

PSALTer results panel

Wave operator and propagator

	$1^+ \sigma^{\parallel}_{\alpha\beta}$	$1^+ \sigma^{\perp}_{\alpha\beta}$	$1^+ \tau^{\parallel}_{\alpha\beta}$	$1^- \sigma^{\parallel}_{\alpha}$	$1^- \sigma^{\perp}_{\alpha}$	$1^- \tau^{\parallel}_{\alpha}$	$1^- \tau^{\perp}_{\alpha}$
$1^+ \sigma^{\parallel} \uparrow^{+\beta}$	0	$-\frac{2\sqrt{2}}{(1+k^2)(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}$	$-\frac{2i\sqrt{2}k}{(1+k^2)(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}$	0	0	0	0
$1^+ \sigma^{\perp} \uparrow^{+\beta}$	$-\frac{2\sqrt{2}}{(1+k^2)(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}$	$\frac{2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)+2k^2\theta^2\xi}{(1+k^2)^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)^2}$	$-\frac{2i k(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)+2k^2\theta^2\xi}{(1+k^2)^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)^2}$	0	0	0	0
$1^+ \tau^{\parallel} \uparrow^{+\beta}$	$\frac{2i\sqrt{2}k}{(1+k^2)(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}$	$\frac{2i k(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)+2k^2\theta^2\xi}{(1+k^2)^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)^2}$	$-\frac{2k^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)+2k^2\theta^2\xi}{(1+k^2)^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)^2}$	0	0	0	0
$1^- \sigma^{\parallel} \uparrow^{+\alpha}$	0	0	0	$\frac{768\beta_1+4k^2\xi}{-3(\mathcal{M}_{\text{Pl}})^2(24(\mathcal{M}_{\text{Pl}})^2+k^2(1+8\theta)\xi)+24\beta_1(24(\mathcal{M}_{\text{Pl}})^2)+(k+4k\theta^2\xi)}$	$-\frac{4\sqrt{2}(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi}{3(1+2k^2)(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$	0	$-\frac{8i k(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi}{3(1+2k^2)(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$
$1^- \sigma^{\perp} \uparrow^{+\alpha}$	0	0	0	$-\frac{4\sqrt{2}(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi}{3(1+2k^2)(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$	$-\frac{8(48\beta_1+18(\mathcal{M}_{\text{Pl}})^2)+(k+6k\theta^2\xi)}{3(1+2k^2)^2(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$	0	$-\frac{8i\sqrt{2}k(48\beta_1+18(\mathcal{M}_{\text{Pl}})^2)+(k+6k\theta^2\xi)}{3(1+2k^2)^2(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$
$1^- \tau^{\parallel} \uparrow^{+\alpha}$	0	0	0	0	0	0	0
$1^- \tau^{\perp} \uparrow^{+\alpha}$	0	0	0	$\frac{8i k(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi}{3(1+2k^2)(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$	$\frac{8i\sqrt{2}k(48\beta_1+18(\mathcal{M}_{\text{Pl}})^2)+(k+6k\theta^2\xi)}{3(1+2k^2)^2(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$	0	$-\frac{16k^2(48\beta_1+18(\mathcal{M}_{\text{Pl}})^2)+(k+6k\theta^2\xi)}{3(1+2k^2)^2(24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2))+k^2(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi)}$

	$1^+ \mathcal{A}^{\parallel}_{\alpha\beta}$	$1^+ \mathcal{A}^{\perp}_{\alpha\beta}$	$1^+ f^{\parallel}_{\alpha\beta}$	$1^- \mathcal{A}^{\parallel}_{\alpha}$	$1^- \mathcal{A}^{\perp}_{\alpha}$	$1^- f^{\parallel}_{\alpha}$	$1^- f^{\perp}_{\alpha}$
$1^+ \mathcal{A}^{\parallel} \uparrow^{+\beta}$	$\frac{1}{4}(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)+2k^2\theta^2\xi$	$\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{2\sqrt{2}}$	$-\frac{i k(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}{2\sqrt{2}}$	0	0	0	0
$1^+ \mathcal{A}^{\perp} \uparrow^{+\beta}$	$\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{2\sqrt{2}}$	0	0	0	0	0	0
$1^+ f^{\parallel} \uparrow^{+\beta}$	$\frac{i k(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}{2\sqrt{2}}$	0	0	0	0	0	0
$1^- \mathcal{A}^{\parallel} \uparrow^{+\alpha}$	0	0	0	$\frac{1}{72}(48\beta_1+18(\mathcal{M}_{\text{Pl}})^2)+(k+6k\theta^2\xi)$	$\frac{96\beta_1-36(\mathcal{M}_{\text{Pl}})^2-k^2(1+6\theta)\xi}{72\sqrt{2}}$	0	$-\frac{1}{72}i k(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi)$
$1^- \mathcal{A}^{\perp} \uparrow^{+\alpha}$	0	0	0	$\frac{96\beta_1-36(\mathcal{M}_{\text{Pl}})^2-k^2(1+6\theta)\xi}{72\sqrt{2}}$	$\frac{4\beta_1}{3}+\frac{k^2\xi}{144}$	0	$\frac{i(192\beta_1k+k^3\xi)}{72\sqrt{2}}$
$1^- f^{\parallel} \uparrow^{+\alpha}$	0	0	0	0	0	0	0
$1^- f^{\perp} \uparrow^{+\alpha}$	0	0	0	$\frac{1}{72}i k(-96\beta_1+36(\mathcal{M}_{\text{Pl}})^2)+k^2(1+6\theta)\xi)$	$-\frac{i(192\beta_1k+k^3\xi)}{72\sqrt{2}}$	0	$\frac{8\beta_1k^2}{3}+\frac{k^4\xi}{72}$

