PSALTer results panel

Wave operator and propagator

	${}^{1^+}\mathcal{W}_s{}^{\perp}{}_{\alpha\beta}$	${}^{1^-}\mathcal{T}^{\perp}{}_{\alpha}$	${}^{1^-}\mathcal{W}_s{}^{\perp t}{}_{\alpha}$	${}^{1^-}\mathcal{W}_s{}^{\parallel t}{}_{\alpha}$	${}^{1^-}\mathcal{W}_s{}^{\perp h}{}_{\alpha}$	${}^{1^-}\mathcal{W}_s{}^{\parallel h}{}_{\alpha}$
${}^{1^+}\mathcal{W}_s{}^{\perp}\dagger^{\alpha\beta}$	$\frac{4}{a_0}$	0	0	0	0	0
${}^{1^-}\mathcal{T}^{\perp}\dagger^{\alpha}$	0	$\frac{2k^2(4k^4(h_7-h_8)(h_7+h_8)+8k^2(2h_7+h_8)a_0+3a_0^2)}{(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{2i\sqrt{\frac{2}{3}}k(2k^4(h_7-h_8)(2(h_7+h_8)-a_0)+3k^2(4(h_7+h_8)a_0)a_0-3a_0^2)}{(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{i\sqrt{\frac{10}{3}}k(2k^2(h_7-h_8)+3a_0)}{(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{2ik(12a_0^2+3k^2a_0(12h_7+4h_8+a_0)+2k^4(h_7-h_8)(4(h_7+h_8)+a_0))}{\sqrt{3}(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{4i\sqrt{\frac{2}{3}}k(k^2(h_7-h_8)-3a_0)}{(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$
${}^{1^-}\mathcal{W}_s{}^{\perp t}\dagger^{\alpha}$	0	$\frac{2i\sqrt{\frac{2}{3}}k(-2k^4(h_7-h_8)(2(h_7+h_8)-a_0)+3a_0^2+3k^2a_0(-4(h_7+h_8)+a_0))}{(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$-\frac{4(13a_0^2+2k^2a_0(-4h_7-8h_8+5a_0)+k^4(-4h_7^2+4h_7a_0+(-2h_8+a_0)^2))}{3(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{2\sqrt{5}(5a_0+k^2(2h_7-2h_8+a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{2\sqrt{2}(4a_0^2+k^2a_0(28h_7+20h_8+a_0)+k^4(8h_7^2-8h_8^2-2h_7a_0+2h_8a_0+a_0^2))}{3(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{8(a_0+k^2(h_7-h_8+2a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$
${}^{1^-}\mathcal{W}_s{}^{\parallel t}\dagger^{\alpha}$	0	$-\frac{i\sqrt{\frac{10}{3}}k(2k^2(h_7-h_8)+3a_0)}{(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{2\sqrt{5}(5a_0+k^2(2h_7-2h_8+a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{4}{3a_0}-\frac{5}{3k^2(h_7-h_8)+9a_0}$	$-\frac{\sqrt{10}(-4a_0+k^2(-4h_7+4h_8+a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{4\sqrt{5}(k^2(h_7-h_8)+a_0)}{3a_0(k^2(h_7-h_8)+3a_0)}$
${}^{1^-}\mathcal{W}_s{}^{\perp h}\dagger^{\alpha}$	0	$-\frac{2ik(12a_0^2+3k^2a_0(12h_7+4h_8+a_0)+2k^4(h_7-h_8)(4(h_7+h_8)+a_0))}{\sqrt{3}(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{2\sqrt{2}(4a_0^2+k^2a_0(28h_7+20h_8+a_0)+k^4(8h_7^2-8h_8^2-2h_7a_0+2h_8a_0+a_0^2))}{3(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$\frac{\sqrt{10}(k^2(4h_7-4h_8-a_0)+4a_0)}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{2(32a_0^2+8k^2a_0(10h_7+2h_8+a_0)+k^4(16h_7^2+8h_7a_0-(4h_8+a_0)^2))}{3(2+k^2)^2a_0^2(k^2(h_7-h_8)+3a_0)}$	$-\frac{8\sqrt{2}(5a_0+k^2(-h_7+h_8+a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$
${}^{1^-}\mathcal{W}_s{}^{\parallel h}\dagger^{\alpha}$	0	$-\frac{4i\sqrt{\frac{2}{3}}k(k^2(h_7-h_8)-3a_0)}{(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{8(a_0+k^2(h_7-h_8+2a_0))}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{4\sqrt{5}(k^2(h_7-h_8)+a_0)}{3a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{8\sqrt{2}(k^2(h_7-h_8-a_0)-5a_0)}{3(2+k^2)a_0(k^2(h_7-h_8)+3a_0)}$	$\frac{4}{3}\left(\frac{5}{a_0}-\frac{16}{k^2(h_7-h_8)+3a_0}\right)$

