On the analysis of an equation concerning the "Universe Wave Function". Mathematical connections with some parameters of String Theory and Number Theory

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Abstract

In this paper, we analyze an equation concerning the "Universe Wave Function". We obtain various mathematical connections with MRB Constant and some parameters of String Theory and Number Theory

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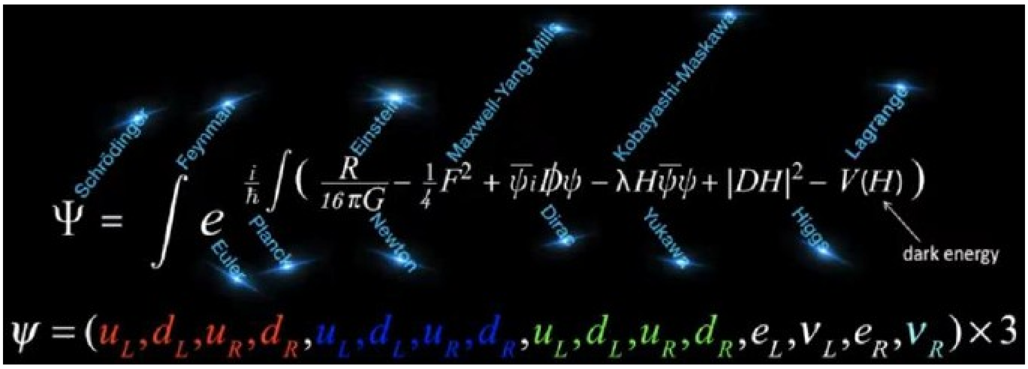
From

“Path Integral for Gravity” – 6 giu 2021- Online workshop-2021: Quantum Gravity and Cosmology - *Neil Turok* (U. of Edinburgh)

We analyze the following equation:



we consider:

(R/(16Pi*G)-1/4*F^2+ψ*i*D*ψ-λ*H*ψ*ψ+(D*H)^2-V(H))

Input

$$\frac{R}{16\pi G} - \frac{1}{4}F^2 + \psi\, i\, D\, \psi - \lambda\, H\, \psi\, \psi + (D\, H)^2 - V(H)$$

i is the imaginary unit

Exact result

$$D^2 H^2 + i\, D\, \psi^2 - \frac{F^2}{4} + \frac{R}{16\pi G} - H\, \lambda\, \psi^2 - V(H)$$

Solutions

$$D = \frac{-i\,\psi^2 \pm \sqrt{-4\,H^2\left(-\frac{F^2}{4} + \frac{R}{16\,\pi\,G} - H\,\lambda\,\psi^2 - V(H)\right) - \psi^4}}{2\,H^2} \quad (H \neq 0)$$

Alternate forms

$$\frac{16\,\pi\,D^2\,G\,H^2 + 16\,i\,\pi\,D\,G\,\psi^2 - 4\,\pi\,F^2\,G - 16\,\pi\,G\left(H\,\lambda\,\psi^2 + V(H)\right) + R}{16\,\pi\,G}$$

$$-\frac{-16\,\pi\,D^2\,G\,H^2 - 16\,i\,\pi\,D\,G\,\psi^2 + 4\,\pi\,F^2\,G + 16\,\pi\,G\,H\,\lambda\,\psi^2 + 16\,\pi\,G\,V(H) - R}{16\,\pi\,G}$$

Property as a function
Parity
even

Derivative

$$\frac{\partial}{\partial D}\left(D^2\,H^2 + i\,D\,\psi^2 - \frac{F^2}{4} + \frac{R}{16\,\pi\,G} - H\,\lambda\,\psi^2 - V(H)\right) = 2\,D\,H^2 + i\,\psi^2$$

Indefinite integral

$$\int\left(-\frac{F^2}{4} + D^2\,H^2 + \frac{R}{16\,G\,\pi} + i\,D\,\psi^2 - H\,\lambda\,\psi^2 - V(H)\right)dD = \frac{D^3\,H^2}{3} + \frac{1}{2}\,i\,D^2\,\psi^2 - \frac{D\,F^2}{4} + \frac{D\,R}{16\,\pi\,G} - D\,H\,\lambda\,\psi^2 - D\,V(H) + \text{constant}$$

From the indefinite integral result

$$\int\left(-\frac{F^2}{4}+D^2 H^2+\frac{R}{16 G \pi}+i D \psi^2-H \lambda \psi^2-V(H)\right) dD =$$
$$\frac{D^3 H^2}{3}+\frac{1}{2} i D^2 \psi^2-\frac{D F^2}{4}+\frac{D R}{16 \pi G}-D H \lambda \psi^2-D V(H) + \text{constant}$$

-(D F^2)/4 + (D^3 H^2)/3 + (D R)/(16 G π) + 1/2 i D^2 ψ^2 - D H λ ψ^2 - D V(H)

we obtain, multiplying by i/h

i/h * ((-(D F^2)/4 + (D^3 H^2)/3 + (D R)/(16 G π) + 1/2 i D^2 ψ^2 - D H λ ψ^2 - D V(H)))

Input

$$\frac{i}{h}\left(-\frac{1}{4}\left(D F^2\right)+\frac{1}{3}\left(D^3 H^2\right)+\frac{D R}{16 G \pi}+\frac{1}{2} i D^2 \psi^2-D H \lambda \psi^2-D V(H)\right)$$

i is the imaginary unit

Exact result

$$\frac{i\left(\frac{D^3 H^2}{3}+\frac{1}{2} i D^2 \psi^2-\frac{D F^2}{4}+\frac{D R}{16 \pi G}-D H \lambda \psi^2-D V(H)\right)}{h}$$

Alternate form

$$\frac{i D\left(16 D^2 H^2+24 i D \psi^2-12 F^2+\frac{3 R}{\pi G}-48 H \lambda \psi^2-48 V(H)\right)}{48 h}$$

Expanded form

$$\frac{i D^3 H^2}{3 h}-\frac{D^2 \psi^2}{2 h}-\frac{i D F^2}{4 h}+\frac{i D R}{16 \pi G h}-\frac{i D H \lambda \psi^2}{h}-\frac{i D V(H)}{h}$$

Alternate form assuming D, F, G, h, H, R, λ, and ψ are real

$$-\frac{D^2\psi^2}{2h}+\frac{i D\left(16\pi D^2 G H^2-12\pi F^2 G-48\pi G H\lambda\psi^2-48\pi G V(H)+3R\right)}{48\pi G h}$$

