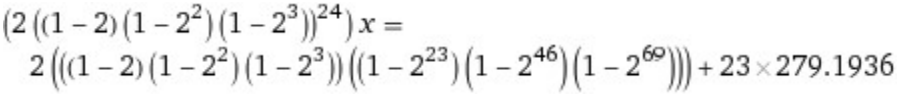




$\Gamma(x)$ is the gamma function

(((2((1-2)(1-2^2)(1-2^3))^24)))x = 2(((1-2)(1-2^2)(1-2^3))*((1-2^23)(1-2^46)(1-2^69)))+23*279.1936

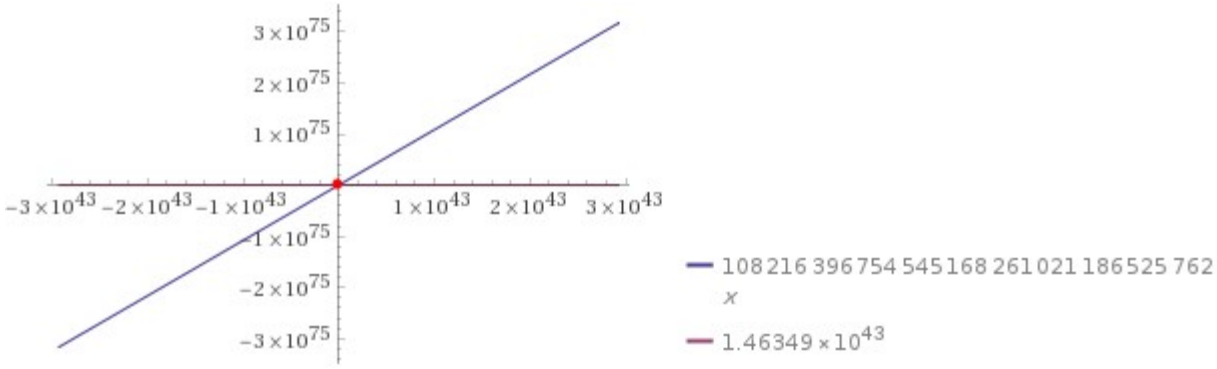
Input interpretation:



Result:

$108\,216\,396\,754\,545\,168\,261\,021\,186\,525\,762\,x = 1.46349\times10^{43}$

Plot:



Alternate form:

$108\,216\,396\,754\,545\,168\,261\,021\,186\,525\,762\,x - 1.46349\times10^{43} = 0$

Solution:

$x \approx 1.35237\times10^{11}$

$1.35237*10^{11}$

(((2((1-2)(1-2^2)(1-2^3))^24)))*(1.35237e+11)

Input interpretation:

$(2\,((1-2)\,(1-2^2)\,(1-2^3))^{24})\times1.35237\times10^{11}$

Result:

14 634 860 847 894 424 920 115 722 202 184 475 594 000 000

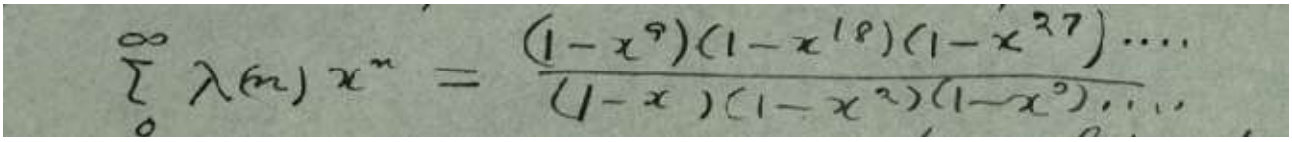
Scientific notation:

$1.463486084789442492011572220218447559 4\times10^{43}$

$1.463486084…*10^{43}$

https://mss-cat.trin.cam.ac.uk/manuscripts/uv/view.php?n=Add.Ms.a.94.13#?c=0&m=0&s=0&cv=39&xywh=-3713%2C0%2C12062%2C7521

Now, we have that:



For x = 2:

((1-2^9)(1-2^18)(1-2^27)) / ((1-2)(1-2^2)(1-2^3))

Input:

$$\frac{(1-2^9)(1-2^{18})(1-2^{27})}{(1-2)(1-2^2)(1-2^3)}$$

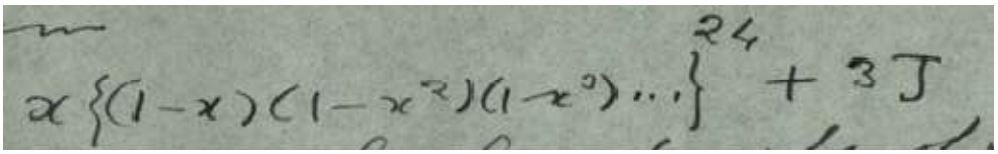
Result:

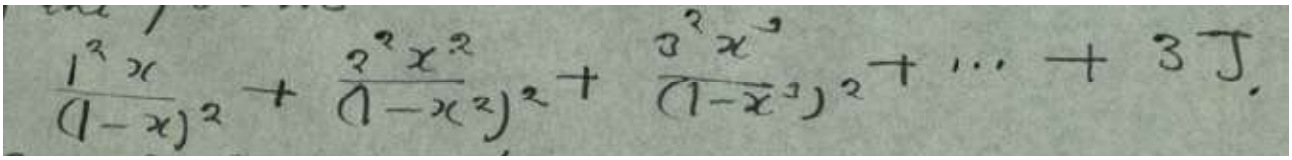
856 149 781 818 051

Scientific notation:

$8.56149781818051 \times 10^{14}$

$8.56149781818051*10^{14}$





For x = 2 and J = 279.1936 , we obtain:

2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936 = 2/(1-2)^2+(2^2*2^2)/(1-2^2)^2+(3^2*2^3)/(1-2^3)^2 + 3*279.1936

2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936

Input interpretation:

$$2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}+3\times 279.1936$$

Result:

$$1.082163967545451682610211865265995808\times 10^{32}$$

$1.0821639\ldots*10^{32}$

2/(1-2)^2+(2^2*2^2)/(1-2^2)^2+(3^2*2^3)/(1-2^3)^2 + 3*279.1936

Input interpretation:

$$\frac{2}{(1-2)^2}+\frac{2^2\times 2^2}{\left(1-2^2\right)^2}+\frac{3^2\times 2^3}{\left(1-2^3\right)^2}+3\times 279.1936$$

Result:

842.827965532879818594104308390022675736961451247165532879 8...

842.8279655…

2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936 = ((((2/(1-2)^2+(2^2*2^2)/(1-2^2)^2+(3^2*2^3)/(1-2^3)^2 + 3*279.1936))))x

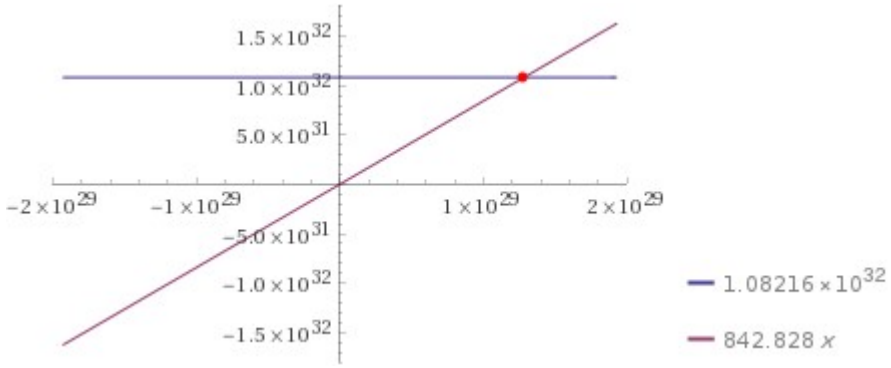
Input interpretation:

$$2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}+3\times 279.1936 = \left(\frac{2}{(1-2)^2}+\frac{2^2\times 2^2}{\left(1-2^2\right)^2}+\frac{3^2\times 2^3}{\left(1-2^3\right)^2}+3\times 279.1936\right)x$$

Result:

$$1.08216\times 10^{32}=842.828\,x$$

Plot:



Alternate form:

$1.08216 \times 10^{32} - 842.828\, x = 0$

Alternate form assuming x is real:

$1.08216 \times 10^{32} = 842.828\, x + 0$

Solution:

$x = 128\,396\,779\,864\,945\,661\,937\,421\,647\,872$

Integer solution:

$x = 128\,396\,779\,864\,945\,661\,937\,421\,647\,872$

((((2/(1-2)^2+(2^2*2^2)/(1-2^2)^2+(3^2*2^3)/(1-2^3)^2 + 3*279.1936))))*128396779864945661937421647872

Input interpretation:

$$\left(\frac{2}{(1-2)^2} + \frac{2^2 \times 2^2}{(1-2^2)^2} + \frac{3^2 \times 2^3}{(1-2^3)^2} + 3 \times 279.1936\right) \times 128\,396\,779\,864\,945\,661\,937\,421\,647\,872$$

Result:

$1.082163967545451798487944338371766471691609977324263 0\ldots \times 10^{32}$

$1.08216396\ldots * 10^{32}$

p(1038) = $1.067406977723661514100924961015 54 \times 10^{32}$

The ratio between the result and the value of p(1038) is:

((2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936)) /
(1.067406977723661514100924961015 54 × 10^32)

Input interpretation:

$$\frac{2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}+3\times 279.1936}{1.067406977723661514100924961015 54\times 10^{32}}$$

Result:

1.013825082775138622853183271760203908402184362028550329418...

1.0138250827…

From which:

1/((((((2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936)) /
(1.067406977723661514100924961015 54 × 10^32)))))

Input interpretation:

$$\frac{1}{\frac{2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}+3\times 279.1936}{1.067406977723661514100924961015 54\times 10^{32}}}$$

Result:

0.986363443743870205988505162575132410126918752985442651196...

0.9863634437…. result very near to the value of the following Rogers-Ramanujan continued fraction:

$$\frac{e^{-\frac{\pi}{\sqrt{5}}}}{\frac{\sqrt{5}}{1+\sqrt[5]{\sqrt{\varphi^5\sqrt[4]{5^3}}-1}}-\varphi+1}=1-\frac{e^{-\pi\sqrt{5}}}{1+\frac{e^{-2\pi\sqrt{5}}}{1+\frac{e^{-3\pi\sqrt{5}}}{1+\frac{e^{-4\pi\sqrt{5}}}{1+\ldots}}}}\approx 0.9991104684$$

and to the Omega mesons ($\omega/\omega_3 \mid 5+3 \mid m_{u/d}=255-390 \mid 0.988-1.18$) Regge slope value (0.988) connected to the dilaton scalar field $\mathbf{0.989117352243} = \boldsymbol{\phi}$

A_1^{**} above the two low-lying pseudo-scalars. (bound states of gluons, or 'glueballs').