Spin-parity form	Covariant form	Multiplicities
$0^+ \tau^{\perp} == 0$	$\partial_\beta \partial_\alpha \tau (\Delta + \mathcal{K})^{\alpha\beta} == 0$	1
$2i k 1^- \sigma^{\perp\alpha} + 1^- \tau^{\perp\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau (\Delta + \mathcal{K})^{\beta\chi} == \hat{Q} \partial^X \partial_\beta \tau (\Delta + \mathcal{K})^{\alpha\beta} + 2 \partial_\sigma \partial^\sigma \partial_\chi \partial_\beta \sigma^{\beta\alpha\chi}$	3
$1^- \tau^{\parallel\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau (\Delta + \mathcal{K})^{\beta\chi} == \hat{Q} \partial^X \partial_\beta \tau (\Delta + \mathcal{K})^{\beta\alpha}$	3
$i k 1^+ \sigma^{\perp\alpha\beta} + 1^+ \tau^{\parallel\alpha\beta} == 0$	$\partial_\chi \partial^\alpha \tau (\Delta + \mathcal{K})^{\beta\chi} + \partial_\chi \partial^\beta \tau (\Delta + \mathcal{K})^{\chi\alpha} + \partial_\chi \partial^X \tau (\Delta + \mathcal{K})^{\alpha\beta} + 2 \partial_\sigma \partial_\chi \partial^\alpha \sigma^X{}^{\beta\sigma} + 2 \partial_\sigma \partial^\sigma \partial_\chi \sigma^{X\alpha\beta} == \partial_\chi \partial^\alpha \tau (\Delta + \mathcal{K})^X{}^\beta + \partial_\chi \partial^\beta \tau (\Delta + \mathcal{K})^{\alpha X} + \partial_\chi \partial^X \tau (\Delta + \mathcal{K})^{\beta\alpha} + 2 \partial_\sigma \partial_\chi \partial^\beta \sigma^{X\alpha\sigma}$	3
Total expected gauge generators:		10

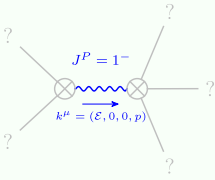
	$2^+ \mathcal{A}^{\parallel}_{\alpha\beta}$	$2^+ f^{\parallel}_{\alpha\beta}$	$2^- \mathcal{A}^{\parallel}_{\alpha\beta\chi}$
$2^+ \mathcal{A}^{\parallel} \uparrow^{+\beta}$	$2\beta_1 - \frac{(\mathcal{M}_{\text{Pl}})^2}{4}$	$-\frac{i k(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}{2\sqrt{2}}$	0
$2^+ f^{\parallel} \uparrow^{+\beta}$	$\frac{i k(8\beta_1-(\mathcal{M}_{\text{Pl}})^2)}{2\sqrt{2}}$	$4\beta_1 k^2$	0
$2^- \mathcal{A}^{\parallel} \uparrow^{+\beta\chi}$	0	0	$2\beta_1 - \frac{(\mathcal{M}_{\text{Pl}})^2}{4}$

	$2^+ \sigma^{\parallel} \uparrow^{+\beta\chi}$	$2^+ \tau^{\parallel} \uparrow^{+\beta\chi}$	$2^+ \sigma^{\perp} \uparrow^{+\beta\chi}$
$2^+ \sigma^{\parallel} \uparrow^{+\beta\chi}$	0	0	$\frac{8\beta_1(\mathcal{M}_{\text{Pl}})^2-(\mathcal{M}_{\text{Pl}})^2z^2}{k(\mathcal{M}_{\text{Pl}})^2}$
$2^+ \tau^{\parallel} \uparrow^{+\beta\chi}$	0	0	$\frac{2i\sqrt{2}}{k(\mathcal{M}_{\text{Pl}})^2}$
$2^+ \sigma^{\perp} \uparrow^{+\beta\chi}$	$\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{4}$	0	0

