PSALTer results panel

Wave operator and propagator

			9. 7	٠,٠	° 'W _S	" 'W _S "	°. 'W _S	_							
Spin-parity form Covariant form Multiplicities	$a_{\beta \chi} = a_{\beta \chi}$	0+T	· † 0	0	0	0	0		0+h ⁺ 0+h	${}^{0^{+}}_{\cdot}\mathcal{A}_{S}{}^{\perpt}$ ${}^{0^{+}}_{\cdot}\mathcal{A}_{S}{}^{\parallel}$		$^{0^+}\mathcal{A}_{s}{}^{\perph}$	1		
$0^{+}\mathcal{T}^{\perp} = 0 \qquad \partial_{\beta}\partial_{\alpha}\mathcal{T}^{\alpha\beta} = 0 \qquad 1$	$\begin{bmatrix} 3 & \mathcal{W}_{s} \\ & & \\$	² ° ∾ 0+η	1 0	$\frac{4(2 k^{2} (h.+h.)+a)}{k^{2} a{0}^{2}}$	<u>;)</u> 0	$\frac{4 i k(h_1 + h_2)}{\sqrt{3} a_0^2}$	$-\frac{8i\sqrt{\frac{2}{3}}k(h_{7}+h_{8})}{a_{0}^{2}}$	0.+ h+ †	0 0	0 0		0			
$1_{\mathcal{T}^{\perp}}^{\alpha} = 0 \qquad \partial_{\chi} \partial_{\beta} \partial^{\alpha} \mathcal{T}^{\beta \chi} = \partial_{\chi} \partial^{\chi} \partial_{\beta} \mathcal{T}^{\alpha \beta} $	αβχ	αβχ		, u.	-6 k ² (h ±h)±a		0.5	0,+ h †	$0 \frac{1}{4} \left(-2 k^4 (h_{.} + h_{.}) + k^2 a_{.} \right)$	$0 \qquad \frac{i k^3 (h. + h.)}{2 \sqrt{3}}$	5	5 i k³ (h.+.	h.) 8		
Total expected gauge generators: 4	- \$	€ 0+Ws	^t † 0	0	$-\frac{-6 k^2 (h_1 + h_2) + a_0}{3 a_0^2}$	5 3 a .	$\frac{2\sqrt{2}}{3a.0}$					4 √6 a.			
	m-	m-		4 i k(h.+h.)			$2\sqrt{2}(-2 k^{2}(h_{1}+h_{2})+a_{0})$	0.*As ¹ †		$0 \qquad \frac{a}{2}$		$\frac{a_0}{4\sqrt{2}}$			
+		0,+W	s" † 0	$-\frac{4i k(h.+h.)}{\sqrt{3} a_0^2}$	5 3 a.	$-\frac{-2 k^2 (h_1 + h_2) + a_1}{7 k^2 0}$ $3 a_1^2$	3 a . 2	0+ <i>A</i> s †	$-\frac{i k^3 (h, +h_1)}{2 \sqrt{3}}$	$\frac{a_0}{2}$ $-\frac{2}{3}k^2(h_1+h_2)$	2 k ²	$(h_1 + h_2) + 12 \sqrt{2}$	+3 a.		
6 + ***********************************	•	0+Ws	h + 0	$8i \sqrt{\frac{2}{3}} k (h_1 + h_1)$	$\frac{2\sqrt{2}}{3a}$	$2\sqrt{2}(-2 k^2 (h_1 + h_1) + a$	$\frac{8(2 k^2 (h_1 + h_2) - a_0)}{77800}$	0+ ıh .	$5i k^3 (h + h)$	$\frac{a_0}{4\sqrt{2}} \frac{2 k^2 (h.+h.) + 3 a_0}{12\sqrt{2}}$					
βχ α α α α α α α α α α α α α α α α α α α	+ ° ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '	と ''' ⁵		a.² 0	3 a . 0	3 a. 2	3 a . 2	^{0,+} ℋ _s ^{⊥h} †	$\begin{array}{c c} 0 & \frac{7 & 8}{4 \sqrt{6}} \end{array}$	$\begin{array}{c c} \hline 4 \sqrt{2} & \hline & 12 \sqrt{2} \\ \hline \end{array}$	12 (- / /	7	h.)-3 a.)		
