I) $\displaystyle \int_0^\infty x^{\alpha-1} \exp\left(-\alpha x - \frac{1}{x}\right) dx = I_a$ (1)

▸ $\exp(z) = \sum_{n\geq 0} \frac{z^n}{n!}$; $\exp\left(-\alpha x - \frac{1}{x}\right) = \sum_{n\geq 0} \phi_n \left(\alpha x + \frac{1}{x}\right)^n$

▸ $\left(\alpha x + \frac{1}{x}\right)^n = \left(\frac{1}{x}\right)^n \underbrace{(\alpha x^2 + 1)^n}_{\text{poly-binomio 1}}$

poly-bin 1) $(\alpha x^2+1)^n = \sum_{i\geq 0}\sum_{j\geq 0} \phi_i \phi_j \, \alpha^i x^{2i} \frac{\langle -n+i+j\rangle}{\Gamma(-n)}$

en la integral:

$I_a = \int_0^\infty x^{\alpha-1} x^{-n} \sum_{n\geq 0}\phi_n \sum_{i,j\geq 0} \phi\phi \, \alpha^i x^{2i} \frac{\langle -n+i+j\rangle}{\Gamma(-n)}$

$= \sum_{i,j,n\geq 0} \phi \, \langle \alpha - n + 2i\rangle \alpha^i \langle i+j-n\rangle \frac{1}{\Gamma(-n)}$

solución con i libre

$I_{\alpha_i} = \sum_i \phi \; \Gamma(-n)\Gamma(-j) \frac{\alpha^i}{\Gamma(-n)}$ $n = -\alpha - 2i$; $j = n - i = -\alpha - 3i$

$$\boxed{I_{\alpha_i} = \sum_i \phi \; \Gamma(\cancel{\alpha+2i}) \frac{\Gamma(-\alpha-3i)}{\Gamma(\cancel{\alpha+2i})} \alpha^i}$$

solución j libre

det: $-2+1 = -1$; $|\det(A)| = 1$

$I_{\alpha_j} = \sum_{j\geq 0} \phi \; \frac{\cancel{\Gamma(-n)}}{\cancel{\Gamma(-n)}} \Gamma(-i) \alpha^i$

$$\overbrace{\begin{pmatrix} 2 & -1 \\ 1 & -1 \end{pmatrix}}^{A} \begin{pmatrix} i \\ n \end{pmatrix} = \begin{pmatrix} -\alpha \\ -j \end{pmatrix}$$

$\Downarrow$

$i = j - \alpha$

$n = 2j - \alpha$

$$\boxed{I_{\alpha_j} = \sum_{j\geq 0} \phi \; \Gamma(\alpha - j) \, \alpha^{(j-\alpha)}}$$

$$\boxed{I_{\alpha_n} = \frac{\ldots}{\Gamma(-n)} = 0}$$ nula.

$$\mathrm{I)}\quad \int_0^\infty x^{\alpha-1} \exp\left(-\alpha x - \frac{1}{x}\right) dx = I_a$$ (1)

▷ $\exp(z) = \sum_{n\geq 0} \frac{z^n}{n!}$; $\exp(-\alpha x - \frac{1}{x}) = \sum_{n\geq 0} \phi_n \left(\alpha x + \frac{1}{x}\right)^n$

▷ $\left(\alpha x + \frac{1}{x}\right)^n = \left(\frac{1}{x}\right)^n \underbrace{\left(\alpha x^2 + 1\right)^n}_{\text{poly-binomio } 1}$

poly-bin 1) $(\alpha x^2+1)^n = \sum_{i\geq 0}\sum_{j\geq 0} \phi_i \phi_j \, \alpha^i x^{2i} \frac{\langle -n+i+j\rangle}{\Gamma(-n)}$

en la integral:

$$I_a = \int_0^\infty x^{\alpha-1} x^{-n} \sum_{n\geq 0} \phi_n \sum_{i,j\geq 0} \phi_{ij} \, \alpha^i x^{2i} \frac{\langle -n+i+j\rangle}{\Gamma(-n)}$$

$$= \sum_{i,j,n\geq 0} \phi \, \langle \alpha - n + 2i\rangle \alpha^i \langle i+j-n\rangle \frac{1}{\Gamma(-n)}$$