	${}^{1^+}\mathcal{A}_s{}^{\perp}{}_{\alpha\beta}$	${}^{1^-}h^{\perp}{}_{\alpha}$	${}^{1^-}\mathcal{A}_s{}^{\perp t}{}_{\alpha}$	${}^{1^-}\mathcal{A}_s{}^{\parallel t}{}_{\alpha}$	${}^{1^-}\mathcal{A}_s{}^{\perp h}{}_{\alpha}$	${}^{1^-}\mathcal{A}_s{}^{\parallel h}{}_{\alpha}$
${}^{1^+}\mathcal{A}_s{}^{\perp}\dagger^{\alpha\beta}$	$\frac{a_0}{4}$	0	0	0	0	0
${}^{1^-}h^{\perp}\dagger^{\alpha}$	0	0	$-\frac{ika_0}{4\sqrt{6}}$	$\frac{1}{4}i\sqrt{\frac{5}{6}}ka_0$	$\frac{ika_0}{8\sqrt{3}}$	$-\frac{ika_0}{4\sqrt{6}}$
${}^{1^-}\mathcal{A}_s{}^{\perp t}\dagger^{\alpha}$	0	$\frac{ika_0}{4\sqrt{6}}$	$\frac{1}{6}(-k^2h_7-2a_0)$	$\frac{1}{6}\sqrt{5}(k^2h_8+a_0)$	$\frac{2k^2h_7+a_0}{12\sqrt{2}}$	$\frac{1}{12}(-2k^2h_8+a_0)$
${}^{1^-}\mathcal{A}_s{}^{\parallel t}\dagger^{\alpha}$	0	$-\frac{1}{4}i\sqrt{\frac{5}{6}}ka_0$	$\frac{1}{6}\sqrt{5}(k^2h_8+a_0)$	$\frac{1}{6}(-5k^2h_7+2a_0)$	$\frac{1}{12}\sqrt{\frac{5}{2}}(-2k^2h_8+a_0)$	$\frac{1}{12}\sqrt{5}(2k^2h_7+a_0)$
${}^{1^-}\mathcal{A}_s{}^{\perp h}\dagger^{\alpha}$	0	$-\frac{ika_0}{8\sqrt{3}}$	$\frac{2k^2h_7+a_0}{12\sqrt{2}}$	$\frac{1}{12}\sqrt{\frac{5}{2}}(-2k^2h_8+a_0)$	$\frac{1}{12}(-k^2h_7+a_0)$	$\frac{k^2h_8-2a_0}{6\sqrt{2}}$
${}^{1^-}\mathcal{A}_s{}^{\parallel h}\dagger^{\alpha}$	0	$\frac{ika_0}{4\sqrt{6}}$	$\frac{1}{12}(-2k^2h_8+a_0)$	$\frac{1}{12}\sqrt{5}(2k^2h_7+a_0)$	$\frac{k^2h_8-2a_0}{6\sqrt{2}}$	$\frac{1}{12}(-2k^2h_7-a_0)$

	${}^{0^+}\mathcal{T}^{\perp}$	${}^{0^+}\mathcal{T}^{\parallel}$	${}^{0^+}\mathcal{W}_s{}^{\perp t}$	${}^{0^+}\mathcal{W}_s{}^{\parallel}$	${}^{0^+}\mathcal{W}_s{}^{\perp h}$
${}^{0^+}\mathcal{T}^{\perp}\dagger$	$\frac{4k^2(6k^2(h_7+h_8)-a_0)}{3(4+k^2)^2a_0^2}$	0	$\frac{8ik(6k^2(h_7+h_8)-a_0)}{3(4+k^2)^2a_0^2}$	$\frac{10ik}{3(4+k^2)a_0}$	$\frac{4i\sqrt{2}k}{3(4+k^2)a_0}$
${}^{0^+}\mathcal{T}^{\parallel}\dagger$	0	$\frac{4(2k^2(h_7+h_8)+a_0)}{k^2a_0^2}$	0	$-\frac{2i}{\sqrt{3}ka_0}$	$\frac{4i\sqrt{\frac{2}{3}}}{ka_0}$
${}^{0^+}\mathcal{W}_s{}^{\perp t}\dagger$	$-\frac{8ik(6k^2(h_7+h_8)-a_0)}{3(4+k^2)^2a_0^2}$	0	$\frac{16(6k^2(h_7+h_8)-a_0)}{3(4+k^2)^2a_0^2}$	$\frac{20}{3(4+k^2)a_0}$	$\frac{8\sqrt{2}}{3(4+k^2)a_0}$
${}^{0^+}\mathcal{W}_s{}^{\parallel}\dagger$	$-\frac{10ik}{12a_0+3k^2a_0}$	$\frac{2i}{\sqrt{3}ka_0}$	$\frac{20}{12a_0+3k^2a_0}$	0	0
${}^{0^+}\mathcal{W}_s{}^{\perp h}\dagger$	$-\frac{4i\sqrt{2}k}{12a_0+3k^2a_0}$	$-\frac{4i\sqrt{\frac{2}{3}}}{ka_0}$	$\frac{8\sqrt{2}}{12a_0+3k^2a_0}$	0	0

