Summary of a Theory of Mathematical Connections between Ramanujan's formulas of Modular Equations and Approximations to π and the equations of Inflationary Cosmology concerning the scalar field ϕ, the Inflaton mass, the Higgs boson mass and the Pion meson $\pi^{\pm}$ mass

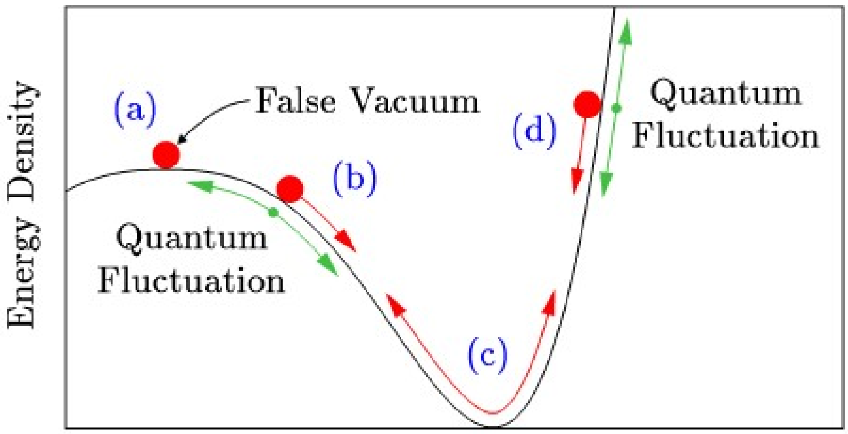
Michele Nardelli[1], **Antonio Nardelli**

https://www.britannica.com/biography/Srinivasa-Ramanujan

https://biografieonline.it/foto-enrico-fermi

[1] M.Nardelli have studied by 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

Inflationary Cosmology: Exploring the Universe from the Smallest to the Largest Scales



$\varphi = 50\ M_P = 1.2175 \times 10^{20}$ GeV

$$\sqrt[4096]{\frac{1}{1.2175 \times 10^{20}}} = 0.98877237\ldots$$

$$\sqrt{\log_{0.98877237}\left(\frac{1}{1.2175 \times 10^{20}}\right)} = 64.0000\ldots$$

$$64^2 = 4096$$

We obtain:

$$\sqrt[4096]{\frac{1}{\phi}} = 0.98877237\ ; \quad \sqrt{\log_{0.98877237}\left(\frac{1}{\phi}\right)} = 64\ ; \quad 64^2 = 4096$$

Generalized dilaton–axion models of inflation, de Sitter vacua and spontaneous SUSY breaking in supergravity

Table 2 The masses of inflaton, axion and gravitino, and the VEVs of F- and D-fields derived from our models by fixing the amplitude A_s according to PLANCK data – see Eq. (57). The value of $\langle F_T \rangle$ for a positive ω_1 is not fixed by A_s

α	3	4		5		6		7	
$\mathrm{sgn}(\omega_1)$	$-$	$+$	$-$	$+$	$-$	$+$	$-$	$-$	
m_φ	2.83	2.95	2.73	2.71	2.71	2.53	2.58	1.86	$\times 10^{13}$ GeV
$m_{t'}$	0	0.93	1.73	2.02	2.02	4.97	2.01	1.56	$\times 10^{13}$ GeV
$m_{3/2}$	≥ 1.41	2.80	0.86	2.56	0.64	3.91	0.49	0.29	$\times 10^{13}$ GeV
$\langle F_T \rangle$	any	$\neq 0$	0	$\neq 0$	0	$\neq 0$	0	0	$\times 10^{31}$ GeV^2
$\langle D \rangle$	8.31	4.48	5.08	3.76	3.76	3.25	2.87	1.73	$\times 10^{31}$ GeV^2

$m_\varphi = 2.542 - 2.33 * 10^{13}$ GeV with an average of $2.636 * 10^{13}$ GeV

$$\sqrt[4096]{\frac{1}{2.83 \times 10^{13}}} = 0.992466536725379764\ldots$$

$$\sqrt{\log_{0.99246653}\left(\frac{1}{2.83 \times 10^{13}}\right)} = 64.0000\ldots$$

$$64^2 = 4096$$

We obtain:

$$\sqrt[4096]{\frac{1}{m_\varphi}} = 0.99246653\ ; \quad \sqrt{\log_{0.99246653}\left(\frac{1}{m_\varphi}\right)} = 64\ ; \quad 64^2 = 4096$$

Mathematical connection

$$\sqrt{\log_{0.98877237}\left(\frac{1}{1.2175\times10^{20}}\right)} = 64; \quad \sqrt{\log_{0.99246653}\left(\frac{1}{2.83\times10^{13}}\right)} = 64$$

$$\sqrt{\log_{0.98877237}\left(\frac{1}{1.2175\times10^{20}}\right)} = \sqrt{\log_{0.99246653}\left(\frac{1}{2.83\times10^{13}}\right)} = 64$$