Roots

$$G h\neq 0,\quad D=0$$

$$G(2H\lambda-iD)\neq 0,\quad h\neq 0,\quad \psi=-\frac{\sqrt{16\pi D^2 G H^2-12\pi F^2 G-48\pi G V(H)+3R}}{2\sqrt{6\pi}\sqrt{-iG(D+2iH\lambda)}}$$

$$G(2H\lambda-iD)\neq 0,\quad h\neq 0,\quad \psi=\frac{\sqrt{16\pi D^2 G H^2-12\pi F^2 G-48\pi G V(H)+3R}}{2\sqrt{6\pi}\sqrt{-iG(D+2iH\lambda)}}$$

$$G h\neq 0,\quad D=0,\quad H=0,\quad R=4\pi\left(F^2 G+4 G V(0)\right)$$

$$H\neq 0,\quad G h\neq 0,\quad R=\frac{4}{3}\pi\left(-4D^2 G H^2+3F^2 G+12 G V(H)\right),\quad \lambda=\frac{iD}{2H}$$

Property as a function

Parity

even

Roots for the variable ψ

$$\psi=-\frac{\sqrt{16\pi D^2 G H^2-12\pi F^2 G-48\pi G V(H)+3R}}{\sqrt{48\pi G H\lambda-24 i\pi D G}}$$

$$\psi=\frac{\sqrt{16\pi D^2 G H^2-12\pi F^2 G-48\pi G V(H)+3R}}{\sqrt{48\pi G H\lambda-24 i\pi D G}}$$

Derivative

$$\frac{\partial}{\partial D}\left(\frac{i\left(\frac{D^3 H^2}{3} + \frac{1}{2} i D^2 \psi^2 - \frac{D F^2}{4} + \frac{D R}{16 \pi G} - D H \lambda \psi^2 - D V(H)\right)}{h}\right) = \frac{i\left(D^2 H^2 + i D \psi^2 - \frac{F^2}{4} + \frac{R}{16 \pi G} - H \lambda \psi^2 - V(H)\right)}{h}$$

Indefinite integral

$$\int \frac{i\left(-\frac{D F^2}{4} + \frac{D^3 H^2}{3} + \frac{D R}{16 G \pi} + \frac{1}{2} i D^2 \psi^2 - D H \lambda \psi^2 - D V(H)\right)}{h} \, dD = \frac{i D^2 \left(8 D^2 H^2 + 16 i D \psi^2 - 12 F^2 + \frac{3 R}{\pi G} - 48 H \lambda \psi^2 - 48 V(H)\right)}{96 h} + \text{constant}$$

From the exact result

$$\frac{i\left(\frac{D^3 H^2}{3} + \frac{1}{2} i D^2 \psi^2 - \frac{D F^2}{4} + \frac{D R}{16 \pi G} - D H \lambda \psi^2 - D V(H)\right)}{h}$$

(i (-(D F^2)/4 + (D^3 H^2)/3 + (D R)/(16 G π) + 1/2 i D^2 ψ^2 - D H λ ψ^2 - D V(H)))/h

we obtain, performing the exp:

exp(((i (-(D F^2)/4 + (D^3 H^2)/3 + (D R)/(16 G π) + 1/2 i D^2 ψ^2 - D H λ ψ^2 - D V(H)))/h))

Input

$$\exp\left(\frac{i\left(-\frac{1}{4}\left(D F^2\right) + \frac{1}{3}\left(D^3 H^2\right) + \frac{D R}{16 G \pi} + \frac{1}{2} i D^2 \psi^2 - D H \lambda \psi^2 - D V(H)\right)}{h}\right)$$

i is the imaginary unit

Exact result

$$e^{\frac{i\left(\frac{D^3 H^2}{3}+\frac{1}{2} i D^2 \psi^2-\frac{D F^2}{4}+\frac{D R}{16 \pi G}-D H \lambda \psi^2-D V(H)\right)}{h}}$$

Alternate forms

$$e^{\frac{i D\left(16 D^2 H^2+24 i D \psi^2-12 F^2+\frac{3 R}{\pi G}-48 H \lambda \psi^2-48 V(H)\right)}{48 h}}$$

$$e^{\frac{i D^3 H^2}{3 h}-\frac{D^2 \psi^2}{2 h}+D\left(-\frac{i F^2}{4 h}+\frac{i R}{16 \pi G h}+\frac{-i H \lambda \psi^2-i V(H)}{h}\right)}$$

Alternate form assuming D, F, G, h, H, R, λ, and ψ are real

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{D\left(16 D^2 H^2-12 F^2+\frac{3 R}{\pi G}-48 H \lambda \psi^2-48 V(H)\right)}{48 h}\right)+ i e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{D\left(16 D^2 H^2-12 F^2+\frac{3 R}{\pi G}-48 H \lambda \psi^2-48 V(H)\right)}{48 h}\right)$$

Roots

(no roots exist)

Property as a function

Parity

even

Series expansion at D=0

$$1+\frac{i\,D\left(-12\,F^2+\frac{3\,R}{\pi\,G}-48\,H\,\lambda\,\psi^2-48\,V(H)\right)}{48\,h}+\frac{1}{2}\,D^2\left(-\frac{\left(12\,F^2-\frac{3\,R}{\pi\,G}+48\,H\,\lambda\,\psi^2+48\,V(H)\right)^2}{2304\,h^2}-\frac{\psi^2}{h}\right)+$$
$$\frac{1}{288\,h^2}i\,D^3\left(h\left(-12\,F^2+\frac{3\,R}{\pi\,G}-48\,H\,\lambda\,\psi^2-48\,V(H)\right)\left(-\frac{\left(12\,F^2-\frac{3\,R}{\pi\,G}+48\,H\,\lambda\,\psi^2+48\,V(H)\right)^2}{2304\,h^2}-\frac{\psi^2}{h}\right)-2\,\psi^2\left(-12\,F^2+\frac{3\,R}{\pi\,G}-48\,H\,\lambda\,\psi^2-48\,V(H)\right)+96\,h\,H^2\right)+\frac{1}{1572864\,\pi^4\,G^4\,h^4}$$
$$D^4\left(24576\,\pi^3\,G^3\,h^2\,H^2\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)+768\,\pi^2\,G^2\,h\,\psi^2\left(\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)^2+256\,\pi^2\,G^2\,h\,\psi^2\right)+\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)\left(512\,\pi^2\,G^2\,h\,\psi^2\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)+\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)\left(\left(4\,\pi\,F^2\,G+16\,\pi\,G\,H\,\lambda\,\psi^2+16\,\pi\,G\,V(H)-R\right)^2+256\,\pi^2\,G^2\,h\,\psi^2\right)+8192\,\pi^3\,G^3\,h^2\,H^2\right)\right)+O\left(D^5\right)$$

(Taylor series)

