PSALTer results panel

Wave operator and propagator

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

Spin-parity form	Covariant form	Multiplicities
$k\,{}^{0^+}\mathcal{W}_s{}^{\perp t}+2\,i\,{}^{0^+}\mathcal{T}^{\perp}==0$ 2	$\partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta}==\partial_\chi\partial_\beta\partial_\alpha\mathcal{W}^{\alpha\beta\chi}$	1
$2k\,{}^{1^-}\mathcal{W}_s{}^{\perp h\alpha}+k\,{}^{1^-}\mathcal{W}_s{}^{\perp t\alpha}+6\,i\,{}^{1^-}\mathcal{T}^{\perp\alpha}==0$ 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

	${}^{0^+}\mathcal{T}^{\perp}$	${}^{0^+}\mathcal{T}^{\parallel}$	${}^{0^+}\mathcal{W}_s{}^{\perp t}$	${}^{0^+}\mathcal{W}_s{}^{\parallel}$	${}^{0^+}\mathcal{W}_s{}^{\perp h}$
${}^{0^+}\mathcal{T}^{\perp}\dagger$	$\frac{4k^2(6k^2(2h_{12}+h_7+h_8)-a_0)}{3(4+k^2)^2 a_0^2}$	$-\frac{16k^2 h_{12}}{\sqrt{3}(4+k^2)a_0^2}$	$\frac{8 i k(6k^2(2h_{12}+h_7+h_8)-a_0)}{3(4+k^2)^2 a_0^2}$	$\frac{10 i k}{3(4+k^2)a_0}$	$\frac{4 i\sqrt{2}k}{3(4+k^2)a_0}$
${}^{0^+}\mathcal{T}^{\parallel}\dagger$	$-\frac{16k^2 h_{12}}{\sqrt{3}(4+k^2)a_0^2}$	$\frac{4(2k^2(-2h_{12}+h_7+h_8)+a_0)}{k^2 a_0^2}$	$-\frac{32 i k h_{12}}{\sqrt{3}(4+k^2)a_0^2}$	$-\frac{2i}{\sqrt{3}k a_0}$	$\frac{4i\sqrt{\frac{2}{3}}}{k a_0}$
${}^{0^+}\mathcal{W}_s{}^{\perp t}\dagger$	$-\frac{8 i k(6k^2(2h_{12}+h_7+h_8)-a_0)}{3(4+k^2)^2 a_0^2}$	$\frac{32 i k h_{12}}{\sqrt{3}(4+k^2)a_0^2}$	$\frac{16(6k^2(2h_{12}+h_7+h_8)-a_0)}{3(4+k^2)^2 a_0^2}$	$\frac{20}{3(4+k^2)a_0}$	$\frac{8\sqrt{2}}{3(4+k^2)a_0}$
${}^{0^+}\mathcal{W}_s{}^{\parallel}\dagger$	$-\frac{10 i k}{12a_0+3k^2a_0}$	$\frac{2i}{\sqrt{3}k a_0}$	$\frac{20}{12a_0+3k^2a_0}$	0	0
${}^{0^+}\mathcal{W}_s{}^{\perp h}\dagger$	$-\frac{4i\sqrt{2}k}{12a_0+3k^2a_0}$	$-\frac{4i\sqrt{\frac{2}{3}}}{k a_0}$	$\frac{8\sqrt{2}}{12a_0+3k^2a_0}$	0	0

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

	${}^{2^+}\mathcal{T}^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta}$	${}^{2^+}\mathcal{W}_s{}^{\perp}{}_{\alpha\beta}$	${}^{2^-}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{2^+}\mathcal{T}^{\parallel}\dagger^{\alpha\beta}$	$\frac{8(-k^4h_{12}^2+k^2(-2h_{12}+h_7+h_8)a_0-a_0^2)}{k^2a_0^3}$	$\frac{4i(2k^2h_{12}+a_0)}{\sqrt{3}k a_0^2}$	$-\frac{4i\sqrt{\frac{2}{3}}(k^2h_{12}+2a_0)}{k a_0^2}$	0
${}^{2^+}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta}$	$-\frac{4i(2k^2h_{12}+a_0)}{\sqrt{3}k a_0^2}$	$-\frac{8}{3a_0}$	$\frac{4\sqrt{2}}{3a_0}$	0
${}^{2^+}\mathcal{W}_s{}^{\perp}\dagger^{\alpha\beta}$	$\frac{4i\sqrt{\frac{2}{3}}(k^2h_{12}+2a_0)}{k a_0^2}$	$\frac{4\sqrt{2}}{3a_0}$	$-\frac{4}{3a_0}$	0
${}^{2^-}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	0 0		0	$\frac{4}{a_0}$

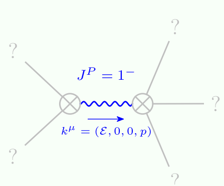
	${}^{3^-}\mathcal{W}_s{}^{\parallel}{}_{\alpha\beta\chi}$
${}^{3^-}\mathcal{W}_s{}^{\parallel}\dagger^{\alpha\beta\chi}$	$-\frac{2}{a_0}$