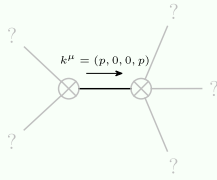
	$0^+ \mathcal{A}^{\parallel}$	$0^+ f^{\parallel}$	$0^+ f^{\perp}$	$0^- \mathcal{A}^{\parallel}$
$0^+ \mathcal{A}^{\parallel} \uparrow$	$\frac{1}{4}(2(\mathcal{M}_{\text{Pl}})^2+3k^2(8\alpha_1+2\alpha_3+\theta^2\xi)) - \frac{i k(\mathcal{M}_{\text{Pl}})^2}{\sqrt{2}}$	0	0	0
$0^+ f^{\parallel} \uparrow$	$\frac{i k(\mathcal{M}_{\text{Pl}})^2}{\sqrt{2}}$	0	0	0
$0^+ f^{\perp} \uparrow$	0	0	0	0
$0^- \mathcal{A}^{\parallel} \uparrow$	0	0	0	$\frac{1}{2}(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)$

	$0^+ \sigma^{\parallel}$	$0^+ \tau^{\parallel}$	$0^+ \tau^{\perp}$	$0^- \sigma^{\parallel}$
$0^+ \sigma^{\parallel} \uparrow$	0	$-\frac{i\sqrt{2}}{k(\mathcal{M}_{\text{Pl}})^2}$	0	0
$0^+ \tau^{\parallel} \uparrow$	$\frac{i\sqrt{2}}{k(\mathcal{M}_{\text{Pl}})^2}$	$-\frac{24\alpha_1+6\alpha_3+\frac{2(\mathcal{M}_{\text{Pl}})^2}{\rho^2}+3\theta^2\xi}{2(\mathcal{M}_{\text{Pl}})^2}$	0	0
$0^+ \tau^{\perp} \uparrow$	0	0	0	0
$0^- \sigma^{\parallel} \uparrow$	0	0	0	$\frac{2}{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}$

Massive and massless spectra



Massive particle



Massless particle

Pole residue:	$(48(-512\beta_1^3(1+4\theta)^2(-32(\mathcal{M}_{\text{Pl}})^2)+(1+4\theta)^2\xi)+8\beta_1(\mathcal{M}_{\text{Pl}})^2)^2(32(3+8\theta(\mathcal{M}_{\text{Pl}})^2)-3(1+4\theta^4\xi)+64\beta_1^2(1+4\theta(\mathcal{M}_{\text{Pl}})^2)(-32(3+4\theta(\mathcal{M}_{\text{Pl}})^2)+(3+36\theta+128\theta^2+128\theta^3)\xi)+(\mathcal{M}_{\text{Pl}})^2)^3(-32(\mathcal{M}_{\text{Pl}})^2)+(1+16\theta+112\theta^2+384\theta^3)\xi)))/((-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2+8\theta(\mathcal{M}_{\text{Pl}})^2)^2\xi(8\beta_1(-48(\mathcal{M}_{\text{Pl}})^2)+(1+4\theta)^2\xi)+(\mathcal{M}_{\text{Pl}})^2(48(\mathcal{M}_{\text{Pl}})^2)-(1+8\theta)\xi)))>0$
Square mass:	$-\frac{24(\mathcal{M}_{\text{Pl}})^2(-8\beta_1+(\mathcal{M}_{\text{Pl}})^2)}{(-8\beta_1(1+4\theta)^2+(\mathcal{M}_{\text{Pl}})^2)+8\theta(\mathcal{M}_{\text{Pl}})^2)\xi}>0$
Spin:	1
Parity:	Odd

Poleresidue:	$\frac{1}{(\mathcal{M}_{\text{Pl}})^2}>0$
Polarisations:	2

Unitarity conditions

$(\mathcal{M}_{\text{Pl}}^2)>0 \ \&\& \ \xi<0 \ \&\& \ (\beta_1<0 \ \&\& \ (\theta<\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{32\beta_1}-\frac{1}{32}\sqrt{\frac{-8\beta_1(\mathcal{M}_{\text{Pl}}^2)+(\mathcal{M}_{\text{Pl}}^2)^2}{\beta_1^2}} \parallel \theta>\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{32\beta_1}+\frac{1}{32}\sqrt{\frac{-8\beta_1(\mathcal{M}_{\text{Pl}}^2)+(\mathcal{M}_{\text{Pl}}^2)^2}{\beta_1^2}})) \parallel$

$(\beta_1==0 \ \&\& \ \theta>-\frac{1}{8}) \parallel (0<\beta_1<\frac{(\mathcal{M}_{\text{Pl}}^2)}{8} \ \&\& \ \frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{32\beta_1}-\frac{1}{32}\sqrt{\frac{-8\beta_1(\mathcal{M}_{\text{Pl}}^2)+(\mathcal{M}_{\text{Pl}}^2)^2}{\beta_1^2}}<\theta<\frac{-8\beta_1+(\mathcal{M}_{\text{Pl}})^2}{32\beta_1}+\frac{1}{32}\sqrt{\frac{-8\beta_1(\mathcal{M}_{\text{Pl}}^2)+(\mathcal{M}_{\text{Pl}}^2)^2}{\beta_1^2}}) \parallel \beta_1>\frac{(\mathcal{M}_{\text{Pl}}^2)}{8}$