Modular equations and approximations to π

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

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

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

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

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

Similarly, from

$$g_{58} = \sqrt{\left(\frac{5+\sqrt{29}}{2}\right)},$$

we obtain

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

Hence

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

From which:

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

(((exp(Pi*sqrt37)+24+(4096+276)exp-(Pi*sqrt37))) / ((((6+sqrt37)^6+(6- sqrt37)^6))))

$$\frac{\exp(\pi\sqrt{37}) + 24 + (4096+276)\exp(-(\pi\sqrt{37}))}{(6+\sqrt{37})^6 + (6-\sqrt{37})^6} = \frac{24 + 4372\, e^{-\sqrt{37}\,\pi} + e^{\sqrt{37}\,\pi}}{(6-\sqrt{37})^6 + (6+\sqrt{37})^6} =$$

$$= \frac{24 + 4372\, e^{-\sqrt{37}\,\pi} + e^{\sqrt{37}\,\pi}}{(6-\sqrt{37})^6 + (6+\sqrt{37})^6} \text{ is a transcendental number } =$$

$$= 64.000000000000000000779965901541408776562042740155278984 30\ldots \sim 64$$

(((exp(Pi*sqrt37)+24+(x+276)exp-(Pi*sqrt37)))/((((6+sqrt37)^6+(6-sqrt37)^6))) = 64

$$\frac{\exp(\pi\sqrt{37}) + 24 + (x+276)\exp(-(\pi\sqrt{37}))}{(6+\sqrt{37})^6 + (6-\sqrt{37})^6} = 64$$

Exact result:

$$\frac{e^{-\sqrt{37}\,\pi}(x+276) + e^{\sqrt{37}\,\pi} + 24}{(6-\sqrt{37})^6 + (6+\sqrt{37})^6} = 64$$

Alternate forms:

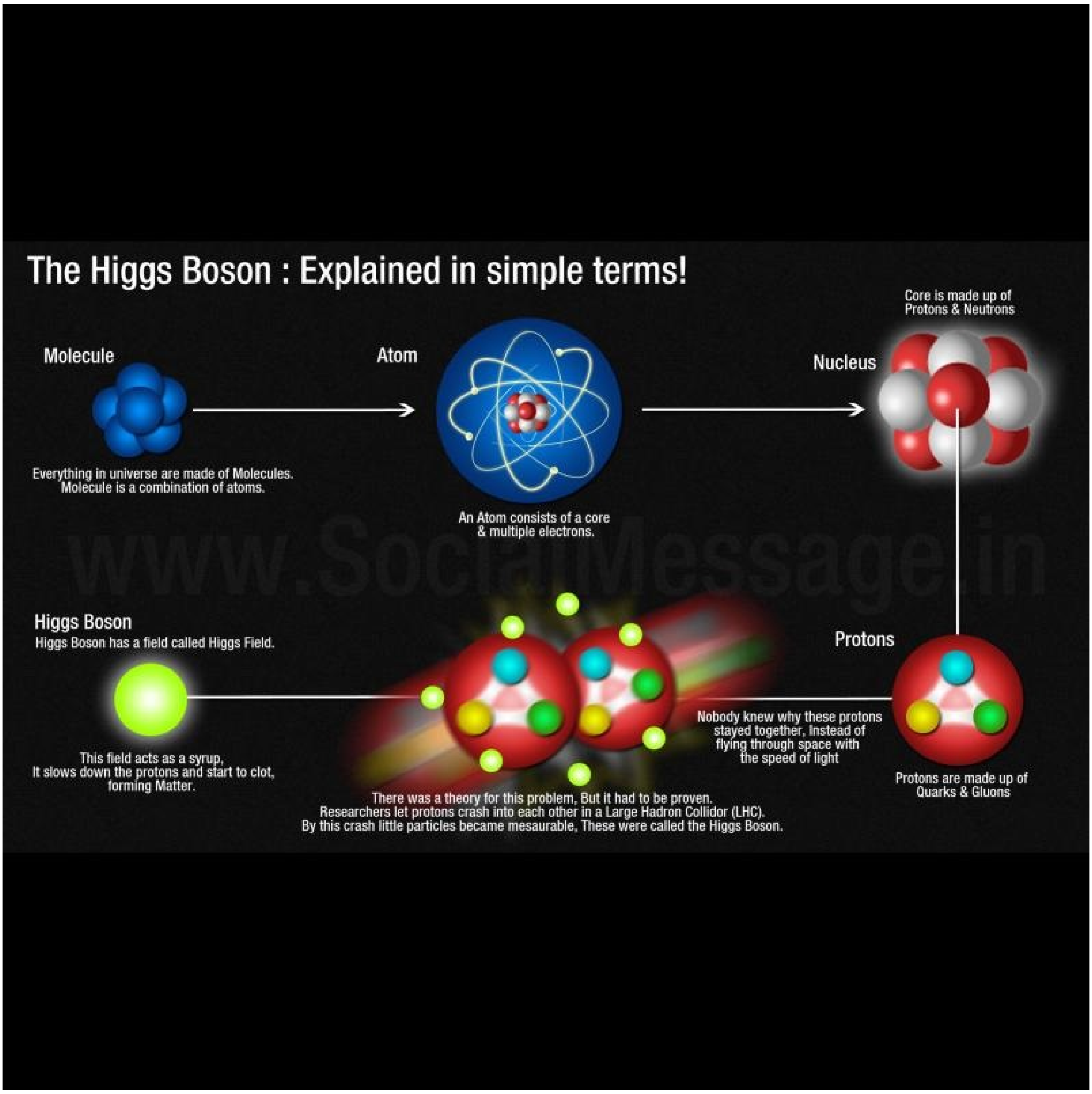
$$\frac{e^{-\sqrt{37}\,\pi}(x+276)}{3111698} + \frac{e^{\sqrt{37}\,\pi}}{3111698} + \frac{12}{1555849} = 64$$