Series expansion at D=∞

$$e^{\frac{i\,D\left(16\,\pi\,D^2\,G\,H^2+24\,i\,\pi\,D\,G\,\psi^2-12\,\pi\,F^2\,G-48\,\pi\,G\,H\,\lambda\,\psi^2-48\,\pi\,G\,V(H)+3\,R\right)}{48\,\pi\,G\,h}}$$

Derivative

$$\frac{\partial}{\partial D}\left(e^{\frac{i\left(\frac{D^3\,H^2}{3}+\frac{1}{2}\,i\,D^2\,\psi^2-\frac{D\,F^2}{4}+\frac{D\,R}{16\,\pi\,G}-D\,H\,\lambda\,\psi^2-D\,V(H)\right)}{h}}\right)=$$
$$\frac{1}{h}i\left(D^2\,H^2+i\,D\,\psi^2-\frac{F^2}{4}+\frac{R}{16\,\pi\,G}-H\,\lambda\,\psi^2-V(H)\right)\exp\left(\frac{i\,D\left(16\,D^2\,H^2+24\,i\,D\,\psi^2-12\,F^2+\frac{3\,R}{\pi\,G}-48\,H\,\lambda\,\psi^2-48\,V(H)\right)}{48\,h}\right)$$

From the alternate form

$$e^{-(D^2 \psi^2)/(2h)} \cos\left(\frac{D\left(16 D^2 H^2 - 12 F^2 + \frac{3R}{\pi G} - 48 H \lambda \psi^2 - 48 V(H)\right)}{48 h}\right) + i e^{-(D^2 \psi^2)/(2h)} \sin\left(\frac{D\left(16 D^2 H^2 - 12 F^2 + \frac{3R}{\pi G} - 48 H \lambda \psi^2 - 48 V(H)\right)}{48 h}\right)$$

we obtain:

e^(-(D^2 ψ^2)/(2 h)) cos((D (16 D^2 H^2 - 12 F^2 + (3 R)/(π G) - 48 H λ ψ^2 - 48 V(H)))/(48 h)) + i*e^(-(D^2 ψ^2)/(2 h)) sin((D (16 D^2 H^2 - 12 F^2 + (3 R)/(π G) - 48 H λ ψ^2 - 48 V(H)))/(48 h))

Input

$$e^{-(D^2 \psi^2)/(2h)} \cos\left(\frac{\frac{\partial}{\partial D}\left(16 D^2 H^2 - 12 F^2 + \frac{3R}{\pi G} - 48 H \lambda \psi^2 - 48 V(H)\right)}{48 h}\right) + i e^{-(D^2 \psi^2)/(2h)} \sin\left(\frac{\frac{\partial}{\partial D}\left(16 D^2 H^2 - 12 F^2 + \frac{3R}{\pi G} - 48 H \lambda \psi^2 - 48 V(H)\right)}{48 h}\right)$$

i is the imaginary unit

Exact result

$$e^{-(D^2 \psi^2)/(2h)} \cos\left(\frac{2 D H^2}{3 h}\right) + i e^{-(D^2 \psi^2)/(2h)} \sin\left(\frac{2 D H^2}{3 h}\right)$$

Derivative

$$\frac{\partial}{\partial D}\left(e^{-(D^2 \psi^2)/(2h)} \cos\left(\frac{2 D H^2}{3 h}\right) + i e^{-(D^2 \psi^2)/(2h)} \sin\left(\frac{2 D H^2}{3 h}\right)\right) = -\frac{e^{-(D^2 \psi^2)/(2h)} \left(3 D \psi^2 - 2 i H^2\right)\left(\cos\left(\frac{2 D H^2}{3 h}\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)\right)}{3 h}$$

Alternate forms

$$e^{(D(-3 D \psi^2 + 4 i H^2))/(6 h)}$$

$$e^{-\frac{D^2 \psi^2}{2 h} + \frac{2 i D H^2}{3 h}}$$

$$e^{-(D^2 \psi^2)/(2 h)} \left(\cos\left(\frac{2 D H^2}{3 h}\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)\right)$$

From the exact result

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 D H^2}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 D H^2}{3 h}\right)$$

we obtain:

e^(-(D^2 ψ^2)/(2 h)) cos((2 D H^2)/(3 h)) + i e^(-(D^2 ψ^2)/(2 h)) sin((2 D H^2)/(3 h))

Input

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 D H^2}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 D H^2}{3 h}\right)$$

i is the imaginary unit

Alternate forms

$$e^{(D(-3 D \psi^2 + 4 i H^2))/(6 h)}$$

$$e^{-\frac{D^2 \psi^2}{2 h} + \frac{2 i D H^2}{3 h}}$$

$$e^{-(D^2 \psi^2)/(2 h)} \left(\cos\left(\frac{2 D H^2}{3 h}\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)\right)$$

Expanded trigonometric form

$$-e^{-(D^2\psi^2)/(2h)}\sin^2\left(\frac{DH^2}{3h}\right)+e^{-(D^2\psi^2)/(2h)}\cos^2\left(\frac{DH^2}{3h}\right)+2\,i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{DH^2}{3h}\right)\cos\left(\frac{DH^2}{3h}\right)$$

Roots

(no roots exist)

Property as a function

Parity

even

Series expansion at D=0

$$1+\frac{2\,i\,D\,H^2}{3h}-\frac{D^2\left(9h\psi^2+4H^4\right)}{18h^2}-\frac{i\,D^3\left(27hH^2\psi^2+4H^6\right)}{81h^3}+\frac{D^4\left(243h^2\psi^4+216hH^4\psi^2+16H^8\right)}{1944h^4}+O\left(D^5\right)$$

(Taylor series)

Derivative

$$\frac{\partial}{\partial D}\left(e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2DH^2}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2DH^2}{3h}\right)\right)=-\frac{e^{-(D^2\psi^2)/(2h)}\left(3D\psi^2-2\,i\,H^2\right)\left(\cos\left(\frac{2DH^2}{3h}\right)+i\sin\left(\frac{2DH^2}{3h}\right)\right)}{3h}$$

Indefinite integral

$$\int\left(e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2DH^2}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2DH^2}{3h}\right)\right)dD = -\frac{i\sqrt{\frac{\pi}{2}}\,\sqrt{h}\,e^{-(2H^4)/(9h\psi^2)}\operatorname{erfi}\left(\frac{2H^2+3iD\psi^2}{3\sqrt{2}\,\sqrt{h}\,\psi}\right)}{\psi} + \text{constant}$$