A_1^{**}	0.943(39) [2.5]	0.988(38)	0.152(53)
A_4	1.03(10) [2.5]	0.999(32)	0.035(21)

(**Glueball Regge trajectories -** *Harvey Byron Meyer*, Lincoln College -Thesis submitted for the degree of Doctor of Philosophy at the University of Oxford Trinity Term, 2004)

(((((2((1-2)(1-2^2)(1-2^3))^24 + 3*279.1936)) /
(1.06740697772366151410092496101554 × 10^32))))^35

Input interpretation:

$$\left(\frac{2\left((1-2)\left(1-2^2\right)\left(1-2^3\right)\right)^{24}+3\times 279.1936}{1.06740697772366151410092496101554\times 10^{32}}\right)^{35}$$

Result:

1.61698545145915352710872789679741816911087133581933080841 9...

1.61698545…. result that is a very good approximation to the value of the golden ratio 1.618033988749...

From:

Borwein, Jonathan M. - **A dictionary of real numbers.** - 1. Numbers, Real—Tables. I. Borwein, Peter B. II.Title. - QA47.B625 1989 512'.7 89-22267 ISBN 0-534-12840-8

We have that:

9490 6147 = 0.94906147 at : (e)^1/3 , where at = arctan. (see Abbreviation in above cited book)

atan(e^(1/3))

Input:

$$\tan^{-1}\left(\sqrt[3]{e}\right)$$

$\tan^{-1}(x)$ is the inverse tangent function

Exact Result:

$$\tan^{-1}\left(\sqrt[3]{e}\right)$$

(result in radians)

Decimal approximation:

0.9490614706332868802738929971364114441899516933360069032 53...

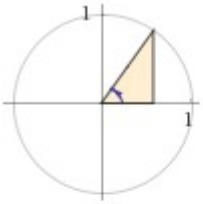
(result in radians)

0.94906147…..

Conversion from radians to degrees:

54.38°

Reference triangle for angle 0.9491 radians:



width	$\cos\left(\tan^{-1}\left(\sqrt[3]{e}\right)\right) = \frac{1}{\sqrt{1+e^{2/3}}} \approx 0.582446$
height	$\sin\left(\tan^{-1}\left(\sqrt[3]{e}\right)\right) = \frac{\sqrt[3]{e}}{\sqrt{1+e^{2/3}}} \approx 0.812869$

Alternate form:

$$\frac{1}{2}\,i\log\left(1-i\sqrt[3]{e}\right)-\frac{1}{2}\,i\log\left(1+i\sqrt[3]{e}\right)$$

Alternative representations:

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \sec^{-1}\left(\sqrt[3]{e} \mid 0\right)$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \tan^{-1}\left(1, \sqrt[3]{e}\right)$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \cot^{-1}\left(\frac{1}{\sqrt[3]{e}}\right)$$

Series representations:

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \frac{\pi}{2} - \sum_{k=0}^{\infty} \frac{(-1)^k \, e^{-1/3-(2k)/3}}{1+2k}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = -\frac{1}{2} i \log\left(\frac{1}{2}\left(1 + i\sqrt[3]{e}\right)\right) - \frac{1}{2} i \sum_{k=1}^{\infty} \frac{\left(\frac{1}{2}\left(1 + i\sqrt[3]{e}\right)\right)^k}{k}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \frac{1}{2} i \log\left(-\frac{1}{2} i\left(i + \sqrt[3]{e}\right)\right) + \frac{1}{2} i \sum_{k=1}^{\infty} \frac{\left(\frac{1}{2}\left(1 - i\sqrt[3]{e}\right)\right)^k}{k}$$

Integral representations:

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \sqrt[3]{e} \int_0^1 \frac{1}{1 + e^{2/3} t^2} \, dt$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = -\frac{i\sqrt[3]{e}}{4\pi^{3/2}} \int_{-i\infty+\gamma}^{i\infty+\gamma} \left(1 + e^{2/3}\right)^{-s} \Gamma\left(\frac{1}{2} - s\right) \Gamma(1-s) \, \Gamma(s)^2 \, ds \quad \text{for } 0 < \gamma < \frac{1}{2}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right) = -\frac{i\sqrt[3]{e}}{4\pi} \int_{-i\infty+\gamma}^{i\infty+\gamma} \frac{e^{-(2s)/3} \, \Gamma\left(\frac{1}{2} - s\right) \Gamma(1-s) \, \Gamma(s)}{\Gamma\left(\frac{3}{2} - s\right)} \, ds \quad \text{for } 0 < \gamma < \frac{1}{2}$$

Continued fraction representations:

$$\tan^{-1}\left(\sqrt[3]{e}\right) = \frac{\sqrt[3]{e}}{1 + \underset{k=1}{\overset{\infty}{\mathrm{K}}} \frac{e^{2/3} k^2}{1+2k}} = \cfrac{\sqrt[3]{e}}{1 + \cfrac{e^{2/3}}{3 + \cfrac{4\,e^{2/3}}{5 + \cfrac{9\,e^{2/3}}{7 + \cfrac{16\,e^{2/3}}{9 + \ddots}}}}}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right)=\sqrt[3]{e}-\frac{e}{3+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{e^{2/3}\left(1+(-1)^{1+k}+k\right)^2}{3+2k}}=\sqrt[3]{e}-\cfrac{e}{3+\cfrac{9\,e^{2/3}}{5+\cfrac{4\,e^{2/3}}{7+\cfrac{25\,e^{2/3}}{9+\cfrac{16\,e^{2/3}}{11+\ldots}}}}}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right)=\frac{\sqrt[3]{e}}{1+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{e^{2/3}(1-2k)^2}{1+e^{2/3}(1-2k)+2k}}=$$

$$\cfrac{\sqrt[3]{e}}{1+\cfrac{e^{2/3}}{3-e^{2/3}+\cfrac{9\,e^{2/3}}{5-3\,e^{2/3}+\cfrac{25\,e^{2/3}}{7-5\,e^{2/3}+\cfrac{49\,e^{2/3}}{9+\ldots-7\,e^{2/3}}}}}}$$

$$\tan^{-1}\left(\sqrt[3]{e}\right)=\frac{\sqrt[3]{e}}{1+e^{2/3}+\underset{k=1}{\overset{\infty}{\mathrm{K}}}\frac{2\,e^{2/3}\left(1-2\left\lfloor\frac{1+k}{2}\right\rfloor\right)\left\lfloor\frac{1+k}{2}\right\rfloor}{\left(1+\frac{1}{2}\left(1+(-1)^k\right)e^{2/3}\right)(1+2k)}}=$$

$$\cfrac{\sqrt[3]{e}}{1+e^{2/3}+-\cfrac{2\,e^{2/3}}{3-\cfrac{2\,e^{2/3}}{5\left(1+e^{2/3}\right)-\cfrac{12\,e^{2/3}}{7-\cfrac{12\,e^{2/3}}{9\left(1+e^{2/3}\right)+\ldots}}}}}$$

With regard the result above obtained, we note that:

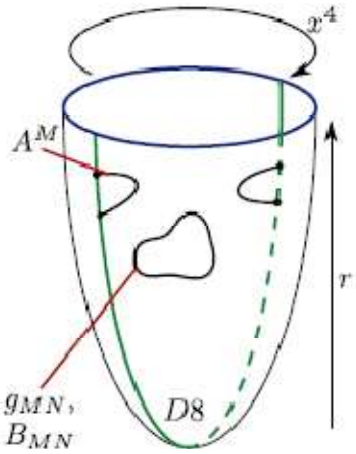
PSEUDOVECTOR GLUEBALL DECAY IN THE WITTEN-SAKAI-SUGIMOTO MODEL - *F. BRÜNNER, J. LEUTGEB AND A. REBHAN*

Sakai-Sugimoto model [4]: Massless quarks introduced by embedding N_f probe $\mathrm{D8}-\overline{\mathrm{D8}}$-brane pairs in the background above

- Geometric realization of chiral symmetry and its breaking

$$\mathrm{SU}(N_f)_L \times \mathrm{SU}(N_f)_R \to \mathrm{SU}(N_f)_V$$

- Mesons as gauge fields on flavor branes: massless pions and massive tower of vector- and axial-vector mesons
- Low energy meson action from Dirac-Born-Infeld and Chern-Simons action for D8-branes:



$\mathrm{D8}-\overline{\mathrm{D8}}$-brane embedding

$$S_{\mathrm{DBI}} = -T_{D8}\mathrm{STr}\int d^9x\, e^{-\Phi}\sqrt{-\det\left(g_{MN}+B_{MN}+2\pi\alpha' F_{MN}\right)}$$

$$S_{\mathrm{CS}} = T_{D8}\mathrm{Tr}\int\left[\exp\left(2\pi\alpha' F_2 + B_2\right)\wedge\sum_q C_q\right]$$

- Only two parameters as input:
  $m_\rho = 776\,\mathrm{MeV}$ and $f_\pi = 92.4\,\mathrm{MeV}$ or large-N lattice string tension fix

$$M_{\mathrm{KK}} \approx 949\,\mathrm{MeV}, \qquad \lambda \equiv g^2 N \approx 16.63...12.55$$

- Background fluctuation introduce **glueball-meson interactions**

We observe that:

$M_{\mathrm{KK}} \approx 949$ MeV = 0.949 GeV

Input interpretation:

convert 949 MeV (megaelectronvolts) to gigaelectronvolts

Result:

0.949 GeV (gigaelectronvolts)

0.949 GeV result practically equal to the value previously obtained

From:

Glueball Decay Rates in the Witten-Sakai-Sugimoto Model

Frederic Brunner, Denis Parganlija, and Anton Rebhan - arXiv:1501.07906v3 [hep-ph] 22 Apr 2016

Matching the result for the ρ meson mass with its experimental value, $m_\rho = \sqrt{\lambda_1} M_{\rm KK} \approx 776$ MeV,[5] fixes the Kaluza-Klein mass to [48, 49] $M_{\rm KK} = 949$ MeV. This determines the masses of the other vector and axial vector mesons, which come out in rough agreement with experiment. The masses of the lowest (exotic) and the predominantly dilatonic scalar glueball, the tensor glueball (degenerate with the dilatonic scalar), and the lowest pseudoscalar glueball are fixed to, respectively,

$$\begin{aligned} M_E &= \sqrt{7.30834/9}\, M_{\rm KK} \approx 855\,\text{MeV}, \\ M_D = M_T &= \sqrt{22.0966/9}\, M_{\rm KK} \approx 1487\,\text{MeV}, \\ M_P &= \sqrt{31.9853/9}\, M_{\rm KK} \approx 1789\,\text{MeV}, \\ M_{E^*} &= \sqrt{46.9855/9}\, M_{\rm KK} \approx 2168\,\text{MeV}, \\ M_{D^*} = M_{T^*} &= \sqrt{55.5833/9}\, M_{\rm KK} \approx 2358\,\text{MeV}, \end{aligned} \tag{3.7}$$

where we have also given the masses of some of the corresponding excited states (marked by a star).