$h^{\alpha}_{\alpha} \partial_{x} \mathcal{A}^{\beta \chi}$ $h^{\alpha}_{\alpha} \partial_{x} \mathcal{A}^{\beta \chi}$ $\delta^{\beta}_{\delta} + \delta^{\alpha}_{\delta} - \delta^{\alpha}_{\delta} \partial_{\beta} \partial_{\lambda} \delta^{\beta}_{\delta} + \delta^{\alpha}_{\alpha} \partial_{\delta} \partial_{\beta} \partial_{\lambda} \delta^{\beta}_{\delta} + \delta^{\alpha}_{\alpha} \partial_{\delta} \partial_{\beta} \partial_{\lambda} \delta^{\delta}_{\delta} + \delta^{\alpha}_{\alpha} \partial_{\delta} \partial_{\delta} \partial_{\lambda} \partial_{\delta} \partial_{\delta$	$+ \frac{x}{x} + \frac{x}{x}$	2 B												+ a.)	<u></u>
2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 +	8 90 g										σ		3 + a.)		$\frac{k^{2}h_{6}-2a_{0}}{6\sqrt{2}}$ (-2 $k^{2}h_{7}-a_{0}$)
$\begin{pmatrix} h_{\alpha y} \\ \chi \end{pmatrix} = \begin{pmatrix} h_{\alpha y} \\ \chi \end{pmatrix} \begin{pmatrix} h_{\alpha y} $	3×3 ^B h ^a , 3×3 ^B h ^a , 3×3 ^A a, B,	, z									$^{1}\mathcal{A}_{\mathrm{s}}^{\parallelh}$	0	$0 \frac{1}{12} (-2 k^2 h_1)$	$\sqrt{5}(2 k^2 h_7)$	$\frac{k^2 h_8 - 2 a_0}{6 \sqrt{2}}$ $2 k^2 h_7$
2 h 2 h 2 h 2 h 2 h 2 h 2 h 2 h 2 h 2 h	2 h 2 9 8 9 4 h 4 h	x x									1		(-2	√5(;	$\frac{k^2}{12}$ (-2
8 6 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	1, 6 + 1, 4 h. 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	o _o o'h _{fx}))[t, x, y, z]a											121	12	1 1 7
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\partial^{\chi}\mathcal{A}^{\alpha}_{\ \alpha}^{\ \ \beta} \partial_{\delta}\partial_{\chi}h_{\beta}^{\ \ \delta}$ $^{(\alpha\beta)}\partial_{\delta}\partial_{\delta}h_{\alpha\beta} + 4I$ $\partial_{\alpha}\partial^{\chi}h^{\alpha\beta} \partial_{\delta}\partial_{\delta}h_{\beta\gamma}$	O h							$2^{+}\mathcal{T}^{\parallel}_{\alpha\beta}$ $2^{+}\mathcal{W}_{S}^{\parallel}_{\alpha\beta}$	$^{2^{+}}W_{s}^{\perp}{}_{\alpha\beta}$ $^{2}W_{s}^{\parallel}$	aßv			-a.)	
				$^{2^{+}}h^{\parallel}_{\alpha\beta}$	$^{2^{+}}\mathcal{H}_{S}^{I}$	2 ⁺ a	$\mathcal{A}_{S^{\perp}\alpha\beta}^{\perp} \qquad \mathcal{A}_{S^{\parallel}\alpha\beta\chi}^{\parallel}$		a.	$8i\sqrt{\frac{2}{3}}k(h.+h.)$	_		4°I.	h. + 8	a - 100