solución con i libre

solución con i libre

$$I_{\alpha_i} = \sum_i \phi \; \Gamma(-n)\Gamma(-j) \frac{\alpha^i}{\Gamma(-n)} \quad \Bigg| \quad \begin{array}{l} n = -\alpha - 2i \\ j = n - i = -\alpha - 3i \end{array}$$

$$\boxed{I_{\alpha_i} = \sum_i \phi \; \cancel{\Gamma(\alpha + 2i)} \frac{\Gamma(-\alpha - 3i)}{\cancel{\Gamma(\alpha + 2i)}} \alpha^i}$$

solución j libre

$$I_{\alpha_j} = \sum_{j \geq 0} \phi \; \frac{\cancel{\Gamma(-n)}}{\cancel{\Gamma(-n)}} \Gamma(-i)\, \alpha^i$$

det

$-2+1 = -1 \quad |\det(A)| = 1$

$$\overbrace{\begin{pmatrix} 2 & -1 \\ 1 & -1 \end{pmatrix}}^{A} \begin{pmatrix} i \\ n \end{pmatrix} = \begin{pmatrix} -\alpha \\ -j \end{pmatrix}$$

$\Downarrow$

$$\begin{array}{l} i = j - \alpha \\ n = 2j - \alpha \end{array}$$

$$\boxed{I_{\alpha_j} = \sum_{j \geq 0} \phi \; \Gamma(\alpha - j)\, \alpha^{j-\alpha}}$$

$$\boxed{I_{\alpha_n} = \frac{1 \ldots}{\Gamma(-n)} = 0} \quad \text{nula}$$

I 2) $\displaystyle\int_0^\infty x^{\alpha-1} \exp\left(-\alpha x^2 - \frac{1}{x^2}\right) dx = I_\beta$

$$\exp\left(-\alpha x^2 - \frac{1}{x^2}\right) = \sum_{n\geq 0} \phi_n \left(\alpha x^2 + \frac{1}{x^2}\right)^n$$

$$\left(\alpha x^2 + \frac{1}{x^2}\right)^n = \left(\left(\frac{1}{x^2}\right)\left(\alpha x^4 + 1\right)\right)^n = x^{-2n} \underbrace{\left(\alpha x^4 + 1\right)^n}$$

$$= x^{-2n} \sum_{i\geq 0} \left(\alpha x^4\right)^i (-n)_i \phi_i$$

así: $\displaystyle \exp(\ldots) = \sum_{i,n} \sum \phi_n \phi_i \, x^{-2n}$

$$\ldots \alpha^i x^{4i} (-n)_i$$

$$I_\beta = \sum_{i,n} \phi \left\langle -2n + 4i + \alpha \right\rangle \alpha^i (-n)_i$$

$$\frac{1}{2}\left\langle -n + 2i + \frac{\alpha}{2} \right\rangle$$

i libre: $\displaystyle I_{\beta i} = \sum_i \phi_i \, \frac{\Gamma(-n)}{2} \alpha^i (-n)_i \Big|_{n = 2i + \frac{\alpha}{2}}$

$$I_{\beta i} = \sum_i \phi_i \, \frac{\Gamma\left(2i + \frac{\alpha}{2}\right)}{2} \alpha^i \underbrace{\left(2i + \frac{\alpha}{2}\right)_i}$$

$$I_{\beta i} = \sum_i \phi \, \frac{\alpha^i}{2} \Gamma\left(3i + \frac{\alpha}{2}\right) \qquad \frac{\Gamma\left(3i + \frac{\alpha}{2}\right)}{\Gamma\left(2i + \frac{\alpha}{2}\right)}$$

n libre: $\displaystyle I_{\beta n} = \sum_{n\geq 0} \phi \, \frac{\Gamma(-i)}{4} \alpha^i (-n)_i \Big|_{i = \frac{n}{2} - \frac{\alpha}{4}}$

$$I_{\beta n} = \sum_{n\geq 0} \phi \, \frac{\Gamma\left(\frac{n}{2} - \frac{\alpha}{4}\right)}{4} \frac{\alpha^{\frac{n}{2}}}{\alpha^{\frac{\alpha}{4}}} \frac{\Gamma\left(-\frac{n}{2} - \frac{\alpha}{4}\right)}{\Gamma(-n)}$$

provoca solución nula

$$\boxed{I = I_{\beta i} = \sum_i \phi \, \frac{\alpha^i}{2} \Gamma\left(3i + \frac{\alpha}{2}\right)}$$

$$I_2) \int_0^\infty x^{\alpha-1} \exp\left(-\alpha x^2 - \frac{1}{x^2}\right) dx = I_p$$