Note that:

sqrt(31.9853/9) * 0.949 ≈ 1789.04049… that is the mass of the lowest pseudoscalar glueball

Now we have (*Borwein, Jonathan M.* - **A dictionary of real numbers.**):

0098 3797 ln : 10 ln 2 / 7

ln((10 ln (2)/7))

Input:

$$\log\left(10 \times \frac{\log(2)}{7}\right)$$

$\log(x)$ is the natural logarithm

Exact result:

$$\log\left(\frac{10\log(2)}{7}\right)$$

Decimal approximation:

−0.009837976642931948099800446991484991490246688790193475 47...

0.00983797664…..

Alternate forms:

$$\log\left(\frac{10}{7}\right) + \log(\log(2))$$

$$\log(2) + \log(5) - \log(7) + \log(\log(2))$$

Alternative representations:

$$\log\left(\frac{10\log(2)}{7}\right) = \log_e\left(\frac{10\log(2)}{7}\right)$$

$$\log\left(\frac{10\log(2)}{7}\right) = \log(a)\log_a\left(\frac{10\log(2)}{7}\right)$$

$$\log\left(\frac{10\log(2)}{7}\right) = -\mathrm{Li}_1\left(1 - \frac{10\log(2)}{7}\right)$$

Series representations:

$$\log\left(\frac{10\log(2)}{7}\right) = -\sum_{k=1}^{\infty} \frac{(-1)^k \left(-1+\frac{10\log(2)}{7}\right)^k}{k}$$

$$\log\left(\frac{10\log(2)}{7}\right) = 2i\pi\left\lfloor \frac{\arg\left(-x+\frac{10\log(2)}{7}\right)}{2\pi}\right\rfloor + \log(x) - \sum_{k=1}^{\infty} \frac{(-1)^k x^{-k}\left(-x+\frac{10\log(2)}{7}\right)^k}{k}$$

for $x < 0$

$$\log\left(\frac{10\log(2)}{7}\right) = \left\lfloor \frac{\arg\left(\frac{10\log(2)}{7}-z_0\right)}{2\pi}\right\rfloor \log\left(\frac{1}{z_0}\right) + \log(z_0) + \left\lfloor \frac{\arg\left(\frac{10\log(2)}{7}-z_0\right)}{2\pi}\right\rfloor \log(z_0) - \sum_{k=1}^{\infty} \frac{(-1)^k \left(\frac{10\log(2)}{7}-z_0\right)^k z_0^{-k}}{k}$$

Integral representation:

$$\log\left(\frac{10\log(2)}{7}\right) = \int_1^{\frac{10\log(2)}{7}} \frac{1}{t}\,dt$$

And:

0098 3965 cu : 3/14

(3/14)^3

Input:

$$\left(\frac{3}{14}\right)^3$$

Result:

$$\frac{27}{2744}$$

Decimal approximation:

0.009839650145772594752186588921282798833819241982507288629...

0.00983965….

With regard the above obtained results, we have that:

3. KALB-RAMOND GLUEBALL

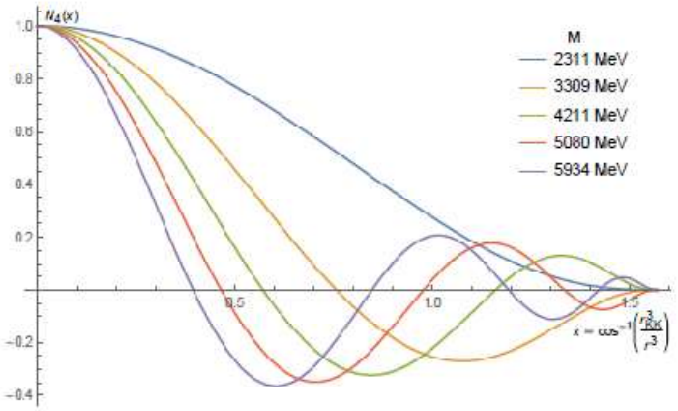
- $J^{PC} = 1^{+-}$ glueball with polarization ε_ρ is dual to $B_{\mu\nu}$ field fluctuation

$$\delta B_{\mu\nu} - r^3 N_4(r) \tilde{B}_{\mu\nu} - \frac{r^3}{M} N_4(r) \eta^{\lambda\rho} \eta^{\kappa\sigma} \epsilon_{\mu\nu\lambda\kappa} \varepsilon_\rho \partial_\sigma \tilde{V}^{(\varepsilon)}(x^\alpha)$$

- Holographic mode satisfies differential equation

$$\frac{d}{dr} r(r^6 - r_{\rm KK}^6) \frac{d}{dr} N_4(r) - (L^4 M^2 r^3 - 27 r^5 + \frac{9 r_{\rm KK}^6}{r}) N_4(r) = 0$$

- Modes are normalizable for discrete mass spectrum with mass gap
- First mode has the mass $M \approx 2311\,\text{MeV}$ and is the lightest glueball with spin different from 2 or 0



Kalb-Ramond modes

- Canonical normalization of $\tilde{V}^{(\varepsilon)}$ for

$$N_4(r_{\rm KK})^{-1} = 0.00983838\, L^3 \lambda^{\frac{1}{2}} N_c M_{\rm KK}$$

The previous results 0.00983965…. , 0.00983797664….. are very near to the values 0.00983838

From:

B. Pioline - (LPTHE, Paris) - **Black holes and mock modular forms** - Amsterdam 7/06/2019

We have that:

- Recall that $f(\tau) = \sum_{n\geq 0} a_n q^{n-\Delta}$ (with $q = e^{2\pi i \tau}$, $\mathrm{Im}\tau > 0$) is a *modular form* of weight k under $\Gamma \subset SL(2,\mathbb{Z})$ if

$$f\left(\frac{a\tau+b}{c\tau+d}\right) = \chi(\gamma)\,(c\tau+d)^k\, f(\tau) \quad \forall \gamma = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \Gamma$$



- Examples include *Dedekind*'s function $\eta(\tau) = q^{1/24}\prod_{n\geq 1}(1-q^n)$ and *Jacobi*'s theta function $\theta(\tau) = \sum_{n=0}^{\infty} q^{n^2}$ which are modular forms of weight 1/2 under $SL(2,\mathbb{Z})$ and $\Gamma_0(4)$, respectively.

Modular forms and BPS black holes

- By viewing black holes as black strings wrapped on a circle, micro-states can be viewed as excitations in a 2D superconformal field theory. The partition function $Z_{T^2(\tau)}$ is then manifestly modular. BPS ground states are chiral excitations of the SCFT, counted (with sign) by a weakly holomorphic modular form.
- E.g. in type II string theory compactified on T^6, $\Omega(Q) = c(I_4(Q))$ where I_4 is a quartic polynomial in Q and $c(n)$ are Fourier coefficients of the modular form

$$\frac{\theta(\tau)}{\eta^6(4\tau)} = \sum_{n\geq -1} c(n)\, q^n = \frac{1}{q} + 2 + 8q^3 + 12q^4 + 39q^7 + 56q^8 + \ldots$$

Moore Maldacena Strominger 1999, BP 2005, Shih Strominger Yin 2005

- The Hardy-Ramanujan formula (aka. Cardy's formula in physics) gives $c(n) \sim e^{\pi\sqrt{n}}$, in perfect agreement with gravity's prediction $\Omega(Q) \sim e^{\pi\sqrt{I_4(Q)}}$.

We note that:

From

Modular equations and approximations to π – *Srinivasa Ramanujan*
Quarterly Journal of Mathematics, XLV, 1914, 350 – 372

We have that:

$$e^{\pi\sqrt{n}} = (64a + 24) - (4096b + 276)e^{-\pi\sqrt{n}} + \cdots$$

$$e^{\pi\sqrt{n}} = (64a - 24) - (4096b + 276)e^{-\pi\sqrt{n}} + \cdots$$

$$64(g_{22}^{24} + g_{22}^{-24}) = e^{\pi\sqrt{22}} - 24 + 4372e^{-\pi\sqrt{22}} + \cdots = 64\{(1+\sqrt{2})^{12} + (1-\sqrt{2})^{12}\}.$$

Hence

$$e^{\pi\sqrt{22}} = 2508951.9982\ldots.$$

$$64(G_{37}^{24} + G_{37}^{-24}) = e^{\pi\sqrt{37}} + 24 + 4372e^{-\pi\sqrt{37}} - \cdots = 64\{(6+\sqrt{37})^{6} + (6-\sqrt{37})^{6}\}.$$

Hence

$$e^{\pi\sqrt{37}} = 199148647.999978\ldots.$$

$$64(g_{58}^{24} + g_{58}^{-24}) = e^{\pi\sqrt{58}} - 24 + 4372e^{-\pi\sqrt{58}} + \cdots = 64\left\{\left(\frac{5+\sqrt{29}}{2}\right)^{12} + \left(\frac{5-\sqrt{29}}{2}\right)^{12}\right\}.$$

Hence

$$e^{\pi\sqrt{58}} = 24591257751.99999982\ldots.$$

Thence, we have the following mathematical connections:

$$\left(\quad e^{\pi\sqrt{n}} = (64a + 24) - (4096b + 276)e^{-\pi\sqrt{n}} + \cdots \right) =$$

$$= \left(\; c(n) \sim e^{\pi\sqrt{n}} \right) = \left(\; \Omega(Q) \sim e^{\pi\sqrt{I_4(Q)}} \right) =$$

$$= \left(\sum_{n \geq -1} c(n)\, q^n = \frac{1}{q} + 2 + 8q^3 + 12q^4 + 39q^7 + 56q^8 + \ldots \right)$$

From

$$64(g_{22}^{24} + g_{22}^{-24}) = e^{\pi\sqrt{22}} - 24 + 4372e^{-\pi\sqrt{22}} + \cdots = 64\{(1+\sqrt{2})^{12} + (1-\sqrt{2})^{12}\}.$$

Hence

$$e^{\pi\sqrt{22}} = 2508951.9982\ldots.$$

we obtain, for $q = e^{2\pi} = 535.49165$ and $n = 22$:

$$\left(\; c(n) \sim e^{\pi\sqrt{n}} \right) = 2508951.9982;$$

for

$$\sum_{n \geq -1} c(n)\, q^n = \frac{1}{q} + 2 + 8q^3 + 12q^4 + 39q^7 + 56q^8 + \ldots$$

n = 22 that is > -1 , we obtain:

2508951.9982 * (e^(2Pi))^22

Input interpretation:

$2.5089519982 \times 10^6 \left(e^{2\pi}\right)^{22}$

Result:

$2.7042816511... \times 10^{66}$

$2.7042816511…*10^{66}$

Alternative representations:

$$2.50895199820000 \times 10^6 \left(e^{2\pi}\right)^{22} = 2.50895199820000 \times 10^6 \left(e^{-2i\log(-1)}\right)^{22}$$

$$2.50895199820000 \times 10^6 \left(e^{2\pi}\right)^{22} = 2.50895199820000 \times 10^6 \exp^{2\pi}(z)^{22} \quad \text{for } z = 1$$