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

Alternative representations

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right) = i\cos\left(\frac{\pi}{2}-\frac{2DH^2}{3h}\right)e^{-(D^2\psi^2)/(2h)}+\frac{1}{2}\left(e^{-(2DiH^2)/(3h)}+e^{(2DiH^2)/(3h)}\right)e^{-(D^2\psi^2)/(2h)}$$

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right) = \cosh\left(-\frac{2iDH^2}{3h}\right)e^{-(D^2\psi^2)/(2h)}+\frac{i\left(-e^{-(2DiH^2)/(3h)}+e^{(2DiH^2)/(3h)}\right)e^{-(D^2\psi^2)/(2h)}}{2i}$$

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right) = \frac{1}{2}\left(e^{-(2DiH^2)/(3h)}+e^{(2DiH^2)/(3h)}\right)e^{-(D^2\psi^2)/(2h)}+\frac{i\left(-e^{-(2DiH^2)/(3h)}+e^{(2DiH^2)/(3h)}\right)e^{-(D^2\psi^2)/(2h)}}{2i}$$

$\cosh(x)$ is the hyperbolic cosine function

Series representations

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right)=$$
$$\left(\sum_{k=0}^{\infty}\frac{2^{-k}\left(-\frac{D^2\psi^2}{h}\right)^k}{k!}\right)\left(\sum_{k=0}^{\infty}\frac{\left(-\frac{4}{9}\right)^k\left(\frac{DH^2}{h}\right)^{2k}}{(2k)!}+i\sum_{k=0}^{\infty}\frac{(-1)^k\,2^{1+2k}\times 3^{-1-2k}\left(\frac{DH^2}{h}\right)^{1+2k}}{(1+2k)!}\right)$$

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right)=\left(\sum_{k=0}^{\infty}\frac{2^{-k}\left(-\frac{D^2\psi^2}{h}\right)^k}{k!}\right)$$
$$\left(i\sum_{k=0}^{\infty}\frac{(-1)^k\,2^{1+2k}\times 3^{-1-2k}\left(\frac{DH^2}{h}\right)^{1+2k}}{(1+2k)!}+\sqrt{\pi}\sum_{j=0}^{\infty}\operatorname{Res}_{s=-j}\frac{9^s\left(\frac{D^2H^4}{h^2}\right)^{-s}\Gamma(s)}{\Gamma\left(\frac{1}{2}-s\right)}\right)$$

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right)=$$
$$\frac{1}{3h}\left(\sum_{k=0}^{\infty}\frac{2^{-k}\left(-\frac{D^2\psi^2}{h}\right)^k}{k!}\right)$$
$$\left(3h\sum_{k=0}^{\infty}\frac{\left(-\frac{4}{9}\right)^k\left(\frac{DH^2}{h}\right)^{2k}}{(2k)!}+i\,D\,H^2\sqrt{\pi}\sum_{j=0}^{\infty}\operatorname{Res}_{s=-j}\frac{9^s\left(\frac{D^2H^4}{h^2}\right)^{-s}\Gamma(s)}{\Gamma\left(\frac{3}{2}-s\right)}\right)$$

$n!$ is the factorial function
$\Gamma(x)$ is the gamma function
$\operatorname{Res}_{z=z_0} f$ is a complex residue

Integral representations

$$e^{-(D^2\psi^2)/(2h)}\cos\left(\frac{2(DH^2)}{3h}\right)+i\,e^{-(D^2\psi^2)/(2h)}\sin\left(\frac{2(DH^2)}{3h}\right)=$$
$$\int_{-i\infty+\gamma}^{i\infty+\gamma}\frac{e^{s-\frac{D^2(2H^4+9hs\psi^2)}{18h^2s}}\left(DH^2-3ihs\right)}{6h\sqrt{\pi}\,s^{3/2}}\,ds\quad\text{for }\gamma>0$$

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 (D H^2)}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 (D H^2)}{3 h}\right) = \frac{i\, e^{-(D^2 \psi^2)/(2 h)} \left(-3 h \int_{-i \infty+\gamma}^{i \infty+\gamma} \frac{e^{-(D^2 H^4)/(9 h^2 s)+s}}{\sqrt{s}} \, ds + 4 D H^2 \sqrt{\pi} \int_0^1 \cos\left(\frac{2 D H^2 t}{3 h}\right) dt\right)}{6 h \sqrt{\pi}}$$

for $\gamma > 0$

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 (D H^2)}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 (D H^2)}{3 h}\right) = -\frac{e^{-(D^2 \psi^2)/(2 h)} \left(-D H^2 \int_{-i \infty+\gamma}^{i \infty+\gamma} \frac{e^{-(D^2 H^4)/(9 h^2 s)+s}}{s^{3/2}} \, ds + 6 h \sqrt{\pi} \int_{\frac{\pi}{2}}^{\frac{2 D H^2}{3 h}} \sin(t) \, dt\right)}{6 h \sqrt{\pi}}$$

for $\gamma > 0$

Multiple-argument formulas

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 (D H^2)}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 (D H^2)}{3 h}\right) = e^{-(D^2 \psi^2)/(2 h)} \left(\cos\left(\frac{2 D H^2}{3 h}\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)\right)$$

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 (D H^2)}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 (D H^2)}{3 h}\right) = \frac{\cos\left(\frac{2 D H^2}{3 h}\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)}{\sqrt{e^{(D^2 \psi^2)/h}}} \quad \text{for } \frac{D^2 \psi^2}{h} \in \mathbb{R}$$

$$e^{-(D^2 \psi^2)/(2 h)} \cos\left(\frac{2 (D H^2)}{3 h}\right) + i\, e^{-(D^2 \psi^2)/(2 h)} \sin\left(\frac{2 (D H^2)}{3 h}\right) = e^{-(D^2 \psi^2)/(2 h)} \left(T_{\frac{2}{3}}\left(\cos\left(\frac{D H^2}{h}\right)\right) + i \sin\left(\frac{2 D H^2}{3 h}\right)\right)$$

$\mathbb{R}$ is the set of real numbers

$T_n(x)$ is the Chebyshev polynomial of the first kind

From the **indefinite integral** result

$$\int \left(e^{-(D^2 \psi^2)/(2h)} \cos\left(\frac{2 D H^2}{3h}\right) + i\, e^{-(D^2 \psi^2)/(2h)} \sin\left(\frac{2 D H^2}{3h}\right)\right) dD = -\frac{i \sqrt{\frac{\pi}{2}} \sqrt{h}\, e^{-(2 H^4)/(9 h \psi^2)} \operatorname{erfi}\left(\frac{2H^2 + 3 i D \psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi} + \text{constant}$$

we obtain:

-(i e^(-(2 H^4)/(9 h ψ^2)) sqrt(h) sqrt(π/2) erfi((2 H^2 + 3 i D ψ^2)/(3 sqrt(2) sqrt(h) ψ)))/ψ