②

$$\exp\left(-\alpha x^2 - \frac{1}{x^2}\right) = \sum_{n\geq 0} \phi_n \left(\alpha x^2 + \frac{1}{x^2}\right)^n$$

$$\left(\alpha x^2 + \frac{1}{x^2}\right)^n = \left(\left(\frac{1}{x^2}\right)\left(\alpha x^4 + 1\right)\right)^n = x^{-2n} \underbrace{(\alpha x^4 + 1)^n}$$

$$= x^{-2n} \sum_{i\geq 0} (\alpha x^4)^i (-n)_i \phi_i$$

así $\exp(\dots) = \sum_{i,n} \sum \phi_n \phi_i \, x^{-2n}$

$$\cdot\, \alpha^i x^{4i} (-n)_i$$

$$I_p = \sum_{i,n} \phi \langle -2n + 4i + \alpha \rangle \alpha^i (-n)_i$$

$$\frac{1}{2}\left\langle -n + 2i + \frac{\alpha}{2} \right\rangle$$

i libre: $I_{pi} = \sum_i \phi_i \dfrac{\Gamma(-n)}{2} \alpha^i (-n)_i \Big|_{n = 2i + \frac{\alpha}{2}}$

$$I_{pi} = \sum_i \phi_i \frac{\Gamma\left(2i + \frac{\alpha}{2}\right)}{2} \alpha^i \underbrace{\left(2i + \frac{\alpha}{2}\right)_i}$$

$$\frac{\Gamma\left(3i + \frac{\alpha}{2}\right)}{\Gamma\left(2i + \frac{\alpha}{2}\right)}$$

$$I_{pi} = \sum_i \phi \cdot \frac{\alpha^i}{2} \Gamma\left(3i + \frac{\alpha}{2}\right)$$

n libre: $I_{pn} = \sum \phi \; \Gamma(-i) \, \alpha^i (-n)_i \;|$

así $\exp(\ldots) = \sum_{i,n} \sum \phi_n \phi_i \; x^{-2n}$ $i \geq 0$

$\therefore \alpha^i x^{4i} (-n)_i$

$$I_\beta = \sum_{i,n} \phi \langle -2n + 4i + \alpha \rangle \alpha^i (-n)_i$$

$\frac{1}{2}\langle -n + 2i + \frac{\alpha}{2} \rangle$

i libre: $I_{\beta i} = \sum_i \phi_i \frac{\Gamma(-n)}{2} \alpha^i (-n)_i \Big|_{n = 2i + \frac{\alpha}{2}}$

$$I_{\beta i} = \sum_i \phi_i \frac{\Gamma(2i + \frac{\alpha}{2})}{2} \alpha^i \underbrace{\left(2i + \frac{\alpha}{2}\right)_i}_{\frac{\Gamma(3i + \frac{\alpha}{2})}{\Gamma(2i + \frac{\alpha}{2})}}$$

$$I_{\beta i} = \sum_i \phi \frac{\alpha^i}{2} \Gamma\left(3i + \frac{\alpha}{2}\right)$$

n libre: $I_{\beta n} = \sum_{n \geq 0} \phi \frac{\Gamma(-i)}{4} \alpha^i (-n)_i \Big|_{i = \frac{n}{2} - \frac{\alpha}{4}}$

$$I_{\beta n} = \sum_{n \geq 0} \phi \frac{\Gamma(\frac{n}{2} - \frac{\alpha}{4})}{4} \frac{\alpha^{\frac{n}{2}}}{\alpha^{\frac{\alpha}{4}}} \frac{\Gamma(-\frac{n}{2} - \frac{\alpha}{4})}{\Gamma(-n)}$$

provoca solución nula

$$\boxed{I = I_{\beta i} = \sum_i \phi \frac{\alpha^i}{2} \Gamma\left(3i + \frac{\alpha}{2}\right)}$$