Series representations:

$$2.50895199820000 \times 10^6 \left(e^{2\pi}\right)^{22} = 2.50895199820000 \times 10^6 \left(\sum_{k=0}^{\infty} \frac{1}{k!}\right)^{176 \sum_{k=0}^{\infty} (-1)^k / (1+2k)}$$

$$2.50895199820000 \times 10^6 \left(e^{2\pi}\right)^{22} = 2.50895199820000 \times 10^6 \left(\sum_{k=0}^{\infty} \frac{(-1+k)^2}{k!}\right)^{176 \sum_{k=0}^{\infty} (-1)^k / (1+2k)}$$

$$2.50895199820000 \times 10^6 \left(e^{2\pi}\right)^{22} = 2.50895199820000 \times 10^6 \left(\sum_{k=0}^{\infty} \frac{1}{k!}\right)^{44 \times \sum_{k=1}^{\infty} 4^{-k} \left(-1+3^k\right) \zeta(1+k)}$$

Integral representations:

$$2.50895199820000\times10^6\left(e^{2\pi}\right)^{22} = 2.50895199820000\times10^6\, e^{88\int_0^\infty 1/(1+t^2)\,dt}$$

$$2.50895199820000\times10^6\left(e^{2\pi}\right)^{22} = 2.50895199820000\times10^6\, e^{176\int_0^1 \sqrt{1-t^2}\,dt}$$

$$2.50895199820000\times10^6\left(e^{2\pi}\right)^{22} = 2.50895199820000\times10^6\, e^{88\int_0^\infty \sin(t)/t\,dt}$$

and:

1/((e^(2Pi))) + 2 + 8*((e^(2Pi)))^3 + 12*((e^(2Pi)))^4 + 39*((e^(2Pi)))^7+56*((e^(2Pi)))^8

Input:

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8$$

Exact result:

$$2 + e^{-2\pi} + 8\,e^{6\pi} + 12\,e^{8\pi} + 39\,e^{14\pi} + 56\,e^{16\pi}$$

Decimal approximation:

$3.791177681816441390472497781751755888964809434367463 0\ldots \times 10^{23}$

$3.7911776\ldots*10^{23}$

Property:

$2 + e^{-2\pi} + 8\,e^{6\pi} + 12\,e^{8\pi} + 39\,e^{14\pi} + 56\,e^{16\pi}$ is a transcendental number

Alternate form:

$$e^{-2\pi}\left(1 + 2\,e^{2\pi} + 8\,e^{8\pi} + 12\,e^{10\pi} + 39\,e^{16\pi} + 56\,e^{18\pi}\right)$$

Alternative representations:

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 =$$
$$\frac{1}{\exp^{2\pi}(z)} + 2 + 8\exp^{2\pi}(z)^3 + 12\exp^{2\pi}(z)^4 + 39\exp^{2\pi}(z)^7 + 56\exp^{2\pi}(z)^8 \quad \text{for } z = 1$$

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 =$$
$$2 + \frac{1}{e^{360^\circ}} + 8\left(e^{360^\circ}\right)^3 + 12\left(e^{360^\circ}\right)^4 + 39\left(e^{360^\circ}\right)^7 + 56\left(e^{360^\circ}\right)^8$$

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 =$$
$$\frac{1}{\exp^{2\cos^{-1}(-1)}(z)} + 2 + 8\exp^{2\cos^{-1}(-1)}(z)^3 + 12\exp^{2\cos^{-1}(-1)}(z)^4 +$$
$$39\exp^{2\cos^{-1}(-1)}(z)^7 + 56\exp^{2\cos^{-1}(-1)}(z)^8 \quad \text{for } z = 1$$

Series representations:

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 =$$
$$2 + e^{-8\sum_{k=0}^{\infty}(-1)^k/(1+2k)} + 8\,e^{24\sum_{k=0}^{\infty}(-1)^k/(1+2k)} +$$
$$12\,e^{32\sum_{k=0}^{\infty}(-1)^k/(1+2k)} + 39\,e^{56\sum_{k=0}^{\infty}(-1)^k/(1+2k)} + 56\,e^{64\sum_{k=0}^{\infty}(-1)^k/(1+2k)}$$

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 = \left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{-2\pi}$$
$$\left(1 + 2\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{2\pi} + 8\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{8\pi} + 12\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{10\pi} + 39\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{16\pi} + 56\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{18\pi}\right)$$

$$\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8 =$$
$$\left(1 + 2\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{2\pi} + 8\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{8\pi} + 12\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{10\pi} +\right.$$
$$\left.39\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{16\pi} + 56\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{18\pi}\right)\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{-2\pi}$$

Integral representations:

$$\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8=2+e^{-8\int_0^1\sqrt{1-t^2}\,dt}+$$
$$8\,e^{24\int_0^1\sqrt{1-t^2}\,dt}+12\,e^{32\int_0^1\sqrt{1-t^2}\,dt}+39\,e^{56\int_0^1\sqrt{1-t^2}\,dt}+56\,e^{64\int_0^1\sqrt{1-t^2}\,dt}$$

$$\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8=$$
$$2+e^{-16/3\int_0^\infty \sin^3(t)/t^3\,dt}+8\,e^{16\int_0^\infty \sin^3(t)/t^3\,dt}+$$
$$12\,e^{64/3\int_0^\infty \sin^3(t)/t^3\,dt}+39\,e^{112/3\int_0^\infty \sin^3(t)/t^3\,dt}+56\,e^{128/3\int_0^\infty \sin^3(t)/t^3\,dt}$$

$$\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8=$$
$$e^{-4\int_0^\infty 1/(1+t^2)\,dt}\left(1+2\,e^{4\int_0^\infty 1/(1+t^2)\,dt}+8\,e^{16\int_0^\infty 1/(1+t^2)\,dt}+\right.$$
$$\left.12\,e^{20\int_0^\infty 1/(1+t^2)\,dt}+39\,e^{32\int_0^\infty 1/(1+t^2)\,dt}+56\,e^{36\int_0^\infty 1/(1+t^2)\,dt}\right)$$

2508951.9982 * (e^(2Pi))^22 = ((((1/((e^(2Pi))) + 2 + 8*((e^(2Pi)))^3 + 12*((e^(2Pi)))^4 + 39*((e^(2Pi)))^7+56*((e^(2Pi)))^8))))x

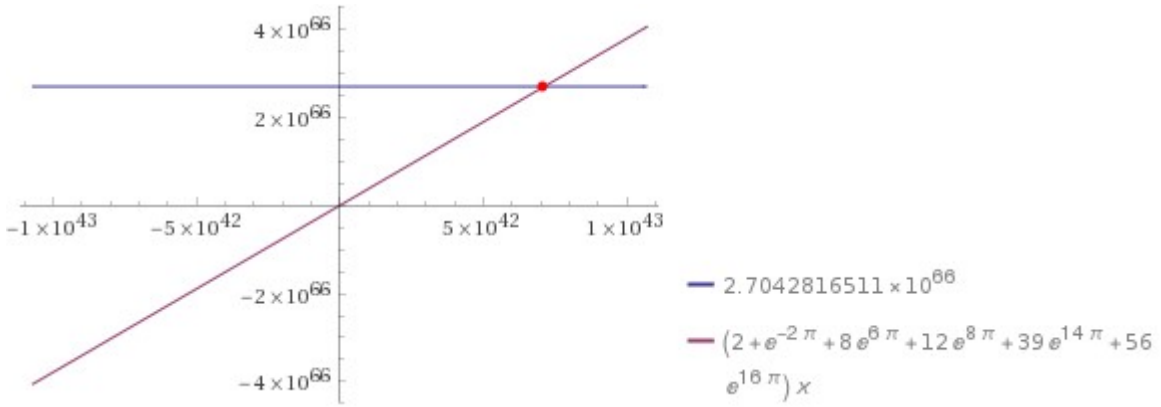
Input interpretation:

$$2.5089519982\times10^6\left(e^{2\pi}\right)^{22}=\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)x$$

Result:

$$2.7042816511\times10^{66}=\left(2+e^{-2\pi}+8\,e^{6\pi}+12\,e^{8\pi}+39\,e^{14\pi}+56\,e^{16\pi}\right)x$$

Plot:



Alternate forms:

$$2.7042816511\times 10^{66} = 56\, e^{16\pi}\, x + 39\, e^{14\pi}\, x + 12\, e^{8\pi}\, x + 8\, e^{6\pi}\, x + e^{-2\pi}\, x + 2\, x$$

$$-56\, e^{16\pi}\, x - 39\, e^{14\pi}\, x - 12\, e^{8\pi}\, x - 8\, e^{6\pi}\, x - e^{-2\pi}\, x - 2\, x + 2.7042816511\times 10^{66} = 0$$

$$2.7042816511\times 10^{66} = e^{-2\pi}\left(1 + 2\, e^{2\pi} + 8\, e^{8\pi} + 12\, e^{10\pi} + 39\, e^{16\pi} + 56\, e^{18\pi}\right) x$$

Solution:

$$x = 7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$

Integer solution:

$$x = 7\,133\,091\,292\,621\,266\,248\,660\,358\,050\,518\,002\,568\,932\,376$$

((((1/((e^(2Pi))) + 2 + 8*((e^(2Pi)))^3 + 12*((e^(2Pi)))^4 + 39*((e^(2Pi)))^7+56*((e^(2Pi)))^8)))) * 7133091292621266248660367233233898860183552

Input:

$$\left(\frac{1}{e^{2\pi}} + 2 + 8\left(e^{2\pi}\right)^3 + 12\left(e^{2\pi}\right)^4 + 39\left(e^{2\pi}\right)^7 + 56\left(e^{2\pi}\right)^8\right)\times$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$

Exact result:

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$\left(2 + e^{-2\pi} + 8\, e^{6\pi} + 12\, e^{8\pi} + 39\, e^{14\pi} + 56\, e^{16\pi}\right)$$

Decimal approximation:

$$2.704281651094493556119475357631274803480501985835021 6\ldots \times 10^{66}$$

$2.70428165\ldots*10^{66}$

Property:

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$\left(2 + e^{-2\pi} + 8\, e^{6\pi} + 12\, e^{8\pi} + 39\, e^{14\pi} + 56\, e^{16\pi}\right) \text{ is a transcendental number}$$

Alternate forms:

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$e^{-2\pi}\left(1+2\,e^{2\pi}+8\,e^{8\pi}+12\,e^{10\pi}+39\,e^{16\pi}+56\,e^{18\pi}\right)$$

$$14\,266\,182\,585\,242\,532\,497\,320\,734\,466\,467\,797\,720\,367\,104 +$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552\,e^{-2\pi} +$$
$$57\,064\,730\,340\,970\,129\,989\,282\,937\,865\,871\,190\,881\,468\,416\,e^{6\pi} +$$
$$85\,597\,095\,511\,455\,194\,983\,924\,406\,798\,806\,786\,322\,202\,624\,e^{8\pi} +$$
$$278\,190\,560\,412\,229\,383\,697\,754\,322\,096\,122\,055\,547\,158\,528\,e^{14\pi} +$$
$$399\,453\,112\,386\,790\,909\,924\,980\,565\,061\,098\,336\,170\,278\,912\,e^{16\pi}$$