Input

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2H^2 + 3 i D \psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi}$$

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

i is the imaginary unit

Roots for the variable ψ

$$\psi = -\frac{\sqrt{\frac{2}{3}} \sqrt{i D H^2}}{D}$$

$$\psi = \frac{\sqrt{\frac{2}{3}} \sqrt{i D H^2}}{D}$$

Series expansion at D=0

$$-\frac{i \sqrt{\frac{\pi}{2}} \sqrt{h}\, e^{-(2 H^4)/(9 h \psi^2)} \operatorname{erfi}\left(\frac{\sqrt{2}\, H^2}{3\sqrt{h}\,\psi}\right)}{\psi} + D + \frac{i D^2 H^2}{3h} - \frac{D^3 (9 h \psi^2 + 4 H^4)}{54 h^2} - \frac{i D^4 H^2 (27 h \psi^2 + 4 H^4)}{324 h^3} + O(D^5)$$

(Taylor series)

Series expansion at D=∞

$$e^{-\frac{D^2 \psi^2}{2h}+\frac{2 i D H^2}{3h}} \left(-\frac{h}{\psi^2 D} - \frac{2 i h H^2}{3 \psi^4 D^2} + \frac{h\left(4 H^4 + 9 h \psi^2\right)}{9 \psi^6 D^3} + \frac{2 i h \left(4 H^6 + 27 h \psi^2 H^2\right)}{27 \psi^8 D^4} - \frac{h\left(16 H^8 + 216 h \psi^2 H^4 + 243 h^2 \psi^4\right)}{81 \psi^{10} D^5} + O\left(\left(\frac{1}{D}\right)^6\right)\right) + \frac{1}{\psi^2}\sqrt{\frac{\pi}{2}}\, h\, e^{-(2H^4)/(9h\psi^2)} \left(\frac{h}{\psi^2}\right)^{1/2 \left\lfloor \arg\left(-\frac{H^4}{h\psi^2} - \frac{3 i D H^2}{h}\right)/(2\pi)\right\rfloor} \left(\frac{\psi^2}{h}\right)^{1/2+1/2\left\lfloor \arg\left(-\frac{H^4}{h\psi^2} - \frac{3 i D H^2}{h}\right)/(2\pi)\right\rfloor}$$

$\arg(z)$ is the complex argument
$\lfloor x \rfloor$ is the floor function

Derivative

$$\frac{\partial}{\partial D}\left(-\frac{i\, e^{-(2H^4)/(9h\psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}}\, \operatorname{erfi}\left(\frac{2H^2+3 i D \psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi}\right) = e^{\left(D\left(-3 D \psi^2 + 4 i H^2\right)\right)/(6h)}$$

Indefinite integral

$$\int -\frac{i\, e^{-(2H^4)/(9h\psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}}\, \operatorname{erfi}\left(\frac{2H^2+3 i D \psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi}\, dD = \frac{1}{6\psi^3} e^{-(2H^4)/(9h\psi^2)} \left(6 h \psi\, e^{\left(2H^2+3 i D \psi^2\right)^2/(18 h \psi^2)} - \sqrt{2\pi}\sqrt{h}\left(2H^2 + 3 i D \psi^2\right) \operatorname{erfi}\left(\frac{2H^2 + 3 i D \psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)\right) + \text{constant}$$

Alternative representations

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2+3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = \frac{i^2 \operatorname{erf}\left(\frac{i (2 H^2+3 D i \psi^2)}{3 \psi \sqrt{2} \sqrt{h}}\right) e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}}}{\psi}$$

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2+3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i^2 \operatorname{erf}\left(\frac{i (2 H^2+3 D i \psi^2)}{3 \psi \sqrt{2} \sqrt{h}}, 0\right) e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}}}{\psi}$$

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2+3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i (-i) \operatorname{erf}\left(\frac{i (2 H^2+3 i D \psi^2)}{3 \sqrt{2} \sqrt{h} \psi}\right) w^a \left(\sqrt{h} \sqrt{\frac{\pi}{2}}\right)}{\psi} \quad \text{for } a = -\frac{2 H^4}{9 h \psi^2 \log(w)}$$

$\operatorname{erf}(x)$ is the error function
$\operatorname{erf}(x_0, x_1)$ is the generalized error function
$\log(x)$ is the natural logarithm

Series representations

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2+3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i \sqrt{2} \sqrt{h} \sum_{k_1=0}^{\infty} \sum_{k_2=0}^{\infty} \frac{2^{-1/2+k_1-k_2} \times 3^{-1-2 k_1-2 k_2} \left(-\frac{H^4}{h \psi^2}\right)^{k_1} \left(\frac{2 H^2+3 i D \psi^2}{\sqrt{h} \psi}\right)^{1+2 k_2}}{k_1! k_2! (1+2 k_2)}}{\psi}$$

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2 + 3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i \sqrt{2} \sqrt{h} \sum_{k_1=0}^{\infty} \sum_{k_2=0}^{\infty} \frac{2^{k_1+1/2(-1-2 k_2)} \times 3^{-1-2 k_1-2 k_2} \left(-\frac{H^4}{h \psi^2}\right)^{k_1} \left(\frac{2 H^2+3 i D \psi^2}{\sqrt{h} \psi}\right)^{1+2 k_2}}{k_1! \, k_2! \, (1+2 k_2)}}{\psi}$$

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2 + 3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{1}{H^4 \psi} i \sqrt{2} \sqrt{h} \sum_{k_1=0}^{\infty} \sum_{k_2=0}^{\infty} \frac{2^{-1/2-k_1+2 k_2} \times 3^{-1-2 k_1-4 k_2} \left(-\frac{H^4}{h \psi^2}\right)^{2 k_2} \left(\frac{2 H^2+3 i D \psi^2}{\sqrt{h} \psi}\right)^{1+2 k_1} \left(H^4 - 9 h \psi^2 k_2\right)}{k_1! \, (2 k_2)! \, (1 + 2 k_1)}$$