$ \begin{array}{l} \beta \beta \mathcal{A}_{\alpha}^{X} \\ \chi \\ \chi$	$\frac{\partial^{x} \mathcal{S}}{\partial \alpha^{2}}$	ν σ	1 2					$2^{+}\mathcal{T}^{\parallel} \uparrow^{\alpha\beta}$	$\frac{8(h_1 + h_2 - \frac{0}{2})}{a_1^2} \qquad \frac{4 i k(h_1 + h_2)}{\sqrt{3} a_1^2}$	$-\frac{3^{1}\sqrt{3}\sqrt{7}\frac{87}{7}}{a_{0}^{2}}$ 0	$^{1}\mathcal{A}_{\mathrm{s}}^{^{\perp}h}$	0	$0 \\ \frac{2k^2 h_1 + a_2}{12 \sqrt{5}}$	-2 k ²	$k^{2}h_{7} + \frac{k^{2}h_{7} + k^{2}h_{8} + k^{2}h_{9}}{6\sqrt{2}}$
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	+4 h $+2$ h $+$	2 ⁺ h †	$-\frac{1}{8}k^2$	$(k^2 (h_1 + h_1) + a_1)$	$-\frac{i k^3 (h_1 + \frac{1}{7})}{4 \sqrt{3}}$	- 2	$\frac{h.+h.)}{7} \frac{7}{8}$ 0		, ,	$4 \sqrt{2} k^{2} (h_{1} + h_{2})$	Н.		2	$\frac{1}{12} \sqrt{\frac{5}{2}} (-2k^2 h, +a_0)$	$\frac{1}{12} \left(-k^2 h_1 + a_1 \right)$ $\frac{k^2 h_8 2 a_0}{6 \sqrt{2}}$
4 4 6 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	6 - h = h = h = h = h = h = h = h = h = h	າ ຂຶ້ ²⁺ Я₅ [∥] †'	ιβ	$\frac{i k^3 (h.+h.)}{7 8} \frac{4 \sqrt{3}}{4 \sqrt{3}}$	$\frac{1}{6} \left(-k^2 \left(h_1 + h_1 \right) \right)$		$\frac{\frac{1}{7} + h.}{\sqrt{2}}$ 0	$2^+W_s^{\parallel} + \alpha^{\alpha\beta}$	$\sqrt{3} \ a^{2}$ $3 \ a^{2}$	$-\frac{78}{3a_0^2}$ 0				12 ,	
$h_{\alpha\beta} + i$ $4 a. h'$ $4x - 3$ $6h_{\alpha}^{x} + i$ $4a_{\alpha}^{x} + 3$ $4a_{\alpha}^{x} + 4$ $4a_{\alpha}^{6} + 4$ $6a_{\alpha}^{6} + 3$ $6a_{\beta}h_{\alpha}$ $6a_{\beta}h_{\alpha}$	$\int_{\alpha}^{\alpha} \partial_{\delta} \partial_{\chi} h$ $\partial_{\delta} \partial_{\delta} h_{\alpha\beta}$ $\int_{\alpha}^{\alpha\beta} \partial_{\delta} \partial_{\delta} h$	200						.+ . αβ	$8i\sqrt{\frac{2}{3}}k(h_{7}+h_{8})$ $4\sqrt{2}k^{2}(h_{7}+h_{8})$	4(4 k ² (h ₂ +h ₂)+3 a ₂)			(°)	.)	-a,) a,)
7 ab (2 3) (2 5) (2 5) (2 5) (2 6) (2 6) (3 6) (4 6) (4 6) (4 6)	$\frac{\partial^{\chi}\mathcal{A}^{\alpha}}{\partial^{\chi}h^{\alpha\beta}}\frac{\partial_{\delta}\partial_{\chi}h_{\beta}}{\partial_{\delta}\partial_{\delta}h_{\alpha\beta}} - h$ $\frac{\partial^{\chi}\mathcal{A}^{\alpha}}{\partial_{\alpha}\partial^{\chi}h^{\alpha\beta}}\frac{\partial_{\delta}\partial_{\delta}h_{\alpha\beta}}{\partial_{\delta}\partial_{\delta}h_{\beta\chi}} - h$	$2^{+}\mathcal{A}_{s}^{\parallel} + 2^{+}\mathcal{A}_{s}^{\parallel} + 2^{+}\mathcal{A}_{s}^{\parallel} + 2^{+}\mathcal{A}_{s}^{\perp} + 2^{+$	ιβ	$\frac{i k^3 (h.+h.)}{2 \sqrt{6}}$	$-\frac{k^2 (h_1 + h_2)}{3 \sqrt{2}}$	$-\frac{1}{3}k^2(h_1)$	$+h_{.})+\frac{a_{.}}{4}$ 0	$f^{+}W_{S^{\perp}} \uparrow^{\alpha\beta}$	$\frac{8 i \sqrt{\frac{2}{3}} k (h_1 + h_8)}{a_0^2} = \frac{4 \sqrt{2} k^2 (h_1 + h_8)}{3 a_0^2}$	3 a. 2	, σ		0 $\sqrt{5}(k^2 h_1 + a_1)$	$\frac{1}{6}$ (-5 k^2 h_1 +2 a_0)	$(-2k^{2}h_{3} + a_{0})$ $(2k^{2}h_{7} + a_{0})$