Alternative representations:

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$
$$\left(\frac{1}{\exp^{2\pi}(z)}+2+8\exp^{2\pi}(z)^3+12\exp^{2\pi}(z)^4+39\exp^{2\pi}(z)^7+56\exp^{2\pi}(z)^8\right)$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 \quad \text{for } z=1$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$\left(2+\frac{1}{e^{360^\circ}}+8\left(e^{360^\circ}\right)^3+12\left(e^{360^\circ}\right)^4+39\left(e^{360^\circ}\right)^7+56\left(e^{360^\circ}\right)^8\right)$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$
$$\left(\frac{1}{\exp^{2\cos^{-1}(-1)}(z)}+2+8\exp^{2\cos^{-1}(-1)}(z)^3+12\exp^{2\cos^{-1}(-1)}(z)^4+\right.$$
$$\left.39\exp^{2\cos^{-1}(-1)}(z)^7+56\exp^{2\cos^{-1}(-1)}(z)^8\right)$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 \quad \text{for } z=1$$

Series representations:

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$

$$14\,266\,182\,585\,242\,532\,497\,320\,734\,466\,467\,797\,720\,367\,104 +$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552\, e^{-8\sum_{k=0}^{\infty}(-1)^k/(1+2k)} +$$

$$57\,064\,730\,340\,970\,129\,989\,282\,937\,865\,871\,190\,881\,468\,416\, e^{24\sum_{k=0}^{\infty}(-1)^k/(1+2k)} +$$

$$85\,597\,095\,511\,455\,194\,983\,924\,406\,798\,806\,786\,322\,202\,624\, e^{32\sum_{k=0}^{\infty}(-1)^k/(1+2k)} +$$

$$278\,190\,560\,412\,229\,383\,697\,754\,322\,096\,122\,055\,547\,158\,528\, e^{56\sum_{k=0}^{\infty}(-1)^k/(1+2k)} +$$

$$399\,453\,112\,386\,790\,909\,924\,980\,565\,061\,098\,336\,170\,278\,912\, e^{64\sum_{k=0}^{\infty}(-1)^k/(1+2k)}$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{-2\pi}$$

$$\left(1+2\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{2\pi}+8\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{8\pi}+12\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{10\pi}+39\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{16\pi}+56\left(\sum_{k=0}^{\infty}\frac{1}{k!}\right)^{18\pi}\right)$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$

$$\left(1+2\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{2\pi}+8\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{8\pi}+12\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{10\pi}+\right.$$

$$\left.39\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{16\pi}+56\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{18\pi}\right)\left(\frac{1}{\sum_{k=0}^{\infty}\frac{(-1)^k}{k!}}\right)^{-2\pi}$$

Integral representations:

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$

$$e^{-4\int_0^{\infty}1/(1+t^2)\,dt}\left(1+2\,e^{4\int_0^{\infty}1/(1+t^2)\,dt}+8\,e^{16\int_0^{\infty}1/(1+t^2)\,dt}+\right.$$

$$\left.12\,e^{20\int_0^{\infty}1/(1+t^2)\,dt}+39\,e^{32\int_0^{\infty}1/(1+t^2)\,dt}+56\,e^{36\int_0^{\infty}1/(1+t^2)\,dt}\right)$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$e^{-4\int_0^\infty \sin(t)/t\,dt}\left(1+2\,e^{4\int_0^\infty \sin(t)/t\,dt}+8\,e^{16\int_0^\infty \sin(t)/t\,dt}+\right.$$
$$\left.12\,e^{20\int_0^\infty \sin(t)/t\,dt}+39\,e^{32\int_0^\infty \sin(t)/t\,dt}+56\,e^{36\int_0^\infty \sin(t)/t\,dt}\right)$$

$$\left(\frac{1}{e^{2\pi}}+2+8\left(e^{2\pi}\right)^3+12\left(e^{2\pi}\right)^4+39\left(e^{2\pi}\right)^7+56\left(e^{2\pi}\right)^8\right)$$

$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552 =$$
$$7\,133\,091\,292\,621\,266\,248\,660\,367\,233\,233\,898\,860\,183\,552$$
$$e^{-4\int_0^1 1/\sqrt{1-t^2}\,dt}\left(1+2\,e^{4\int_0^1 1/\sqrt{1-t^2}\,dt}+8\,e^{16\int_0^1 1/\sqrt{1-t^2}\,dt}+\right.$$
$$\left.12\,e^{20\int_0^1 1/\sqrt{1-t^2}\,dt}+39\,e^{32\int_0^1 1/\sqrt{1-t^2}\,dt}+56\,e^{36\int_0^1 1/\sqrt{1-t^2}\,dt}\right)$$

From the following partition number:

p(4049)= 272473535190800504016080733718647913505759618655416027617884862790 0

that is:

$2.724735351908005040160807337186479135057596186554160276178848627900 \times 10^{66}$

From the ratio between the previous result and the following value, we obtain:

a)

(2.724735351908005040160807337186479135057596186554160276178848627900 × 10^66)/(((2508951.9982 * (e^(2Pi))^22)))

Input interpretation:

$$\frac{2.724735351908005040160807337186479135057596186554160276178848627900\times 10^{66}}{2.5089519982\times 10^6\left(e^{2\pi}\right)^{22}}$$

Result:

1.0075634507...

1.0075634507…

From which:

[(2.724735351908005040160807337186479135057596186554160 2 × 10^66)/(((2508951.9982 * (e^(2Pi))^22)))]^64

Input interpretation:

$$\left(\frac{2.724735351908005040160807337186479135057596186554160 2 \times 10^{66}}{2.5089519982 \times 10^6 \left(e^{2\pi}\right)^{22}}\right)^{64}$$

Result:

1.61969755...

1.61969755…. result that is a very good approximation to the value of the golden ratio 1.618033988749...

and:

27(((1/log base 1.61969755((([(2.724735351908005040160807337186479135057596186554160 2 × 10^66)/(((2508951.9982 * (e^(2Pi))^22)))]))))))+1

Input interpretation:

$$27 \times \frac{1}{\log_{1.61969755}\left(\frac{2.724735351908005040160807337186479135057596186554160 2 \times 10^{66}}{2.5089519982 \times 10^6 \left(e^{2\pi}\right)^{22}}\right)} + 1$$

$\log_b(x)$ is the base-b logarithm

Result:

1729.0000...

1729

This result is very near to the mass of candidate glueball **f_0(1710) scalar meson.** Furthermore, 1728 occurs in the algebraic formula for the j-invariant of an elliptic curve. The number 1728 is one less than the Hardy–Ramanujan number 1729 (taxicab number)

With regard 27 (From Wikipedia):

"The fundamental group of the complex form, compact real form, or any algebraic version of E_6 is the cyclic group $\boldsymbol{Z}/3\boldsymbol{Z}$, and its outer automorphism group is the cyclic group $\boldsymbol{Z}/2\boldsymbol{Z}$. Its fundamental representation is 27-dimensional (complex), and a basis is given by the 27 lines on a cubic surface. The dual representation, which is inequivalent, is also 27-dimensional. In particle physics, E_6 plays a role in some grand unified theories".

2(((1/log base 1.61969755((([(2.72473535190800504016080733718647913505759618655416 02 × 10^66)/(((2508951.9982 * (e^(2Pi))^22)))])))))+7

Input interpretation:

$$2\times\frac{1}{\log_{1.61969755}\left(\frac{2.72473535190800504016080733718647913505759618655416\,02\times 10^{66}}{2.508951\,9982\times 10^{6}\,(e^{2\pi})^{22}}\right)}+7$$

$\log_b(x)$ is the base-b logarithm

Result:

135.00000...

135 (cubic root of a Ramanujan taxicab number)

2(((1/log base 1.61969755((([(2.72473535190800504016080733718647913505759618655416 02 × 10^66)/(((2508951.9982 * (e^(2Pi))^22)))])))))+7+3

Input interpretation:

$$2\times\frac{1}{\log_{1.61969755}\left(\frac{2.72473535190800504016080733718647913505759618655416\,02\times 10^{66}}{2.508951\,9982\times 10^{6}\,(e^{2\pi})^{22}}\right)}+7+3$$

$\log_b(x)$ is the base-b logarithm

Result:

138.000000...

138 (cubic root of a Ramanujan taxicab number)

b)

(((2508951.9982 * (e^(2Pi))^22)))/
(2.72473535190800504016080733718647913505759618655416 02 × 10^66)

Input interpretation:

$$\frac{2.5089519982\times 10^{6}\,(e^{2\pi})^{22}}{2.72473535190800504016080733718647913505759618655416 02\times 10^{66}}$$

Result:

0.99249332571...

0.99249332571…. result very near to the value of the following Rogers-Ramanujan continued fraction:

$$\frac{e^{-\frac{\pi}{\sqrt{5}}}}{\frac{\sqrt{5}}{1+\sqrt[5]{\sqrt{\varphi^5\sqrt[4]{5^3}}-1}}-\varphi+1}=1-\cfrac{e^{-\pi\sqrt{5}}}{1+\cfrac{e^{-2\pi\sqrt{5}}}{1+\cfrac{e^{-3\pi\sqrt{5}}}{1+\cfrac{e^{-4\pi\sqrt{5}}}{1+\ldots}}}}\approx 0.9991104684$$

and to the Omega mesons ($\omega/\omega_3 \mid 5+3 \mid m_{u/d}=255-390 \mid 0.988-1.18$) Regge slope value (0.988) connected to the dilaton scalar field $\mathbf{0.989117352243 = \phi}$

A_1^{**} above the two low-lying pseudo-scalars. (bound states of gluons, or 'glueballs').