$n!$ is the factorial function

Integral representations

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2 + 3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i \sqrt{2}\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h}}{\psi} \int_0^{\frac{2 H^2+3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}} e^{t^2} \, dt$$

$$-\frac{i\, e^{-(2 H^4)/(9 h \psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2 H^2 + 3 i D \psi^2}{3 \sqrt{2} \sqrt{h} \psi}\right)}{\psi} = -\frac{i \sqrt{2}\, e^{(D(4 i H^2 - 3 D \psi^2))/(6 h)} \sqrt{h}}{\psi} \int_0^{\infty} e^{-t^2} \sin\left(\frac{\sqrt{2}\, t \left(2 H^2 + 3 i D \psi^2\right)}{3 \sqrt{h} \psi}\right) dt$$

for $\frac{2 H^2 + 3 i D \psi^2}{\sqrt{h} \psi} \in \mathbb{R}$

$$-\frac{i\, e^{-(2H^4)/(9h\psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2H^2+3iD\psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi} = \frac{i\, e^{-(2H^4)/(9h\psi^2)} \sqrt{h}}{2\sqrt{2}\,\pi\,\psi} \int_{-i\infty+\gamma}^{i\infty+\gamma} \frac{18^s \left(\frac{2iH^2-3D\psi^2}{\sqrt{h}\,\psi}\right)^{-2s} \Gamma(-s)\,\Gamma\left(\frac{1}{2}+s\right)}{\Gamma(1-s)}\, ds$$

$$\text{for } \left(\gamma > -\frac{1}{2} \text{ and } \left|\arg\left(\frac{2iH^2-3D\psi^2}{\sqrt{h}\,\psi}\right)\right| < \frac{\pi}{2}\right)$$

$$-\frac{i\, e^{-(2H^4)/(9h\psi^2)} \sqrt{h} \sqrt{\frac{\pi}{2}} \operatorname{erfi}\left(\frac{2H^2+3iD\psi^2}{3\sqrt{2}\sqrt{h}\,\psi}\right)}{\psi} = \frac{i\, e^{(D(4iH^2-3D\psi^2))/(6h)} \sqrt{h}\, \mathcal{P}\int_{-\infty}^{\infty} \frac{e^{-t^2}}{t-\frac{2H^2+3iD\psi^2}{3\sqrt{2}\sqrt{h}\,\psi}}\, dt}{\sqrt{2\pi}\,\psi} \quad \text{for } \frac{2H^2+3iD\psi^2}{\sqrt{h}\,\psi} \in \mathbb{R}$$

$\mathbb{R}$ is the set of real numbers

$\Gamma(x)$ is the gamma function

$|z|$ is the absolute value of z

$\mathcal{P}\int f\, dx$ is the Cauchy principal value integral

From the **series expansion at D = 0**

$$-\frac{i\sqrt{\frac{\pi}{2}}\sqrt{h}\, e^{-(2H^4)/(9h\psi^2)} \operatorname{erfi}\left(\frac{\sqrt{2}\,H^2}{3\sqrt{h}\,\psi}\right)}{\psi} + D + \frac{iD^2H^2}{3h} - \frac{D^3\left(9h\psi^2+4H^4\right)}{54h^2} - \frac{iD^4H^2\left(27h\psi^2+4H^4\right)}{324h^3} + O\left(D^5\right)$$

(Taylor series)

for H = Higgs = 125.35 ; D = Dirac = 1.054571817 ; h = Planck = 6.62607015e-34 and dividing the above expressions in three partial expressions, we obtain:

-(i sqrt(π/2) sqrt(6.62607e-34) e^(-(2 125.35^4)/(9 (6.62607e-34) ψ^2)) erfi((sqrt(2) 125.35^2)/(3 sqrt(6.62607e-34) ψ)))/ψ

Input interpretation

$$-\frac{i\sqrt{\frac{\pi}{2}}\sqrt{6.62607\times 10^{-34}}\exp\left(-\frac{2\times 125.35^4}{9\times 6.62607\times 10^{-34}\psi^2}\right)\operatorname{erfi}\left(\frac{\sqrt{2}\times 125.35^2}{3\sqrt{6.62607\times 10^{-34}}\psi}\right)}{\psi}$$

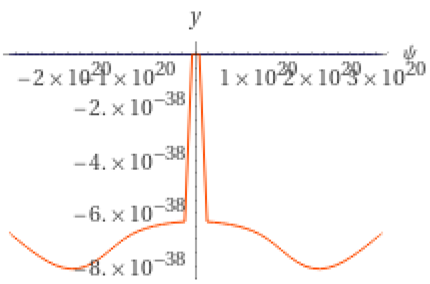
erfi(x) is the imaginary error function

i is the imaginary unit

Result

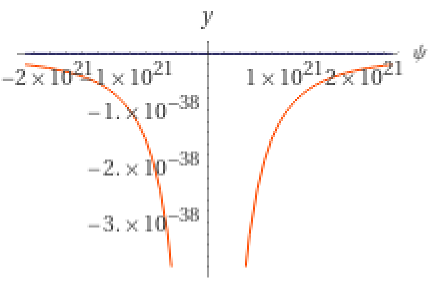
$$-\frac{(3.22618\times 10^{-17}\, i)\, e^{-8.27997\times 10^{40}/\psi^2}\operatorname{erfi}\left(\frac{2.87749\times 10^{20}}{\psi}\right)}{\psi}$$

Plots **(figures that can be related to the open strings)**



(ψ from −2.9 × 10^20 to 2.9 × 10^20)

— real part
— imaginary part



(ψ from −2.3 × 10^21 to 2.3 × 10^21)

— real part
— imaginary part

Series expansion at ψ=0

$$e^{-9.67141\times10^{24}/\psi^2}\left(-6.32555\times10^{-38}\,i+O\left(\psi^1\right)\right)+$$
$$e^{-8.27997\times10^{40}/\psi^2}\,(-1)^{\lfloor 0.31831\arg(\psi)\rfloor}\left(-\frac{3.22618\times10^{-17}+0\,i}{\psi}+O\left(\psi^2\right)\right)$$

arg(z) is the complex argument
⌊x⌋ is the floor function

Series expansion at ψ=∞

$$-\frac{10\,475.1\,i}{\psi^2}+\frac{5.78222\times10^{44}\,i}{\psi^4}+O\left(\left(\frac{1}{\psi}\right)^6\right)$$

(Laurent series)

Derivative

$$\frac{d}{d\psi}\left(-\frac{1}{\psi}\left(3.22618\times10^{-17}\,i\right)e^{-82\,799\,710\,781\,304\,816\,736\,432\,268\,844\,747\,244\,699\,648/\psi^2}\operatorname{erfi}\left(\frac{287\,749\,388\,846\,101\,299\,200}{\psi}\right)\right)=$$
$$\frac{1}{\psi^4}\left(e^{-82\,799\,710\,781\,304\,816\,736\,432\,268\,844\,747\,244\,699\,648/\psi^2}\left(\left(3.22618\times10^{-17}\,i\right)\psi^2-5\,342\,527\,468\,767\,408\,105\,193\,472\,i\right)\operatorname{erfi}\left(\frac{287\,749\,388\,846\,101\,299\,200}{\psi}\right)+\left(10\,475.1\,i\right)e^{-9\,671\,406\,556\,917\,033\,397\,649\,408/\psi^2}\,\psi\right)$$