Escaneado con CamScanner

③

$$\mathbb{I} = \int_0^\infty J_\nu\left(\frac{\alpha}{x}\right) J_\nu(bx)\,dx$$

$$J_\nu\left(\frac{\alpha}{x}\right) = \left(\frac{\alpha}{2x}\right)^\nu \frac{1}{\Gamma(1+\nu)}\, {}_0F_1\left(\begin{matrix} - \\ 1+\nu \end{matrix} \middle| -\frac{\alpha^2}{4x^2}\right)$$

$$J_\nu(bx) = \left(\frac{bx}{2}\right)^\nu \frac{1}{\Gamma(1+\nu)}\, {}_0F_1\left(\begin{matrix} - \\ 1+\nu \end{matrix} \middle| -\frac{b^2x^2}{4}\right)$$

$$\mathbb{I} = \int_0^\infty \frac{\alpha^\nu b^\nu}{4^\nu} \frac{1}{(\Gamma(1+\nu))^2} \sum_{i\geq 0} \frac{1}{(1+\nu)_i} \phi_i \frac{\alpha^{2i}}{4^i x^{2i}} \sum_{j\geq 0} \frac{1}{(1+\nu)_j} \phi_j \frac{b^{2j} x^{2j}}{4^j}\,dx$$

$$\mathbb{I} = \sum_{i,j>0} \phi_i \phi_j \frac{\alpha^{\nu+2i} b^{\nu+2j}}{4^{\nu+i+j}} \frac{1}{\cancel{(\Gamma(1+\nu))^2}} \frac{\cancel{\Gamma(1+\nu)}}{\Gamma(1+\nu+i)} \frac{\cancel{\Gamma(1+\nu)}}{\Gamma(1+\nu+j)} \underbrace{\int_0^\infty x^{2j-2i+1-1}\,dx}_{\frac{1}{2}\left\langle \cancel{2}j - \cancel{2}i + \frac{1}{2}\right\rangle}$$

resolviendo i dejo j libre

$$i = j + \frac{1}{2} \quad\downarrow\quad j = i - \frac{1}{2}$$

$$\mathbb{I}_j = \sum_{j\geq 0} \phi \frac{\alpha^{\nu+2j+1}}{2} \frac{b^{\nu+2j}}{4^{\nu+2j+\frac{1}{2}}} \frac{\Gamma\left(-j-\frac{1}{2}\right)}{\Gamma\left(1+\nu+j+\frac{1}{2}\right)\Gamma(1+\nu+j)} \quad A$$

resolv j dejo i libre

soluciones

$$\mathbb{I}_i = \sum_{i\geq 0} \phi \frac{\alpha^{\nu+2i}}{2} \frac{b^{\nu+2i-2}}{4^{\nu+2i-\frac{1}{2}}} \frac{\Gamma\left(\frac{1}{2}+i\right)}{\Gamma(1+\nu+i)\,\Gamma\left(1+\nu+i-\frac{1}{2}\right)}$$

//

III $\exp(xM^2) = \sum_{i\geq 0} \frac{x^i M^{2i}}{i!}$; $\exp(yM^2) = \sum_{j\geq 0} \frac{y^j M^{2j}}{j!}$

(4)

$$\exp\left(-\frac{xy}{x+y}p^2\right) = \sum_{k\geq 0} \phi_k (xy)^k p^{2k} (x+y)^{-k}$$

2 brackets y 3 sumatorias , veamos por juntar polinomio

$$(x+y)^{-k}(x+y)^{-\frac{p}{2}} = \sum_{\gamma\geq 0}\phi_\gamma \sum_{\zeta\geq 0}\phi_\zeta\, x^\gamma y^\zeta \frac{\langle \frac{p}{2}+k+\gamma+\zeta\rangle}{\Gamma(\frac{p}{2}+k)}$$

+ 2 sum
+ 1 brac

entonces III $= \iint_0^\infty \sum_{i,j,k,\gamma,\zeta} \phi$ 5 sumatorias : $\binom{5}{2}$ forma una
2 brackets

idea
juntar las exponenciales primero $\exp(xM^2)\exp(yM^2)\exp\left(-\frac{xy}{x+y}p^2\right)$