		\mathcal{A}_{s}° $^{2}\mathcal{A}_{s}^{\parallel}$ \dagger^{al}	dx	0	0	0		$W_s^{\parallel} \dagger^{\alpha\beta\chi}$		0 $\frac{4}{a}$	$^{1}\mathcal{A}_{s}^{\parallelt}$	0	0 (k ² h	2 h	$(-2k^2)$
$\lambda_{\alpha\beta}$ λ		7-		1.2	1.41	ıt							75	(-5 <i>k</i>	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
$\mathcal{A}^{\alpha\beta\chi}$ γ $\alpha^{\alpha\beta\chi} \gamma$ $\alpha^{\chi} + 2$ $\alpha^{\chi} \alpha^{\mu} + 2$ $\alpha^{\chi} \alpha^{\mu} \beta^{\mu} + 4$ $\alpha^{\chi} \alpha^{\mu} \beta^{\mu} \alpha^{\mu} \beta^{\mu} \alpha^{\mu} \beta^{\mu} \alpha^{\mu} \beta^{\mu} \beta^{\mu} \alpha^{\mu} \beta^{\mu} \beta^{\mu}$	$\partial_{\delta}\partial_{\chi}h_{\beta}^{\ \ \ \ \ }$ $\partial_{\delta}\partial_{\chi}h_{\beta}^{\ \ \ \ \ \ \ \ }$ $\partial_{\delta}\partial_{\lambda}h_{\alpha\chi}$	P BX	Δ	$^{\perp}_{\alpha\beta}$ $^{1}\mathcal{T}^{\perp}_{\alpha}$	$^{1}\mathcal{W}_{S}$	α	$^{1}\mathcal{W}_{S}^{\parallelt}_{$		¹Ws¹hα	${}^{1}\mathcal{W}_{S}{}^{lh}{}_{\alpha}$	_		119	9	$\frac{1}{12}$
	αβ θδί α θδί βχ θδί	1+W _s +	$a\beta$ a 0	0	0		0		0	0			a.)	+ a.)	-a.)
$\begin{array}{c} 2 a_{\alpha} \mu^{\alpha\beta\kappa} + 8 \\ 2 a_{\alpha} h^{\alpha\beta} \partial_{\beta^{\alpha}} \\ 2 a_{\alpha} \partial^{\mu}_{\alpha} a_{\alpha} \\ 4 h_{\alpha} \partial_{\beta} A^{\alpha\beta\kappa} \\ 2 a_{\alpha} h^{\alpha}_{\alpha} \partial_{\lambda^{\alpha}} \\ 4 h_{\alpha} \partial_{\lambda} \partial_{\beta} h^{\delta}_{\delta} \\ 2 h_{\alpha} \partial_{\lambda} \partial_{\alpha} h^{\alpha}_{\delta} \\ 2 h_{\alpha} \partial_{\alpha} \partial_{\lambda} h^{\alpha\beta} \\ 2 h_{\alpha} \partial_{\alpha} \partial_{\alpha} h^{\alpha\beta} \\ 2 h_{\alpha} \partial_{\alpha} \partial_{\alpha} h^{\alpha\beta} \\ 2 h_{\alpha} \partial_{\alpha} h^{\alpha\beta} \\ 2 h_$	$2h, \frac{\partial_{\alpha} \partial^{\chi} h^{\alpha \beta}}{8} \partial_{\delta} \partial_{\chi} h_{\delta}^{\delta}$ $2h, \frac{\partial^{\chi} \partial^{\beta} h^{\alpha}}{8} \partial_{\delta} \partial_{\chi} h_{\delta}^{\delta}$ $4h, \frac{\partial_{\beta} \mathcal{A}^{\alpha \beta \gamma}}{8} \partial_{\delta} \partial_{\delta} h_{\alpha \gamma}$	1 W ₅ + 1 W	r ^α 0	d	0		0		0	0	As tt		$0 \\ \frac{1}{6} \left(-k^2 h, -2 a_{,} \right)$	$\sqrt{5} \left(k^2 h, + a, \right)$	$\frac{2k^2h_7+a_0}{12\sqrt{2}}$ (-2 k^2h_8 +