$$S == \iiiint\Big(\frac{1}{4}(-2a_0\,\mathcal{A}_{\alpha\chi\beta}\mathcal{A}^{\alpha\beta\chi}+2a_0\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\mathcal{A}^{\chi}{}_{\beta\chi}+4\mathcal{A}^{\alpha\beta\chi}\mathcal{W}_{\alpha\beta\chi}+4\mathcal{T}^{\alpha\beta}h_{\alpha\beta}+2a_0\,h^{\alpha\beta}\partial_\beta\mathcal{A}_{\alpha}{}^{\chi}{}_{\chi}-2a_0\,h^{\alpha\beta}\partial_\chi\mathcal{A}_{\alpha}{}^{\chi}{}_{\beta}-a_0\,h^{\alpha}{}_{\alpha}\partial_\chi\mathcal{A}^{\beta}{}_{\beta}{}^{\chi}+a_0\,h^{\alpha}{}_{\alpha}\partial_\chi\mathcal{A}^{\beta\chi}{}_{\beta}-2h_8\partial_\beta\mathcal{A}_{\chi}{}^{\delta}{}_{\delta}\partial^\chi\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}-2h_7\partial_\chi\mathcal{A}_{\beta}{}^{\delta}{}_{\delta}\partial^\chi\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}-2h_7\partial_\beta\mathcal{A}^{\alpha\beta\chi}\partial_\delta\mathcal{A}_{\alpha}{}^{\delta}{}_{\chi}-2h_8\partial_\beta\mathcal{A}^{\alpha\beta\chi}\partial_\delta\mathcal{A}_{\alpha}{}^{\delta}{}_{\chi}+4h_7\partial^\chi\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\partial_\delta\mathcal{A}_{\beta}{}^{\delta}{}_{\chi}+4h_8\partial^\chi\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\partial_\delta\mathcal{A}_{\beta}{}^{\delta}{}_{\chi}))[t,x,y,z]\,dz\,dy\,dx\,dt$$

	${}^{2^+}h^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{A}_s{}^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{A}_s{}^{\perp}{}_{\alpha\beta}$	${}^{2^-}\mathcal{A}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{2^+}h^{\parallel}\dagger^{\alpha\beta}$	0	$-\frac{ika_0}{4\sqrt{3}}$	$-\frac{ika_0}{2\sqrt{6}}$	0
${}^{2^+}\mathcal{A}_s{}^{\parallel}\dagger^{\alpha\beta}$	$\frac{ika_0}{4\sqrt{3}}$	$\frac{1}{6}(-k^2(h_7+h_8)-3a_0)$	$-\frac{k^2(h_7+h_8)}{3\sqrt{2}}$	0
${}^{2^+}\mathcal{A}_s{}^{\perp}\dagger^{\alpha\beta}$	$\frac{ika_0}{2\sqrt{6}}$	$-\frac{k^2(h_7+h_8)}{3\sqrt{2}}$	$-\frac{1}{3}k^2(h_7+h_8)+\frac{a_0}{4}$	0
${}^{2^-}\mathcal{A}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	0	0	0	$\frac{a_0}{4}$