$\exp(M^2(x+y)) = \sum_{i\geq 0} M^{2i}(x+y)^i$ (1) ; $\exp\left(-\frac{xy}{x+y}p^2\right) = \sum_{k\geq 0}\phi\, \frac{x^k y^k p^{2k}}{(x+y)^k}$ (2)

multinomio que ya requerimos expandir

ahora juntar $(x+y)^{\cdot\cdot} \to \frac{1}{(x+y)^{-i+k+\frac{p}{2}}} = \sum_{\gamma,\zeta\geq 0}\phi\, x^\gamma y^\zeta \frac{\langle -i+k+\frac{p}{2}+\gamma+\zeta\rangle}{\Gamma(-i+k+\frac{p}{2})}$

en buen

(3)

bracket de x bracket de y

$$\boxed{\text{III} = \sum_{i,k,\gamma,\zeta}\phi\, M^{2i} p^{2k} \frac{\langle k-i+\frac{p}{2}+\gamma+\zeta\rangle}{\Gamma(k-i+\frac{p}{2})} \langle \alpha+k+\gamma\rangle\langle\beta+k+\zeta\rangle}$$

1) serie de brackets equivalente

ver $\#_3$ para matrices útiles

(*3)

III 2) Matrices para distintos casos

$$\overset{A}{\begin{pmatrix} \cdot \\ \cdot \end{pmatrix}} \overset{Var}{\begin{pmatrix} x \\ y \\ z \end{pmatrix}} = \overset{Conste}{\begin{pmatrix} \cdot \\ \cdot \end{pmatrix}}$$

i libre

$$\underset{m_i}{\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}} \cdot \underset{V_i}{\begin{pmatrix} k \\ \gamma \\ \zeta \end{pmatrix}} = \underset{c_i}{\begin{pmatrix} i - \frac{p}{2} \\ -\alpha \\ -\beta \end{pmatrix}} \qquad |\det(A)| = 1$$

k libre

$$\underset{m_k}{\begin{pmatrix} -1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{pmatrix}} \cdot \underset{V_k}{\begin{pmatrix} i \\ \gamma \\ \zeta \end{pmatrix}} = \underset{C_k}{\begin{pmatrix} -\frac{p}{2} - k \\ -\alpha - k \\ -\beta - k \end{pmatrix}} \qquad |\det(A)| = 0$$

γ libre

$$\underset{m_\gamma}{\begin{pmatrix} -1 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \end{pmatrix}} \cdot \underset{V_\gamma}{\begin{pmatrix} i \\ k \\ \zeta \end{pmatrix}} = \underset{C_\gamma}{\begin{pmatrix} -\frac{p}{2} - \gamma \\ -\alpha - \gamma \\ -\beta \end{pmatrix}} \qquad |\det(A)| = 1$$

ζ libre

$$\underset{m_\zeta}{\begin{pmatrix} -1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 1 & 0 \end{pmatrix}} \cdot \underset{V_\zeta}{\begin{pmatrix} i \\ k \\ \gamma \end{pmatrix}} = \underset{C_\zeta}{\begin{pmatrix} -\frac{p}{2} - \zeta \\ -\alpha \\ -\beta - \zeta \end{pmatrix}} \qquad |\det A| = 1$$

Soluciones

i libre
$$k = \frac{p}{2} - i - \alpha - \beta$$
$$\gamma = \frac{1}{2}(2i - p + 2\beta)$$
$$\zeta = \frac{1}{2}(2i - p + 2\alpha)$$

k libre

no solution
$\det(m_i) = 0$

γ libre
$$i = \frac{p}{2} - \beta + \gamma$$
$$k = -\alpha - \gamma$$
$$\zeta = \alpha - \beta + \gamma$$

ζ libre
$$i = \frac{p}{2} - \alpha + \zeta$$
$$k = -\beta - \zeta$$
$$\gamma = -\alpha + \beta + \zeta$$

solución i libre

$$\text{II}_i = \sum_{i\geq 0} \phi_i \frac{\Gamma\left(-i-\alpha+\frac{P}{2}\right)\Gamma\left(-i-\beta+\frac{P}{2}\right)\Gamma\left(i+\alpha+\beta-\frac{P}{2}\right)}{\Gamma\left(-2i+P-\alpha-\beta\right)} \frac{M^{2i}}{p^{2i}}$$

$$\cdot\cdot \frac{p^P}{p^\alpha p^\beta}$$ constante definida por cond. de borde