A_1^{**}	0.943(39) [2.5]	0.988(38)	0.152(53)
A_4	1.03(10) [2.5]	0.999(32)	0.035(21)

(**Glueball Regge trajectories -** *Harvey Byron Meyer*, Lincoln College -Thesis submitted for the degree of Doctor of Philosophy at the University of Oxford Trinity Term, 2004)

From:

Black Hole Entropy and Soft Hair
Sasha Haco, Stephen W. Hawking, Malcolm J. Perry and Andrew Strominger - arXiv:1810.01847v4 [hep-th] 13 Dec 2018

We have that:

> Kerr black holes with generic mass M and spin $J \leq M^2$ exhibit a hidden conformal symmetry which acts on low-lying soft modes [52]. The symmetry emerges, not in a near-horizon region of *spacetime*, but in the near-horizon region of *phase space* defined by
>
> $$\omega(r - r_+) \ll 1, \tag{2.1}$$
>
> where ω is the energy of the soft mode, r is the Boyer-Lindquist radial coordinate and $r_+ = M + \sqrt{M^2 - a^2}$, with $a = \frac{J}{M}$, is the location of the outer horizon. This simply states

For SMBH87 data: M = 13.12806e+39 ; r = 1.94973E13 , we obtain:

M87* rotates clockwise with an estimated rotation parameter a = 0.90±0.05; a = 0.998

From:

$$\Omega = \frac{a}{2Mr_+}$$

that is the angular velocity of the horizon, we obtain:

0.998 / (2*13.12806e+39*1.94973e+13)

Input interpretation:

$$\frac{0.998}{2 \times 13.12806 \times 10^{39} \times 1.94973 \times 10^{13}}$$

Result:

$1.9495102304281110606916742268675356085878157515304899... \times 10^{-54}$

$1.949510230428....*10^{-54}$

Now, we have that:

7 The area law

Using $c_L = c_R = 12J$ as given above, the temperature formulae (2.4) and the Cardy formula

$$S_{Cardy} = \frac{\pi^2}{3}(c_L T_L + c_R T_R), \tag{7.1}$$

yields the Hawking-Bekenstein area-entropy law for generic Kerr

$$S_{BH} = S_{Cardy} = 2\pi M r_+ = \frac{Area}{4}. \tag{7.2}$$

From

$$S_{BH} = S_{Cardy} = 2\pi M r_+ = \frac{Area}{4}.$$

we obtain:

S_{BH} = (2Pi*13.12806e+39*1.94973e+13) =

(2Pi*13.12806e+39*1.94973e+13)

Input interpretation:

$$2\pi \times 13.12806 \times 10^{39} \times 1.94973 \times 10^{13}$$

Result:

$1.608254944932554635349624201471046914645203043646045 8\ldots \times 10^{54}$

$1.608254944\ldots *10^{54}$

Performing the ln, we obtain:

ln(2Pi*13.12806e+39*1.94973e+13)

Input interpretation:

$\log(2\,\pi \times 13.12806 \times 10^{39} \times 1.94973 \times 10^{13})$

$\log(x)$ is the natural logarithm

Result:

124.8147...

124.8147… result very near to the Higgs boson mass 125.18 GeV

Appendix

Now, we have that:

from:

Supersymmetric Black Holes in String Theory - Napoli, October 2006
Thomas Mohaupt - University of Liverpool

We have that:

State counting problem $\Leftrightarrow$ Counting partitions of (large) integer n.
G.H. Hardy and S. Ramanujan (1918).
Familiar from string partition functions.

$$d(q) = d(q^2) = 16 \oint d\tau \frac{\exp(i\pi\tau q^2)}{\eta^{24}(\tau)}$$

where $\tau = \tau_1 + i\tau_2 \in \mathcal{H}$ (upper half plane) and $\eta(\tau) =$ Dedekind η-function.
η^{24} is a modular form of weight 12.

Systematic method of asymptotic expansion: Rademacher expansion, aka. Farey tail expansion.

Result for $\frac{1}{2}$-BPS states of heterotic string:

$$d(q^2) = 16 \sum_{c=1}^{\infty} c^{-14} \mathrm{Kl}(\tfrac{1}{2}|q^2|, -1; c) \hat{I}_{13}\left(\frac{4\pi}{c}\sqrt{\frac{1}{2}|q^2|}\right)$$

$\hat{I}_{13} =$ modified Bessel functions, Kl= 'Kloosterman sums'. Contributions $c > 1$ are exponentially suppressed for large $|q^2|$. Leading term

$$d(q^2) = 16\, \hat{I}_{13}(4\pi\sqrt{\tfrac{1}{2}|q^2|})$$

can be further expanded:

$$\mathrm{S}_{\mathrm{micro}}(q^2) = \log d(q^2) \approx 4\pi\sqrt{\tfrac{1}{2}|q^2|} - \frac{27}{4}\log|q^2| + \frac{15}{2}\log(2) - \frac{675}{32\pi|q^2|} + \cdots$$

We know that:

From:

Precision Counting of Small Black Holes
Atish Dabholkar, Frederik Denef, Gregory W. Moore, and Boris Pioline - arXiv:hep-th/0507014v1 1 Jul 2005

2.3 Asymptotic Degeneracies and the Rademacher Formula

In order to determine the asymptotic density of states at large $N-1=nw$, it is convenient to extract $d(N)$ from the partition function (2.6) by an inverse Laplace transform,

$$p_{24}(N)=\frac{1}{2\pi i}\int_{\epsilon-i\pi}^{\epsilon+i\pi}d\beta\, e^{\beta(N-1)}\frac{16}{\Delta(e^{-\beta})}. \tag{2.8}$$

where the contour C runs from $\epsilon - i\pi$ to $\epsilon + i\pi$, parallel to the imaginary axis. One may now take the high temperature limit $\epsilon \to 0$, and use the modular property of the discriminant function (see Appendix B)

$$\Delta(e^{-\beta})=\left(\frac{\beta}{2\pi}\right)^{12}\Delta(e^{-4\pi^2/\beta}). \tag{2.9}$$

As $e^{-4\pi^2/\beta}\to 0$, we can approximate $\Delta(q)\sim q$ and write the integral as

$$p_{24}(N)=\frac{16}{2\pi i}\int_C d\beta\,\left(\frac{\beta}{2\pi}\right)^{12}e^{\beta(N-1)+4\frac{\pi^2}{\beta}} \tag{2.10}$$

This integral may be evaluated by steepest descent: the saddle point occurs at $\beta = 2\pi/\sqrt{N-1}$, leading to the characteristic exponential growth $p_{24}(N)\sim \exp\left(4\pi\sqrt{nw}\right)$ for the degeneracies.

To calculate the sub-leading terms systematically in an asymptotic expansion at large N, one may recognize that (2.10) is proportional to the integral representation of a modified Bessel function,

$$I_\nu(z)=\left(\frac{z}{2}\right)^\nu\frac{1}{2\pi i}\int_{\epsilon-i\infty}^{\epsilon+i\infty}\frac{dt}{t^{\nu+1}}e^{(t+z^2/4t)}:=\frac{1}{2\pi}\left(\frac{z}{4\pi}\right)^\nu\hat{I}_\nu(z) \tag{2.11}$$

In order to reach (2.11) from (2.10), notice however that one should extend the contour C to the whole line $\epsilon + i\mathbb{R}$. While this would have lead to an infinite multiplicative factor in (2.8) (a Dirac delta at integer N rather than a Kronecker delta), this is no longer a problem in (2.10), where periodicity under $\beta\to\beta+2\pi i$ has been broken. We thus obtain

$$p_{24}(N)\sim 2^4\,\hat{I}_{13}\left(4\pi\sqrt{N-1}\right)\ . \tag{2.12}$$

Using the asymptotic expansion of $\hat{I}_\nu(z)$ at large z (see e.g. [53])

$$\hat{I}_\nu(z)\sim\frac{e^z}{\sqrt{2}}\left(\frac{z}{4\pi}\right)^{-\nu-\frac{1}{2}}\left[1-\frac{(\mu-1)}{8z}+\frac{(\mu-1)(\mu-3^2)}{2!(8z)^2}-\frac{(\mu-1)(\mu-3^2)(\mu-5^2)}{3!(8z)^3}+\ldots\right], \tag{2.13}$$

where $\mu=4\nu^2$, we can thus compute the subleading corrections to the microscopic entropy of DH states,

$$\log\Omega(n,w)\sim 4\pi\sqrt{|nw|}-\frac{27}{4}\log|nw|+\frac{15}{2}\log 2-\frac{675}{32\pi\sqrt{|nw|}}-\frac{675}{2^8\pi^2|nw|}-\ldots \tag{2.14}$$

With regard N, we observe the following equations:

Accordingly, the generating function of the degeneracies of DH states is

$$\sum_{N=0}^{\infty} p_{24}(N) q^{N-1} = \frac{1}{\Delta(q)}, \tag{2.6}$$

where $\Delta(q)$ is Jacobi's discriminant function

$$\Delta(q) = \eta^{24}(q) = q \prod_{n=1}^{\infty} (1 - q^n) \tag{2.7}$$

We know that p(N) represents the number of possible partitions of a non-negative integer N. Thence, if we take N = 144, i.e. p(144) = 22540654445, *nw* = N – 1 = 22540654444.

From the above equation:

$$\log \Omega(n, w) \sim 4\pi\sqrt{|nw|} - \frac{27}{4} \log |nw| + \frac{15}{2} \log 2 - \frac{675}{32\pi\sqrt{|nw|}} - \frac{675}{2^8 \pi^2 |nw|} - \dots$$

For *nw* = N – 1 = 22540654444 , we obtain:

4*Pi*sqrt(22540654444)-27/4 ln(22540654444)+15/2 ln(2) – 675/(32*Pi*sqrt(22540654444))-675/(2^8*Pi^2*22540654444)

Input:

$$4\pi\sqrt{22\,540\,654\,444} - \frac{27}{4}\log(22\,540\,654\,444) + \frac{15}{2}\log(2) - \frac{675}{32\pi\sqrt{22\,540\,654\,444}} - \frac{675}{2^8\,\pi^2 \times 22\,540\,654\,444}$$

$\log(x)$ is the natural logarithm

Exact result:

$$-\frac{675}{5\,770\,407\,537\,664\,\pi^2} - \frac{675}{448\sqrt{115\,003\,339}\,\pi} + \frac{\sqrt{115\,003\,339}\,\pi}{56} + \frac{15\log(2)}{2} - \frac{27\log(22\,540\,654\,444)}{4}$$

Decimal approximation:

$1.886502041076680735863489403601121268336294246652270 06\ldots \times 10^6$

$1.886502\ldots*10^6$

Alternate forms:

$$\frac{112\sqrt{115\,003\,339}\ \pi\left(2\,885\,203\,768\,832\,\pi^2-675\right)-675}{5\,770\,407\,537\,664\,\pi^2}+\frac{3}{4}\left(\log(1024)-9\log(22\,540\,654\,444)\right)$$

$$\frac{1}{5\,770\,407\,537\,664\,\pi^2}\left(-675-75\,600\sqrt{115\,003\,339}\ \pi+323\,142\,822\,109\,184\sqrt{115\,003\,339}\ \pi^3+43\,278\,056\,532\,480\,\pi^2\log(2)-38\,950\,250\,879\,232\,\pi^2\log(22\,540\,654\,444)\right)$$

$$-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\ \pi}+56\sqrt{115\,003\,339}\ \pi+\frac{3}{4}\left(10\log(2)-9\log(22\,540\,654\,444)\right)$$

Alternative representations:

$$4\pi\sqrt{22\,540\,654\,444}-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\,\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\,\pi^2\,22\,540\,654\,444}=\frac{15}{2}\log(a)\log_a(2)-\frac{27}{4}\log(a)\log_a(22\,540\,654\,444)-\frac{675}{22\,540\,654\,444\times 2^8\,\pi^2}-\frac{675}{32\,\pi\sqrt{22\,540\,654\,444}}+4\pi\sqrt{22\,540\,654\,444}$$

$$4\pi\sqrt{22\,540\,654\,444}-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\,\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\,\pi^2\,22\,540\,654\,444}=\frac{15\log_e(2)}{2}-\frac{27\log_e(22\,540\,654\,444)}{4}-\frac{675}{22\,540\,654\,444\times 2^8\,\pi^2}-\frac{675}{32\,\pi\sqrt{22\,540\,654\,444}}+4\pi\sqrt{22\,540\,654\,444}$$

$$4\pi\sqrt{22\,540\,654\,444}\;-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{15\,\mathrm{Li}_1(-1)}{2}+\frac{27\,\mathrm{Li}_1(-22\,540\,654\,443)}{4}-\frac{675}{22\,540\,654\,444\times 2^8\pi^2}-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}+4\pi\sqrt{22\,540\,654\,444}$$