	${}^{2^+}\mathcal{T}^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{W}_s{}^{\perp}{}_{\alpha\beta}$	${}^{2^-}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{2^+}\mathcal{T}^{\parallel}\dagger^{\alpha\beta}$	$\frac{8(h_7+h_8-\frac{a_0}{k^2})}{a_0^2}$	$\frac{4i}{\sqrt{3}ka_0}$	$-\frac{8i\sqrt{\frac{2}{3}}}{ka_0}$	0
${}^{2^+}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta}$	$-\frac{4i}{\sqrt{3}ka_0}$	$-\frac{8}{3a_0}$	$\frac{4\sqrt{2}}{3a_0}$	0
${}^{2^+}\mathcal{W}_s{}^{\perp}\dagger^{\alpha\beta}$	$\frac{8i\sqrt{\frac{2}{3}}}{ka_0}$	$\frac{4\sqrt{2}}{3a_0}$	$-\frac{4}{3a_0}$	0
${}^{2^-}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	0	0	0	$\frac{4}{a_0}$

	${}^{3^-}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{3^-}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	$-\frac{2}{a_0}$

	${}^{3^-}\mathcal{A}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{3^-}\mathcal{A}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	$-\frac{a_0}{2}$

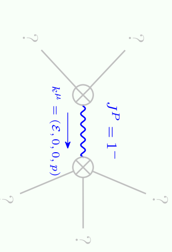
	${}^{0^+}h^{\perp}$	${}^{0^+}h^{\parallel}$	${}^{0^+}\mathcal{A}_s{}^{\perp t}$	${}^{0^+}\mathcal{A}_s{}^{\parallel}$	${}^{0^+}\mathcal{A}_s{}^{\perp h}$
${}^{0^+}h^{\perp}\dagger$	0	0	0	$\frac{ika_0}{4}$	$\frac{ika_0}{8\sqrt{2}}$
${}^{0^+}h^{\parallel}\dagger$	0	0 0		$-\frac{ika_0}{4\sqrt{3}}$	$\frac{5ika_0}{8\sqrt{6}}$
${}^{0^+}\mathcal{A}_s{}^{\perp t}\dagger$	0	0 0		$\frac{a_0}{2}$	$\frac{a_0}{4\sqrt{2}}$
${}^{0^+}\mathcal{A}_s{}^{\parallel}\dagger$	$-\frac{1}{4}ika_0$	$\frac{ika_0}{4\sqrt{3}}$	$\frac{a_0}{2}$	$-\frac{2}{3}k^2(h_7+h_8)$	$\frac{2k^2(h_7+h_8)+3a_0}{12\sqrt{2}}$
${}^{0^+}\mathcal{A}_s{}^{\perp h}\dagger$	$-\frac{ika_0}{8\sqrt{2}}$	$-\frac{5ika_0}{8\sqrt{6}}$	$\frac{a_0}{4\sqrt{2}}$	$\frac{2k^2(h_7+h_8)+3a_0}{12\sqrt{2}}$	$\frac{1}{12}(-7k^2(h_7+h_8)-3a_0)$

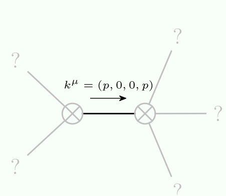
Spin-parity form	Covariant form	Multiplicities
$k\,{}^{0^+}\mathcal{W}_s{}^{\perp t}+2i\,{}^{0^+}\mathcal{T}^{\perp}==0$ 2	$\partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta}==\partial_\chi\partial_\beta\partial_\alpha\mathcal{W}^{\alpha\beta\chi}$	1
$2k\,{}^{1^-}\mathcal{W}_s{}^{\perp h\alpha}+k\,{}^{1^-}\mathcal{W}_s{}^{\perp t\alpha}+6i\,{}^{1^-}\mathcal{T}^{\perp\alpha}==0$ 2	$\partial_\chi\partial_\beta\partial^\alpha\mathcal{T}^{\beta\chi}+\partial_\delta\partial^\delta\partial_\chi\partial_\beta\mathcal{W}^{\beta\alpha\chi}==2\partial_\chi\partial^\chi\partial_\beta\mathcal{T}^{\alpha\beta}+\partial_\delta\partial_\chi\partial_\beta\partial^\alpha\mathcal{W}^{\beta\chi\delta}$	3
Total expected gauge generators:		4

Massive and massless spectra

Pole residue:	Square mass:	Spin:	Parity:
$\frac{68h_7-68h_8-75a_0}{(h_7-h_8)(2h_7-2h_8-3a_0)}>0$	$-\frac{3a_0}{h_7-h_8}>0$	1	Odd

Massive particle





Massless particle

Pole residue:	$-\frac{1}{a_0}>0$
Polarisations:	2

Unitarity conditions

$h_7\in\mathbb{R}$ && $a_0<0$ && $h_8<h_7$