$$\frac{e^{-\sqrt{37}\,\pi}\left(x + e^{2\sqrt{37}\,\pi} + 24\, e^{\sqrt{37}\,\pi} + 276\right)}{3111698} = 64$$

$$\frac{e^{-\sqrt{37}\,\pi}\,x}{(6-\sqrt{37})^6+(6+\sqrt{37})^6}+\frac{e^{\sqrt{37}\,\pi}}{(6-\sqrt{37})^6+(6+\sqrt{37})^6}+\frac{276\,e^{-\sqrt{37}\,\pi}}{(6-\sqrt{37})^6+(6+\sqrt{37})^6}+\frac{24}{(6-\sqrt{37})^6+(6+\sqrt{37})^6}-64=0$$

$$x=-276+199\,148\,648\,e^{\sqrt{37}\,\pi}-e^{2\sqrt{37}\,\pi}$$

$$x\approx 4096.0$$



http://therealmrscience.net/exactly-what-does-the-higgs-boson-do.html

From the above values of scalar field ϕ, and of the inflaton mass m_φ , we obtain results that are in the range of the Higgs boson mass:

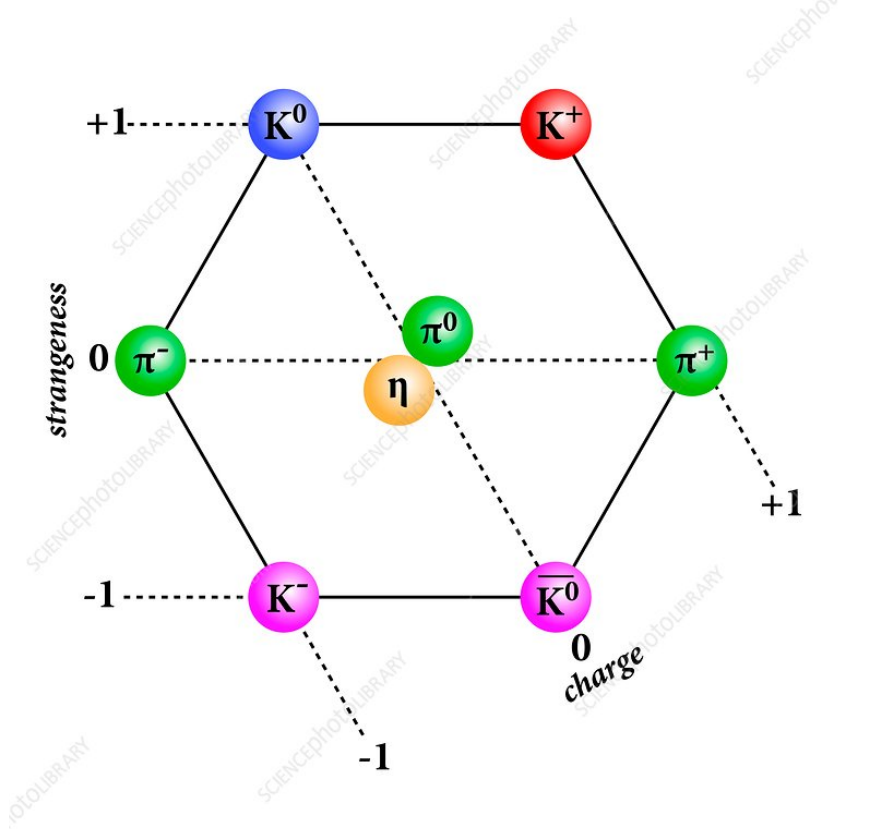
$$2\sqrt{\log_{0.98877237}\left(\frac{1}{1.2175\times 10^{20}}\right)}-\pi+\frac{1}{\phi}$$