$$\Gamma\left(-i-\alpha+\tfrac{P}{2}\right) = \frac{\Gamma\left(\frac{P}{2}-\alpha\right)}{\left(\frac{P}{2}-\alpha\right)_i}$$

$$\hookrightarrow = \Gamma\left(\tfrac{P}{2}-\alpha\right)\frac{(-1)^i}{\left(1+\alpha-\frac{P}{2}\right)_i}$$

$$\Gamma\left(i+\alpha+\beta-\tfrac{P}{2}\right) = \left(\alpha+\beta-\tfrac{P}{2}\right)_i \Gamma\left(\alpha+\beta-\tfrac{P}{2}\right)$$

$$\Gamma\left(-i-\beta+\tfrac{P}{2}\right) = \Gamma\left(\tfrac{P}{2}-\beta\right)\frac{(-1)^i}{\left(1+\beta-\frac{P}{2}\right)_i}$$

$$\left(\Gamma\left(-2i+P-\alpha-\beta\right)\right)^{-1} = \left(\frac{\Gamma(P-\alpha-\beta)}{(P-\alpha-\beta)_{2i}}\right)^{-1}$$

$$\hookrightarrow = \left(\Gamma(P-\alpha-\beta)\frac{(-1)^{2i}}{(1-P+\alpha+\beta)_{2i}}\right)^{-1}$$

$$(\underbrace{1-P+\alpha+\beta}_{z})_{2i} = \left(4^i\left(\tfrac{z}{2}\right)_i\left(\tfrac{z}{2}+\tfrac{1}{2}\right)_i\right)^{-1}$$

Para notar algo

$$\frac{\Gamma\left(-i-\alpha+\frac{P}{2}\right)\Gamma\left(-i-\beta+\frac{P}{2}\right)}{\Gamma\left(-2i-\alpha-\beta+P\right)} = B\left(-i-\alpha+\tfrac{P}{2}, -i-\beta+\tfrac{P}{2}\right)$$

sin embargo solo hay o halle representaciones hipergeometrica para la beta incompleta

---

$$\text{II}_i = \sum_{i\geq 0}\phi_i \, p^{P-\alpha-\beta}\frac{\Gamma\left(\frac{P}{2}-\alpha\right)\Gamma\left(\frac{P}{2}-\beta\right)\Gamma\left(\alpha+\beta-\frac{P}{2}\right)}{\Gamma(P-\alpha-\beta)} \frac{\left(\alpha+\beta-\frac{P}{2}\right)_i}{\left(1+\alpha-\frac{P}{2}\right)_i\left(1+\beta-\frac{P}{2}\right)_i}\left(-4\frac{M^2}{p^2}\right)^i$$

$$\text{II} = p^{P-\alpha-\beta}\frac{\Gamma\left(\frac{P}{2}-\alpha\right)\Gamma\left(\frac{P}{2}-\beta\right)\Gamma\left(\alpha+\beta-\frac{P}{2}\right)}{\Gamma(P-\alpha-\beta)}\, {}_3F_2\left(\left.\begin{matrix}\alpha+\beta-\frac{P}{2}, z, g\\ 1+\alpha-\frac{P}{2}, 1+\beta-\frac{P}{2}\end{matrix}\right| -\frac{4M^2}{p^2}\right)$$

$$(z, g) = \left(\frac{1-P+\alpha+\beta}{2}, 1+\frac{\alpha+\beta-P}{2}\right)$$

${}_{2+1}F_2$ converge para $\left|\frac{4M^2}{p^2}\right| < 1$

$$\hookrightarrow 1 < \left|\frac{p^2}{4M^2}\right|$$

solución γ libre

$$\mathrm{III}_\gamma = \frac{M^{p-2\beta}}{p^{2\alpha}} \left(\frac{M^{2\gamma}}{p^{2\gamma}}\right) \frac{\Gamma\left(-\frac{p}{2}+\beta-\gamma\right)\Gamma\left(-\alpha+\beta-\gamma\right)\Gamma(\alpha+\gamma)}{\Gamma\left(-\alpha+\beta-2\gamma\right)} \Big/\!\!\Big/ \sum_{\gamma\geq 0}\phi$$