(1.0545718e-34) + (i (1.0545718e-34)^2*125.35^2)/(3*6.62607e-34)

Input interpretation

$$1.0545718\times10^{-34}+\frac{i\left(1.0545718\times10^{-34}\right)^2\times125.35^2}{3\times6.62607\times10^{-34}}$$

i is the imaginary unit

Result

$1.05457\ldots \times 10^{-34} +$
$8.79071\ldots \times 10^{-32}\, i$

Alternate complex forms

$1.05457\times 10^{-34} + 8.79071\times 10^{-32}\, i$

$8.79071\times 10^{-32}\,(\cos(1.5696) + i \sin(1.5696))$

$8.79071\times 10^{-32}\, e^{1.5696\, i}$

Polar coordinates

$r = 8.79071\times 10^{-32}$ (radius), $\theta = 1.5696$ (angle)

$8.79071*10^{-32}$

- ((1.0545718e-34)^3 (9 (6.62607e-34) ψ^2 + 4 125.35^4))/(54 (6.62607e-34)^2) - (i (1.0545718e-34)^4 125.35^2 (27 (6.62607e-34) ψ^2 + 4 125.35^4))/(324 (6.62607e-34)^3) + ((1.0545718e-34)^5)

Input interpretation

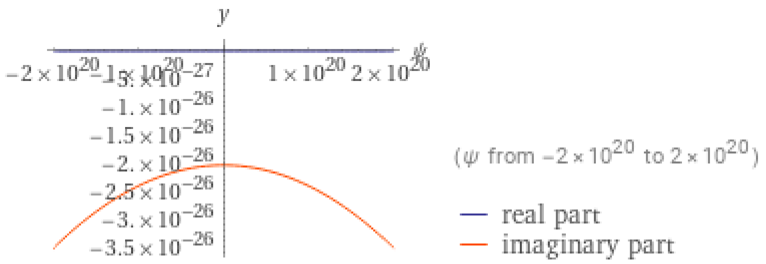
$$-\frac{(1.0545718\times 10^{-34})^3\,(9\times 6.62607\times 10^{-34}\,\psi^2 + 4\times 125.35^4)}{54\,(6.62607\times 10^{-34})^2} - \frac{i\,(1.0545718\times 10^{-34})^4\times 125.35^2\,(27\times 6.62607\times 10^{-34}\,\psi^2 + 4\times 125.35^4)}{324\,(6.62607\times 10^{-34})^3} + (1.0545718\times 10^{-34})^5$$

i is the imaginary unit

Result

$$-4.94678\times 10^{-38}\,(5.96346\times 10^{-33}\,\psi^2 + 9.87546\times 10^{8}) - (2.06177\times 10^{-35}\, i)\,(1.78904\times 10^{-32}\,\psi^2 + 9.87546\times 10^{8}) + 1.30431\times 10^{-170}$$

Plot **(figure that can be related to an open string)**



Alternate forms

$$4.94678\times10^{-38}\left(-5.96346\times10^{-33}\,\psi^2-9.87546\times10^{8}\right)-\left(2.06177\times10^{-35}\,i\right)\left(1.78904\times10^{-32}\,\psi^2+9.87546\times10^{8}\right)+1.30431\times10^{-170}$$

$$-i\left(\left(3.68859\times10^{-67}-2.94999\times10^{-70}\,i\right)\psi^2+\left(2.03609\times10^{-26}-4.88517\times10^{-29}\,i\right)\right)$$

$$\left(\left(4.29281\times10^{-34}-4.29624\times10^{-34}\,i\right)\psi-\left(1.01019\times10^{-13}+1.00777\times10^{-13}\,i\right)\right)\left(\left(4.29281\times10^{-34}-4.29624\times10^{-34}\,i\right)\psi+\left(1.01019\times10^{-13}+1.00777\times10^{-13}\,i\right)\right)$$

Expanded form

$$\left(-2.94999\times10^{-70}-3.68859\times10^{-67}\,i\right)\psi^2-\left(4.88517\times10^{-29}+2.03609\times10^{-26}\,i\right)$$

Alternate form assuming ψ is real

$$-2.94999\times10^{-70}\,\psi^2+i\left(-3.68859\times10^{-67}\,\psi^2-2.03609\times10^{-26}\right)-4.88517\times10^{-29}$$

Complex roots

$$\psi=-187\,901\,077\,611\,419\,168-234\,946\,617\,571\,230\,613\,504\,i$$

$$\psi=187\,901\,077\,611\,419\,168+234\,946\,617\,571\,230\,613\,504\,i$$

Polynomial discriminant

$$\Delta=3.00412\times10^{-92}-9.61034\times10^{-95}\,i$$

Property as a function
Parity

even

Derivative

$$\frac{d}{d\psi}\left(-4.94678\times10^{-38}\left(5.96346\times10^{-33}\,\psi^2+9.87546\times10^{8}\right)-\left(2.06177\times10^{-35}\,i\right)\left(1.78904\times10^{-32}\,\psi^2+9.87546\times10^{8}\right)+1.30431\times10^{-170}\right)=\left(-5.89999\times10^{-70}-7.37717\times10^{-67}\,i\right)\psi$$

Indefinite integral

$$\int\left(1.30431\times10^{-170}-4.94678\times10^{-38}\left(9.87546\times10^{8}+5.96346\times10^{-33}\,\psi^2\right)-\left(2.06177\times10^{-35}\,i\right)\left(9.87546\times10^{8}+1.78904\times10^{-32}\,\psi^2\right)\right)d\psi=\left(-9.83331\times10^{-71}-1.22953\times10^{-67}\,i\right)\psi^3-\left(4.88517\times10^{-29}+2.03609\times10^{-26}\,i\right)\psi+\text{constant}$$

For

ψ = (2.3+4.8+2.3+4.8+2.3+4.8+2.3+ 4.8+2.3+4.8+2.3 +4.8 +0.511+0.511+5e-8+5e-8)*3

we obtain:

Input interpretation

$$(2.3+4.8+2.3+4.8+2.3+4.8+2.3+4.8+2.3+4.8+2.3+4.8+0.511+0.511+5\times10^{-8}+5\times10^{-8})\times3$$

Result

130.8660003

130.866

From the above three partial results, we obtain:

-((3.22618×10^-17 i) e^(-8.27997×10^40/(130.866)^2) erf*i*((2.87749×10^20)/(130.866)))/(130.866)+8.79071×10^-32