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

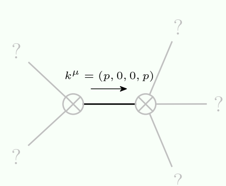
$$S==\iiiint\Big(\tfrac{1}{4}\big(-2a_0\mathcal{A}_{\alpha\chi\beta}\mathcal{A}^{\alpha\beta\chi}+2a_0\mathcal{A}^{\alpha\beta}{}_{\alpha}\mathcal{A}^{\chi}{}_{\beta\chi}+4\mathcal{A}^{\alpha\beta\chi}\mathcal{W}_{\alpha\beta\chi}+4\mathcal{T}^{\alpha\beta}h_{\alpha\beta}+2a_0h^{\alpha\beta}\partial_\beta\mathcal{A}_{\alpha\chi}{}^{\chi}-2a_0h^{\alpha\beta}\partial_\chi\mathcal{A}_{\alpha\beta}{}^{\chi}-a_0h^{\alpha}{}_{\alpha}\partial_\chi\mathcal{A}_{\beta}{}^{\beta\chi}+a_0h^{\alpha}{}_{\alpha}\partial_\chi\mathcal{A}^{\beta\chi}{}_{\beta}-2h_8\partial_\beta\mathcal{A}_{\chi}{}^{\delta}{}_{\delta}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}-2h_{12}\partial_\beta\mathcal{A}^{\delta}{}_{\chi\delta}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}-2h_7\partial_\chi\mathcal{A}_{\beta\delta}{}^{\delta}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}-2h_{12}\partial_\chi\mathcal{A}^{\delta}{}_{\beta\delta}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}-2h_7\partial_\beta\mathcal{A}^{\alpha\beta\chi}\partial_\delta\mathcal{A}_{\alpha\chi}{}^{\delta}-2h_8\partial_\beta\mathcal{A}^{\alpha\beta\chi}\partial_\delta\mathcal{A}^{\delta}{}_{\alpha\chi}+2h_{12}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}\partial_\delta\mathcal{A}^{\delta}{}_{\beta\chi}-4h_{12}\partial_\alpha\mathcal{A}^{\alpha\beta\chi}\partial_\delta\mathcal{A}^{\delta}{}_{\beta\chi}+4h_7\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}\partial_\delta\mathcal{A}_{\beta\chi}{}^{\delta}+4h_8\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}\partial_\delta\mathcal{A}^{\delta}{}_{\beta\chi}+4h_{12}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}\partial_\delta\mathcal{A}_{\beta\chi}{}^{\delta}+2h_{12}\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\alpha}\partial_\delta\mathcal{A}_{\chi\beta}{}^{\delta}\big)\Big)[t,x,y,z]\,dz\,dy\,dx\,dt$$

	${}^{0^+}h^{\perp}$	${}^{0^+}h^{\parallel}$	${}^{0^+}\mathcal{A}_s{}^{\perp t}$	${}^{0^+}\mathcal{A}_s{}^{\parallel}$	${}^{0^+}\mathcal{A}_s{}^{\perp h}$
${}^{0^+}h^{\perp}\dagger$	0	0	0	$\frac{i k a_0}{4}$	$\frac{i k a_0}{8\sqrt{2}}$
${}^{0^+}h^{\parallel}\dagger$	0	0 0		$-\frac{i k a_0}{4\sqrt{3}}$	$\frac{5 i k a_0}{8\sqrt{6}}$
${}^{0^+}\mathcal{A}_s{}^{\perp t}\dagger$	0	0 0		$\frac{a_0}{2}$	$\frac{a_0}{4\sqrt{2}}$
${}^{0^+}\mathcal{A}_s{}^{\parallel}\dagger$	$-\frac{1}{4} i k a_0$	$\frac{i k a_0}{4\sqrt{3}}$	$\frac{a_0}{2}$	$-\frac{2}{3}k^2(2h_{12}+h_7+h_8)$	$\frac{2k^2(-4h_{12}+h_7+h_8)+3a_0}{12\sqrt{2}}$
${}^{0^+}\mathcal{A}_s{}^{\perp h}\dagger$	$-\frac{i k a_0}{8\sqrt{2}}$	$-\frac{5 i k a_0}{8\sqrt{6}}$	$\frac{a_0}{4\sqrt{2}}$	$\frac{2k^2(-4h_{12}+h_7+h_8)+3a_0}{12\sqrt{2}}$	$\frac{1}{12}(k^2(16h_{12}-7(h_7+h_8))-3a_0)$

Massive and massless spectra



Massive particle



Massless particle

Pole residue:	$\frac{1152h_{12}^2-288h_{12}(h_7-h_8)+(h_7-h_8)(68h_7-68h_8-75a_0)}{(h_7-h_8)^2(2h_7-2h_8-3a_0)}>0$
Square mass:	$-\frac{3a_0}{h_7-h_8}>0$
Spin:	1
Parity:	Odd

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

Unitarity conditions

$$(h_7 \mid h_{12})\in\mathbb{R}\ \&\&\ a_0<0\ \&\&\ h_8<h_7$$