$$\left(\Gamma(-\alpha+\beta-2\gamma)\right)^{-1} = \left(\Gamma(\beta-\alpha)(\beta-\alpha)_{-2\gamma}\right)^{-1} = \left(\frac{\Gamma(\beta-\alpha)}{(\underbrace{1-\beta+\alpha}_{z})_{2\gamma}}\right)^{-1} = \left(\frac{\Gamma(\beta-\alpha)}{4^\gamma\left(\frac{1-\beta+\alpha}{2}\right)_\gamma\left(\frac{\alpha-\beta}{2}\right)_\gamma}\right)^{-1}$$

$$\Gamma\left(-\frac{p}{2}+\beta-\gamma\right) = \Gamma\left(-\frac{p}{2}+\beta\right)\left(\beta-\frac{p}{2}\right)_{-\gamma} = \Gamma\left(-\frac{p}{2}+\beta\right)\frac{(-1)^\gamma}{\left(1-\beta+\frac{p}{2}\right)_\gamma}$$

$$\Gamma(-\alpha+\beta-\gamma) = \Gamma(\beta-\alpha)\frac{(-1)^\gamma}{(1+\alpha-\beta)_\gamma}$$

$$\Gamma(\alpha+\gamma) = (\alpha)_\gamma\,\Gamma(\alpha)$$

$$\mathrm{III}_\gamma = \frac{M^{p-2\beta}}{p^{2\alpha}} \frac{\Gamma\left(\beta-\frac{p}{2}\right)\cancel{\Gamma(\beta-\alpha)}\,\Gamma(\alpha)}{\cancel{\Gamma(\beta-\alpha)}}\; {}_3F_2\left(\left.\begin{matrix}(\alpha),\left(\frac{1-\beta+\alpha}{2}\right),\left(\frac{\alpha-\beta}{2}\right)\\ \left(1-\beta+\frac{p}{2}\right),(1+\alpha-\beta)\end{matrix}\right| -\frac{4M^2}{p^2}\right)$$

convergencia para $\left|\frac{4M^2}{p^2}\right| < 1$

esto es posible para $M = 0$

$\mathrm{III}_\gamma = 0$ // pero $\underline{p-2\beta > 0}$

condición

solución ζ libre

$$\mathrm{III}_{\zeta} = \sum_{\zeta \geq 0} \phi \; \frac{M^{P}}{M^{\alpha} p^{+2\beta}} \left(\frac{M^2}{p^2}\right)^{\zeta} \frac{\Gamma\left(-\frac{P}{2}+\alpha\right)\left(\alpha-\frac{P}{2}\right)_{-\zeta} \cancel{\Gamma(\alpha-\beta)}\,(\alpha-\beta)_{-\zeta}\,\Gamma(\beta)(\beta)_{\zeta}}{\cancel{\Gamma(\alpha-\beta)}\,(\alpha-\beta)_{-2\zeta}}$$

$$\left((\alpha-\beta)_{-2\zeta}\right)^{-1} = 4^{\zeta}\left(\frac{1-\alpha+\beta}{2}\right)_{\zeta}\left(\frac{\beta-\alpha}{2}\right)_{\zeta}$$

$$\left(\alpha-\frac{P}{2}\right)_{-\zeta} = \frac{(-1)^{\zeta}}{\left(1-\alpha+\frac{P}{2}\right)_{\zeta}}$$

$$(\alpha-\beta)_{-\zeta} = \frac{(-1)^{\zeta}}{(1-\alpha+\beta)_{\zeta}}$$

$$\mathrm{III}_{\zeta} = \frac{M^{P-\alpha}}{p^{2\beta}}\,\Gamma\left(\alpha-\frac{P}{2}\right)\Gamma(\beta)\; F\left(\cdot \right.$$

$$\hookrightarrow \cdots {}_3F_2\left(\left.\begin{matrix}\beta,\ \left(\frac{1-\alpha+\beta}{2}\right),\ \left(\frac{\beta-\alpha}{2}\right)\\ \left(1-\alpha+\frac{P}{2}\right),\ (1-\alpha+\beta)\end{matrix}\right|\; -\frac{4M^2}{p^2}\right)$$

converge pm $\left|\frac{4M^2}{p^2}\right| < 1$

$$1 < \left|\frac{p^2}{4M^2}\right|$$