2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 h; 0 2 h; 0 4 h; 0	5 1 W _s ^{⊥t} .	ρα 0	d <u>1</u>	($\frac{4 k^2 (h.+h.)-4 a.}{a0^{2}})$	$\frac{1}{3} \sqrt{5} \left(\frac{1}{k^2 \left(-h_1 + h_2 \right) - 3 a_0} + \frac{1}{2} \right)$	$-\frac{2}{a_0}$) $\frac{2\sqrt{2}}{}$	$(2 k^4 (hh.)(h.+h.)+k^2 (7 h.+5 h.) a.+a$	$\frac{a_0^{2}}{a_0^{2}} = \frac{4}{3} \left(\frac{1}{a_0} - \frac{2}{k^2 (h_0 - h_0) + 3 a_0^{2}} \right)$	1 3		[-k ²]	/5 (k	$\frac{2k^2}{12}$
<u>α</u> 2		i vv _S		3	$\frac{1}{k^2 (-h.+h.)-3 a.}$	a.2 /			$3a{0}^{2}(k^{2}(hh.)+3a.)$			0	0 0	اء ح	$\frac{1}{12}$
a		$^{1}\mathcal{W}_{s}^{\parallelt}$	r ^α 0	0	$\frac{1}{3} \sqrt{5} \left(\frac{1}{k^2 \left(-h_1 + h_2 \right)} \right)$	$\frac{1}{(a_1)^{-3}a_2} + \frac{2}{a_2}$	$\frac{4}{3a} - \frac{5}{3k^2 (h - h) + 9a}$		$\frac{2\sqrt{10}(k^2(hh.)+a.)}{2\sqrt{k^2(hh.)+a.}}$	$\frac{4\sqrt{5}(k^2(hh.)+a.)}{780}$	$^{1} h^{^{\perp}}_{$	0	0 0	0	0 0
$S = \iiint \left(\frac{1}{8} \left(.4 a_0 \right) \right)$		•							$\frac{3a.(k^{2}(h_{7}-h_{8})+3a.)}{78800000000000000000000000000000000000$	$3 a_0 (k^2 (hh.) + 3 a_0)$	8				
		¹ W _s ^{⊥h} .	r ^α 0	$0 \frac{2\sqrt{2}}{}$	$\frac{(2 k^4 (h_7 - h_8)(h_7 + h_8)}{3 a_0^2 (k^2 (h_7 - h_8))}$	$\frac{1+k^2(7h_1+5h_1)a_1+a_1^2}{78000000000000000000000000000000000000$	$\frac{2\sqrt{10}(k^2(h_7-h_8)+a_0)}{3a_0(k^2(h_7-h_8)+3a_0)}$		$\frac{8}{3} \left(\frac{k^2 (h_{7} + h_{8}) + 2 a_{0}}{a_{0}^{2}} - \frac{4}{k^2 (h_{7} - h_{8}) + 3 a_{0}} \right)$	$\frac{4}{3} \sqrt{2} \left(\frac{1}{a_0} - \frac{8}{k^2 (h_{7} - h_{8}) + 3} \right)$	$\mathcal{A}_{s^{\perp}\alpha\beta}^{1}$. ₀ 4	0 0	0	0
												+αβ	a+ a+	φ+	ε ₊ +
Ŋ		¹ W _s ∥h	r ^α 0	0	$\frac{4}{3} \left(\frac{1}{a} - \frac{1}{k^2 (h)} \right)$	-h.)+3a.	$\frac{4\sqrt{5}(k^{2}(hh.)+a.)}{3a.(k^{2}(hh.)+3a.)}$		$\frac{4}{3}\sqrt{2}\left(\frac{1}{a_0}-\frac{8}{k^2(h_0-h_0)+3a_0}\right)$	$\frac{4}{3} \left(\frac{5}{a_0} - \frac{16}{k^2 (h_1 - h_1) + 3 a_0} \right)$)	As t	$\frac{1}{n^{\perp}} + \frac{\alpha}{\alpha}$ $\mathcal{A}_{s^{\perp t}} + \frac{\alpha}{\alpha}$	$\mathcal{A}_{s^{llt}} \!$	As ^{⊥h} †" As™†"

Massive and massless spectra

$J^{P} = 1^{-}$ $\chi^{P} = (0,0,p)$ $\chi^{P} = (0,0$	Pole residue: $\frac{1}{a_0} > 0$ Polarisations: 2	? $k^{\mu} = (p, 0, p, p)$? Massless particle
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Unitarity conditions

$$h. \in \mathbb{R} \&\& a. < 0 \&\& h. < h. 7$$