Input interpretation

$$-\frac{(3.22618\times 10^{-17}\, i)\exp\left(-\frac{8.27997\times 10^{40}}{130.866^2}\right)\left(\text{erf}(x)\, i\times\frac{2.87749\times 10^{20}}{130.866}\right)}{130.866}+8.79071\times 10^{-32}$$

erf(x) is the error function
i is the imaginary unit

Result
8.79071×10^{-32}
$8.79071*10^{-32}$

8.79071*10^-32-4.94678×10^-38 (5.96346×10^-33 (130.866)^2 + 9.87546×10^8) - (2.06177×10^-35 i) (1.78904×10^-32 (130.866)^2 + 9.87546×10^8) + 1.30431×10^-170

Input interpretation

$$8.79071\times 10^{-32}-4.94678\times 10^{-38}\left(5.96346\times 10^{-33}\times 130.866^2+9.87546\times 10^8\right)-\left(2.06177\times 10^{-35}\, i\right)\left(1.78904\times 10^{-32}\times 130.866^2+9.87546\times 10^8\right)+\frac{1.30431}{10^{170}}$$

i is the imaginary unit

Result

$$-4.87638\ldots\times 10^{-29}-2.03609\ldots\times 10^{-26}\, i$$

Alternate complex forms

$$2.0361\times 10^{-26}\left(\cos(-1.57319)+i\sin(-1.57319)\right)$$

$$2.0361\times 10^{-26}\, e^{-1.57319\, i}$$

Polar coordinates

$r = 2.0361\times10^{-26}$ (radius), $\theta = -1.57319$ (angle)

$2.0361*10^{-26}$ final result

From which, after some calculations:

(ln(8.79071*10^-32-4.94678×10^-38 (5.96346×10^-33 (130.866)^2 + 9.87546×10^8) - (2.06177×10^-35 i) (1.78904×10^-32 (130.866)^2 + 9.87546×10^8) + 1.30431×10^-170)-5+MRB const)^2+φ

Input interpretation

$$\left(\log\left(8.79071\times10^{-32} - 4.94678\times10^{-38}\left(5.96346\times10^{-33}\times130.866^2 + 9.87546\times10^8\right) - \left(2.06177\times10^{-35}\,i\right)\left(1.78904\times10^{-32}\times130.866^2 + 9.87546\times10^8\right) + \frac{1.30431}{10^{170}}\right) - 5 + C_{\mathrm{MRB}}\right)^2 + \phi$$

$\log(x)$ is the natural logarithm
i is the imaginary unit
C_{MRB} is the MRB constant
ϕ is the golden ratio

Result

$4091.089\ldots +$
$201.2688\ldots\, i$

Alternate complex forms

$4091.09 + 201.269\, i$

$4096.04\,(\cos(0.0491572) + i\sin(0.0491572))$

$4096.04\, e^{0.0491572\, i}$

Polar coordinates

$r = 4096.04$ (radius), $\theta = 0.0491572$ (angle)

$4096.04 \approx 4096 = 64^2$, that multiplied by 2 give 8192, indeed:

The total amplitude vanishes for gauge group SO(8192), while the vacuum energy is negative and independent of the gauge group.
The vacuum energy and dilaton tadpole to lowest non-trivial order for the open bosonic string. While the vacuum energy is non-zero and independent of the gauge group, the dilaton tadpole is zero for a unique choice of gauge group, SO(2^{13}) i.e. SO(8192). (From: "Dilaton Tadpole for the Open Bosonic String " Michael R. Douglas and Benjamin Grinstein - September 2,1986)

and also:

27sqrt((ln(8.79071*10^-32-4.94678×10^-38 (5.96346×10^-33 (130.866)^2 + 9.87546×10^8) - (2.06177×10^-35 i) (1.78904×10^-32 (130.866)^2 + 9.87546×10^8) + 1.30431×10^-170)-5+MRB const)^2+φ)+1

Input interpretation

$$27 \sqrt{\left(\left(\log\left(8.79071 \times 10^{-32} - 4.94678 \times 10^{-38} \left(5.96346 \times 10^{-33} \times 130.866^2 + 9.87546 \times 10^8\right) - \left(2.06177 \times 10^{-35}\, i\right)\left(1.78904 \times 10^{-32} \times 130.866^2 + 9.87546 \times 10^8\right) + \frac{1.30431}{10^{170}}\right) - 5 + C_{\text{MRB}}\right)^2 + \phi\right)} + 1$$

log(x) is the natural logarithm
i is the imaginary unit
C_{MRB} is the MRB constant
ϕ is the golden ratio

Result

1728.486… +
42.46777… i

Alternate complex forms

$1729.01\,(\cos(0.0245644) + i\,\sin(0.0245644))$

$1729.01\,e^{0.0245644\,i}$

Polar coordinates

$r = 1729.01$ (radius), $\theta = 0.0245644$ (angle)

1729.01

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 ($1728 = 8^2 * 3^3$). The number 1728 is one less than the Hardy–Ramanujan number 1729 (taxicab number)

(27sqrt((ln(8.79071e-32-4.94678e-38(5.96346e-33(130.866)^2+9.87546e+8)-(2.06177e-35i)(1.78904e-32(130.866)^2+9.87546e+8)+1.30431e-170)-5+MRB const)^2+φ)+1)^1/15+(MRB const)^(1-1/(4π)+π)

Input interpretation

$$\left(27\sqrt{\left(\left(\log\left(8.79071\times10^{-32} - 4.94678\times10^{-38}\left(5.96346\times10^{-33}\times130.866^2 + 9.87546\times10^8\right) - \left(2.06177\times10^{-35}\,i\right)\left(1.78904\times10^{-32}\times130.866^2 + 9.87546\times10^8\right) + \frac{1.30431}{10^{170}}\right) - 5 + C_{\text{MRB}}\right)^2 + \phi\right) + 1}\right)\,\hat{}\,(1/15) + C_{\text{MRB}}^{\,1-1/(4\pi)+\pi}$$

log(x) is the natural logarithm
i is the imaginary unit
C_{MRB} is the MRB constant
ϕ is the golden ratio

Result

$1.6449363\ldots +$
$0.0026919562\ldots\,i$

Alternate complex forms

$1.64494\,(\cos(0.00163651) + i\,\sin(0.00163651))$

$1.64494\,e^{0.00163651\,i}$

Polar coordinates

$r = 1.64494$ (radius), $\theta = 0.00163651$ (angle)

$1.64494 \approx \zeta(2) = \pi^2/6 = 1.644934$ (trace of the instanton shape)

References

“Path Integral for Gravity” – 6 giu 2021- Online workshop-2021: Quantum Gravity and Cosmology - ***Neil Turok* (U. of Edinburgh)**