Series representations:

$$4\pi\sqrt{22\,540\,654\,444}\;-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\;\pi}+56\sqrt{115\,003\,339}\;\pi+\frac{3}{2}i\pi\left\lfloor\frac{\pi-\arg\left(\frac{1}{z_0}\right)-\arg(z_0)}{2\pi}\right\rfloor+\frac{3\log(z_0)}{4}+\sum_{k=1}^{\infty}-\frac{3(-1)^k\left(10(2-z_0)^k-9(22\,540\,654\,444-z_0)^k\right)z_0^{-k}}{4k}$$

$$4\pi\sqrt{22\,540\,654\,444}\;-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\;\pi}+56\sqrt{115\,003\,339}\;\pi+15\,i\pi\left\lfloor\frac{\arg(2-x)}{2\pi}\right\rfloor-\frac{27}{2}i\pi\left\lfloor\frac{\arg(22\,540\,654\,444-x)}{2\pi}\right\rfloor+\frac{3\log(x)}{4}+\sum_{k=1}^{\infty}-\frac{3(-1)^k\left(10(2-x)^k-9(22\,540\,654\,444-x)^k\right)x^{-k}}{4k}\quad\text{for } x<0$$

$$4\pi\sqrt{22\,540\,654\,444}-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\,\pi}+56\sqrt{115\,003\,339}\,\pi+\frac{15}{2}\left\lfloor\frac{\arg(2-z_0)}{2\pi}\right\rfloor\log\left(\frac{1}{z_0}\right)-\frac{27}{4}\left\lfloor\frac{\arg(22\,540\,654\,444-z_0)}{2\pi}\right\rfloor\log\left(\frac{1}{z_0}\right)+\frac{3\log(z_0)}{4}+\frac{15}{2}\left\lfloor\frac{\arg(2-z_0)}{2\pi}\right\rfloor\log(z_0)-\frac{27}{4}\left\lfloor\frac{\arg(22\,540\,654\,444-z_0)}{2\pi}\right\rfloor\log(z_0)+\sum_{k=1}^{\infty}-\frac{3(-1)^k\left(10\,(2-z_0)^k-9\,(22\,540\,654\,444-z_0)^k\right)z_0^{-k}}{4k}$$

Integral representations:

$$4\pi\sqrt{22\,540\,654\,444}-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\,\pi}+56\sqrt{115\,003\,339}\,\pi+\int_1^2\left(\frac{608\,597\,669\,961}{90\,162\,617\,768-90\,162\,617\,772\,t}+\frac{15}{2\,t}\right)dt$$

$$4\pi\sqrt{22\,540\,654\,444}-\frac{1}{4}\log(22\,540\,654\,444)\,27+\frac{1}{2}\log(2)\,15-\frac{675}{32\pi\sqrt{22\,540\,654\,444}}-\frac{675}{2^8\pi^2\,22\,540\,654\,444}=-\frac{675}{5\,770\,407\,537\,664\,\pi^2}-\frac{675}{448\sqrt{115\,003\,339}\,\pi}+56\sqrt{115\,003\,339}\,\pi+\int_{-i\infty+\gamma}^{i\infty+\gamma}-\frac{i\,3^{1-s}\times 7513\,551\,481^{-s}\,(-9+10\times 22\,540\,654\,443^s)\,\Gamma(-s)^2\,\Gamma(1+s)}{8\pi\,\Gamma(1-s)}\,ds$$

for $-1<\gamma<0$

We note that the result:

$1.886502041076680735863489403601121268336294246652270 06\times 10^6$ is very near to the result of the following formula of coefficients of the '5th order' mock theta function $\psi_1(q)$: (A053261 OEIS Sequence)

sqrt(golden ratio) * exp(Pi*sqrt(n/15)) / (2*5^(1/4)*sqrt(n)) for n = 516

sqrt(golden ratio) * exp(Pi*sqrt(516/15)) / (2*5^(1/4)*sqrt(516))

Input:

$$\sqrt{\phi} \times \frac{\exp\left(\pi \sqrt{\frac{516}{15}}\right)}{2 \sqrt[4]{5} \sqrt{516}}$$

ϕ is the golden ratio

Exact result:

$$\frac{e^{2 \sqrt{43/5}\, \pi} \sqrt{\frac{\phi}{129}}}{4 \sqrt[4]{5}}$$

Decimal approximation:

$1.882219396317729189420646851608166300213352522801968 21\ldots \times 10^6$

$1.882219\ldots * 10^6$

Property:

$$\frac{e^{2 \sqrt{43/5}\, \pi} \sqrt{\frac{\phi}{129}}}{4 \sqrt[4]{5}}$$ is a transcendental number

Alternate forms:

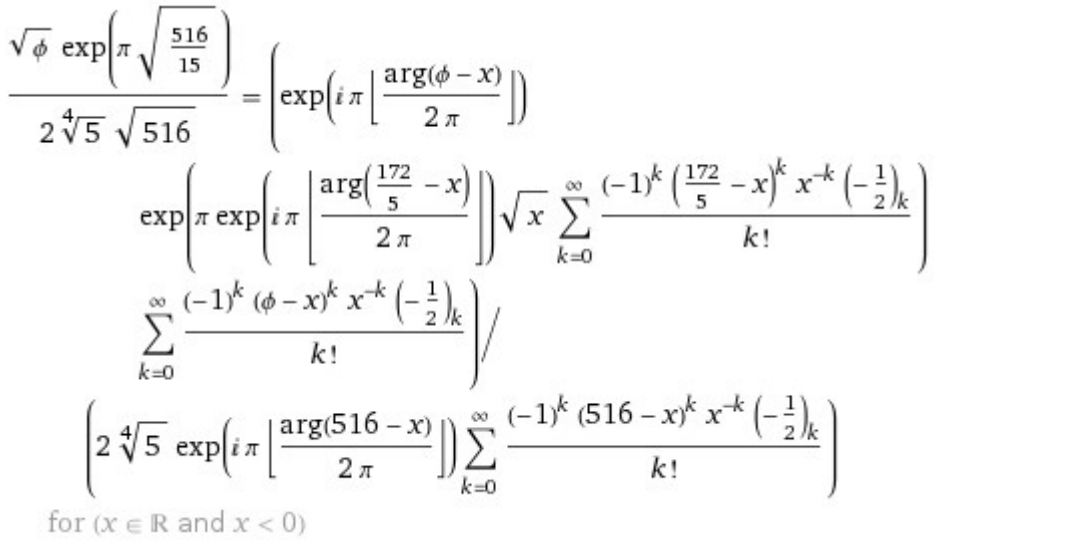
$$\frac{\frac{1}{4} \sqrt{\frac{5+\sqrt{5}}{1290}}\, e^{2 \sqrt{43/5}\, \pi}}{4 \sqrt[4]{5}}$$

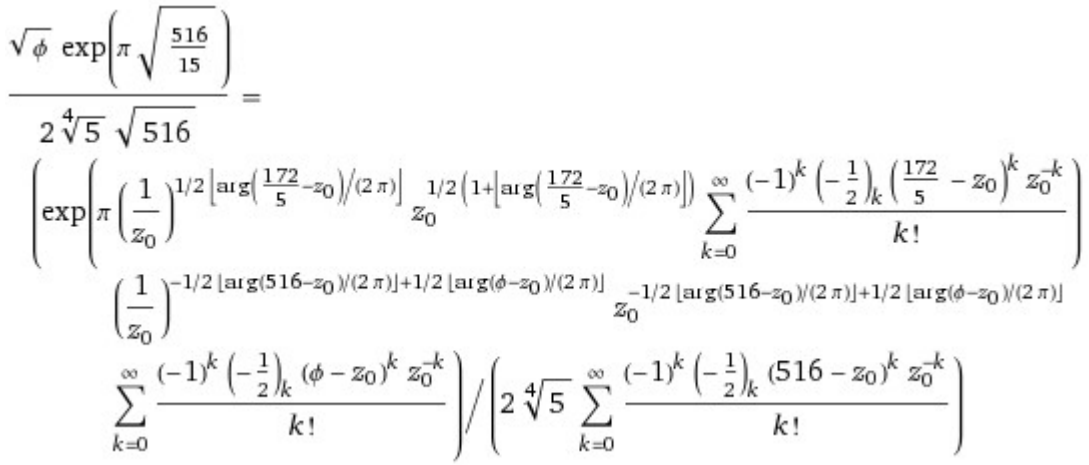
$$\frac{\sqrt{\frac{1}{258}\left(1+\sqrt{5}\right)}\, e^{2 \sqrt{43/5}\, \pi}}{4 \sqrt[4]{5}}$$

Series representations:

$$\frac{\sqrt{\phi}\, \exp\left(\pi \sqrt{\frac{516}{15}}\right)}{2 \sqrt[4]{5} \sqrt{516}} = \frac{\exp\left(\pi \sqrt{z_0} \sum_{k=0}^{\infty} \frac{(-1)^k \left(-\frac{1}{2}\right)_k \left(\frac{172}{5}-z_0\right)^k z_0^{-k}}{k!}\right) \sum_{k=0}^{\infty} \frac{(-1)^k \left(-\frac{1}{2}\right)_k (\phi-z_0)^k z_0^{-k}}{k!}}{2 \sqrt[4]{5} \sum_{k=0}^{\infty} \frac{(-1)^k \left(-\frac{1}{2}\right)_k (516-z_0)^k z_0^{-k}}{k!}}$$

for $(\text{not } (z_0 \in \mathbb{R} \text{ and } -\infty < z_0 \leq 0))$

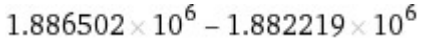




From the difference between the two results (approximating the digits), we obtain:

1.886502 × 10^6 - 1.882219 × 10^6

Input interpretation:



Result:

4283

4283

We remember that (**Modular equations and approximations to π** – *Srinivasa Ramanujan* - Quarterly Journal of Mathematics, XLV, 1914, 350 – 372):

Again

$$G_{37} = (6 + \sqrt{37})^{\frac{1}{4}},$$

$$\begin{aligned} 64G_{37}^{24} &= e^{\pi\sqrt{37}} + 24 + 276e^{-\pi\sqrt{37}} + \cdots, \\ 64G_{37}^{-24} &= 4096e^{-\pi\sqrt{37}} - \cdots, \end{aligned}$$

so that

$$64(G_{37}^{24} + G_{37}^{-24}) = e^{\pi\sqrt{37}} + 24 + 4372e^{-\pi\sqrt{37}} - \cdots = 64\{(6 + \sqrt{37})^6 + (6 - \sqrt{37})^6\}.$$