125.476...

$$2\sqrt{\log_{0.99246653}\left(\frac{1}{2.83\times 10^{13}}\right)}-\pi+\frac{1}{\phi}$$

125.476...

https://www.sciencephoto.com/media/476068/view/meson-octet-diagram

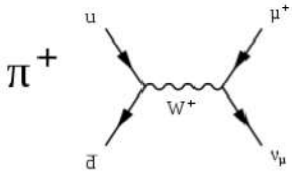


Meson octet. Diagram organising mesons into an octet according to their charge and strangeness. Particles along the same diagonal line share the same charge; positive (+1), neutral (0), or negative (-1). Particles along the same horizontal line share the same strangeness. Strangeness is a quantum property that is conserved in strong and electromagnetic interactions, between particles, but not in weak interactions. Mesons are made up of one quark and one antiquark. Particles with a strangeness of +1, such as the kaons (blue and red) in the top line, contain one strange antiquark. Particles with a strangeness of 0, such as the pion mesons (green) and eta meson (yellow) in the middle line, contain no strange quarks. Particles with a strangeness of -1, such as the antiparticle kaons (pink) in the bottom line, contain one strange quark

Pion mesons

The $\pi^{\pm}$ mesons have a mass of 139.6 MeV/c^2 and a mean lifetime of 2.6033×10^{-8} s. They decay due to the weak interaction. The primary decay mode of a pion, with a branching fraction of 0.999877, is a leptonic decay into a muon and a muon neutrino:

$$\pi^+ \rightarrow \mu^+ + \nu_\mu$$
$$\pi^- \rightarrow \mu^- + \bar{\nu}_\mu$$

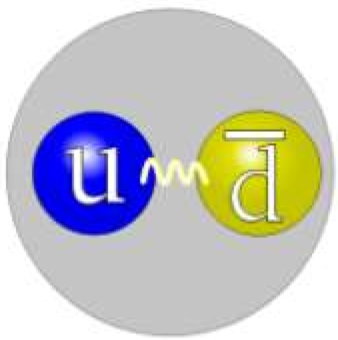


Feynman diagram of the dominant leptonic pion decay.

The second most common decay mode of a pion, with a branching fraction of 0.000123, is also a leptonic decay into an electron and the corresponding electron antineutrino. This "electronic mode" was discovered at CERN in 1958:[6]

$$\pi^+ \rightarrow e^+ + \nu_e$$
$$\pi^- \rightarrow e^- + \bar{\nu}_e$$

Pion



The quark structure of the pion.

Composition	π^+: $u\bar{d}$ π^0: $u\bar{u}$ or $d\bar{d}$ π^-: $d\bar{u}$
Statistics	Bosonic
Interactions	Strong, Weak, Electromagnetic and Gravity
Symbol	π^+, π^0, and π^-
Theorized	Hideki Yukawa (1935)
Discovered	César Lattes, Giuseppe Occhialini (1947) and Cecil Powell
Types	3
Mass	$\pi^{\pm}$: 139.570 18(35) MeV/c^2 π^0: 134.9766(6) MeV/c^2

From the above values of scalar field ϕ, and the inflaton mass m_φ , we obtain also the value of Pion meson $\pi^\pm$ = 139.57018 MeV/c^2

$$2\sqrt{\log_{0.98877237}\left(\frac{1}{1.2175\times 10^{20}}\right)}+11+\frac{1}{\phi}$$

139.618...

$$2\sqrt{\log_{0.99246653}\left(\frac{1}{2.83\times 10^{13}}\right)}+11+\frac{1}{\phi}$$

139.618...

The $\pi^\pm$ mesons have a mass of 139.6 MeV/c^2 and a mean lifetime of 2.6033×10^{-8} s. They decay due to the weak interaction. The primary decay mode of a pion, with a branching fraction of 0.999877, is a leptonic decay into a muon and a muon neutrino.

Note that the value 0.999877 is very closed to the following Rogers-Ramanujan continued fraction:

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

http://www.bitman.name/math/article/102/109/

We observe that also the results of 4096th root of the values of scalar field ϕ, and the inflaton mass m_φ:

$$\sqrt[4096]{\frac{1}{\phi}}=0.98877237\;;\qquad \sqrt[4096]{\frac{1}{m_\varphi}}=0.99246653$$

are very closed to the above continued fraction.

In conclusion, we have showed a possible theoretical connection between some parameters of inflationary cosmology, of particle masses (Higgs boson and Pion meson $\pi^{\pm}$) and some fundamental equations of Ramanujan's mathematics.