Hence

$$e^{\pi\sqrt{37}} = 199148647.999978\ldots.$$

exp(Pi*sqrt37) + 24 + 4372*exp(-Pi*sqrt37)

Input:

$$\exp\left(\pi\sqrt{37}\right) + 24 + 4372\exp\left(-\pi\sqrt{37}\right)$$

Exact result:

$$24 + 4372\,e^{-\sqrt{37}\,\pi} + e^{\sqrt{37}\,\pi}$$

Decimal approximation:

$1.99148672000000000002427018335894598607210555270455701\ldots \times 10^8$

$1.99148672\ldots*10^8$

Property:

$24 + 4372\,e^{-\sqrt{37}\,\pi} + e^{\sqrt{37}\,\pi}$ is a transcendental number

From which:

exp(Pi*sqrt37) + 24 + x*exp(-Pi*sqrt37) = 199148672

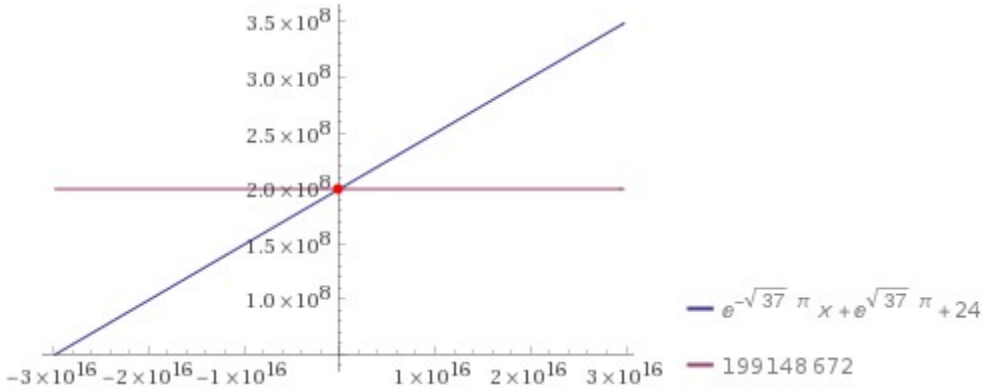
Input:

$$\exp\left(\pi\sqrt{37}\right)+24+x\exp\left(-\pi\sqrt{37}\right)=199\,148\,672$$

Exact result:

$$e^{-\sqrt{37}\,\pi}\,x+e^{\sqrt{37}\,\pi}+24=199\,148\,672$$

Plot:



Alternate forms:

$$e^{-\sqrt{37}\,\pi}\,x+e^{\sqrt{37}\,\pi}-199\,148\,648=0$$

$$e^{-\sqrt{37}\,\pi}\left(x+e^{2\sqrt{37}\,\pi}+24\,e^{\sqrt{37}\,\pi}\right)=199\,148\,672$$

Solution:

$$x=-e^{\sqrt{37}\,\pi}\left(e^{\sqrt{37}\,\pi}-199\,148\,648\right)$$

Solution:

$x \approx 4372.0$

4372

In conclusion, we observe that:

4372 – 4283 = 89, that is a Fibonacci number

Observations

From:
https://www.scientificamerican.com/article/mathematics-ramanujan/?fbclid=IwAR2caRXrn_RpOSvJ1QxWsVLBcJ6KVgd_Af_hrmDYBNyU8mpSjRs1BDeremA

Ramanujan's statement concerned the deceptively simple concept of partitions—the different ways in which a whole number can be subdivided into smaller numbers. Ramanujan's original statement, in fact, stemmed from the observation of patterns, such as the fact that p(9) = 30, p(9 + 5) = 135, p(9 + 10) = 490, p(9 + 15) = 1,575 and so on are all divisible by 5. Note that here the n's come at intervals of five units.

Ramanujan posited that this pattern should go on forever, and that similar patterns exist when 5 is replaced by 7 or 11—there are infinite sequences of p(n) that are all divisible by 7 or 11, or, as mathematicians say, in which the "moduli" are 7 or 11.

Then, in nearly oracular tone Ramanujan went on: "There appear to be corresponding properties," he wrote in his 1919 paper, "in which the moduli are powers of 5, 7 or 11...and no simple properties for any moduli involving primes other than these three." (Primes are whole numbers that are only divisible by themselves or by 1.) Thus, for instance, there should be formulas for an infinity of n's separated by 5^3 = 125 units, saying that the corresponding p(n)'s should all be divisible by 125.
In the past methods developed to understand partitions have later been applied to physics problems such as the theory of the strong nuclear force or the entropy of black holes.

From Wikipedia

In particle physics, Yukawa's interaction or Yukawa coupling, named after Hideki Yukawa, is an interaction between a scalar field ϕ and a Dirac field ψ. The Yukawa

interaction can be used to describe the nuclear force between nucleons (which are fermions), mediated by pions (which are pseudoscalar mesons). The Yukawa interaction is also used in the Standard Model to describe the coupling between the Higgs field and massless quark and lepton fields (i.e., the fundamental fermion particles). Through spontaneous symmetry breaking, these fermions acquire a mass proportional to the vacuum expectation value of the Higgs field.

Can be this the motivation that from the development of the Ramanujan's equations we obtain results very near to the dilaton mass calculated as a type of Higgs boson: 125 GeV for T = 0 and to the Higgs boson mass 125.18 GeV and practically equal to the rest mass of Pion meson 139.57 MeV

Note that:

$$g_{22} = \sqrt{(1+\sqrt{2})}.$$

Hence

$$\begin{aligned} 64g_{22}^{24} &= e^{\pi\sqrt{22}} - 24 + 276e^{-\pi\sqrt{22}} - \cdots, \\ 64g_{22}^{-24} &= 4096e^{-\pi\sqrt{22}} + \cdots, \end{aligned}$$

so that

$$64(g_{22}^{24} + g_{22}^{-24}) = e^{\pi\sqrt{22}} - 24 + 4372e^{-\pi\sqrt{22}} + \cdots = 64\{(1+\sqrt{2})^{12} + (1-\sqrt{2})^{12}\}.$$

Hence

$$e^{\pi\sqrt{22}} = 2508951.9982\ldots.$$

Thence:

$$64g_{22}^{-24} \quad - \qquad 4096e^{-\pi\sqrt{22}} + \cdots$$

And

$$64(g_{22}^{24} + g_{22}^{-24}) = e^{\pi\sqrt{22}} - 24 + 4372e^{-\pi\sqrt{22}} + \cdots = 64\{(1+\sqrt{2})^{12} + (1-\sqrt{2})^{12}\}$$

That are connected with 64, 128, 256, 512, 1024 and 4096 = 64^2

(Modular equations and approximations to π - S. Ramanujan - Quarterly Journal of Mathematics, XLV, 1914, 350 – 372)

All the results of the most important connections are signed in blue throughout the drafting of the paper. We highlight as in the development of the various equations we use always the constants π, ϕ, 1/ϕ, the Fibonacci and Lucas numbers, linked to the golden ratio, that play a fundamental role in the development, and therefore, in the final results of the analyzed expressions.

In mathematics, the Fibonacci numbers, commonly denoted F_n, form a sequence, called the Fibonacci sequence, such that each number is the sum of the two preceding ones, starting from 0 and 1. Fibonacci numbers are strongly related to the golden ratio: Binet's formula expresses the nth Fibonacci number in terms of n and the golden ratio, and implies that the ratio of two consecutive Fibonacci numbers tends to the golden ratio as n increases.
Fibonacci numbers are also closely related to Lucas numbers ,in that the Fibonacci and Lucas numbers form a complementary pair of Lucas sequences

The beginning of the sequence is thus:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765, 10946, 17711, 28657, 46368, 75025, 121393, 196418, 317811, 514229, 832040, 1346269, 2178309, 3524578, 5702887, 9227465, 14930352, 24157817, 39088169, 63245986, 102334155...

The Lucas numbers or Lucas series are an integer sequence named after the mathematician François Édouard Anatole Lucas (1842–91), who studied both that sequence and the closely related Fibonacci numbers. Lucas numbers and Fibonacci numbers form complementary instances of Lucas sequences.

The Lucas sequence has the same recursive relationship as the Fibonacci sequence, where each term is the sum of the two previous terms, but with different starting values. This produces a sequence where the ratios of successive terms approach the golden ratio, and in fact the terms themselves are roundings of integer powers of the golden ratio.[1] The sequence also has a variety of relationships with the Fibonacci numbers, like the fact that adding any two Fibonacci numbers two terms apart in the Fibonacci sequence results in the Lucas number in between.

The sequence of Lucas numbers is:

2, 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, 199, 322, 521, 843, 1364, 2207, 3571, 5778, 9349, 15127, 24476, 39603, 64079, 103682, 167761, 271443, 439204, 710647, 1149851, 1860498, 3010349, 4870847, 7881196, 12752043, 20633239, 33385282, 54018521, 87403803……

All Fibonacci-like integer sequences appear in shifted form as a row of the Wythoff array; the Fibonacci sequence itself is the first row and the Lucas sequence is the second row. Also like all Fibonacci-like integer sequences, the ratio between two consecutive Lucas numbers converges to the golden ratio.

A Lucas prime is a Lucas number that is prime. The first few Lucas primes are:

2, 3, 7, 11, 29, 47, 199, 521, 2207, 3571, 9349, 3010349, 54018521, 370248451, 6643838879, ... (sequence A005479 in the OEIS).

In geometry, a golden spiral is a logarithmic spiral whose growth factor is φ, the golden ratio.[1] That is, a golden spiral gets wider (or further from its origin) by a factor of φ for every quarter turn it makes. Approximate logarithmic spirals can occur in nature, for example the arms of spiral galaxies[3] - golden spirals are one special case of these logarithmic spirals

We observe that 1728 and 1729 are results very near to the mass of candidate glueball **$f_0(1710)$ scalar meson.** Furthermore, 1728 occurs in the algebraic formula for the j-invariant of an elliptic curve. As a consequence, it is sometimes called a Zagier as a pun on the Gross–Zagier theorem. The number 1728 is one less than the Hardy–Ramanujan number 1729 (taxicab number).

Furthermore, we obtain as results of our computations, always values very near to the Higgs boson mass 125.18 GeV and practically equals to the rest mass of Pion meson 139.57 MeV. In conclusion we obtain also many results that are very good approximations to the value of the golden ratio 1.618033988749... and to $\zeta(2) = \frac{\pi^2}{6} = 1.644934\ldots$

We note how the following three values: 137.508 (golden angle), 139.57 (mass of the Pion - meson Pi) and 125.18 (mass of the Higgs boson), are connected to each other. In fact, just add 2 to 137.508 to obtain a result very close to the mass of the Pion and subtract 12 to 137.508 to obtain a result that is also very close to the mass of the Higgs boson. We can therefore hypothesize that it is the golden angle (and the related golden ratio inherent in it) to be a fundamental ingredient both in the structures of the microcosm and in those of the macrocosm.

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