Particle spectrograph

Wave operator and propagator

Spin-parity form	Covariant form	Multiplicities
$0^+_1\ \sigma$ ==0	$\epsilon\eta_{\alpha\beta\chi\delta}\ \partial^\delta\sigma^{\alpha\beta\chi}$ == 0	1
$0^+_2\ \tau$ ==0	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}$ == 0	1
$0^+_1\ \tau$ -2 i k $0^+_1\ \sigma$ ==0	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}$ == $\partial_\chi\partial^\beta\tau^\alpha{}_\alpha$ +2 $\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}{}_\alpha$	1
$1^-_2\ \tau^\alpha$ +2 i k $1^-_2\ \sigma^\alpha$ == 0	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi}$ == $\partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta}$ +2 $\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	3
$1^-_1\ \tau^\alpha$ == 0	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi}$ == $\partial_\chi\partial^\chi\partial_\beta\tau^{\beta\alpha}$	3
$1^+_1\ \tau^{\alpha\beta}$ + i k $1^+_2\ \sigma^{\alpha\beta}$ == 0	$\partial_\chi\partial^\alpha\tau^{\beta\chi}$ + $\partial_\chi\partial^\beta\tau^{\chi\alpha}$ + $\partial_\chi\partial^\chi\tau^{\alpha\beta}$ +2 $\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta}$ +2 $\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi}$ == $\partial_\chi\partial^\alpha\tau^{\chi\beta}$ + $\partial_\chi\partial^\beta\tau^{\alpha\chi}$ + $\partial_\chi\partial^\chi\tau^{\beta\alpha}$ +2 $\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
$2^+_1\ \tau^{\alpha\beta}$ -2 i k $2^+_2\ \sigma^{\alpha\beta}$ == 0	-i (4 $\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta}$ +2 $\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi$ -3 $\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi}$ -3 $\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\chi\beta}$ - 3 $\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi}$ -3 $\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha}$ +3 $\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}$ + 3 $\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha}$ +4 i k^χ $\partial_\epsilon\partial_\chi\partial^\beta\partial^\alpha\sigma^{\delta\epsilon}{}_\delta$ -6 i i k^χ $\partial_\epsilon\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\delta\epsilon}$ - 6 i i k^χ $\partial_\epsilon\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\delta\epsilon}$ +2 $\eta^{\alpha\beta}$ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta}$ + 6 i i k^χ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\alpha\delta\beta}$ +6 i i k^χ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\beta\delta\alpha}$ - 2 $\eta^{\alpha\beta}$ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi$ -4 i i $\eta^{\alpha\beta}$ k^χ $\partial_\phi\partial^\phi\partial_\epsilon\partial_\chi\sigma^{\delta\epsilon}{}_\delta$) == 0	5
Total expected gauge generators:		17

	$1^+_1\ \sigma_{\alpha\beta}$	$1^+_2\ \sigma_{\alpha\beta}$	$1^+_1\ \tau_{\alpha\beta}$	$1^-_1\ \sigma_\alpha$	$1^-_2\ \sigma_\alpha$	$1^-_1\ \tau_\alpha$	$1^-_2\ \tau_\alpha$
$1^+_1\ \sigma\dagger^{\alpha\beta}$	$\frac{1}{k^2(2r_1+r_5)}$	$\frac{1}{\sqrt{2}(k^2+k^4)(2r_1+r_5)}$	$\frac{i}{\sqrt{2}(k+k^3)(2r_1+r_5)}$	0	0	0	0
$1^+_2\ \sigma\dagger^{\alpha\beta}$	$\frac{1}{\sqrt{2}(k^2+k^4)(2r_1+r_5)}$	$\frac{6k^2(2r_1+r_5)+t_1}{2(k+k^3)^2(2r_1+r_5)t_1}$	$\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0
$1^+_1\ \tau\dagger^{\alpha\beta}$	$-\frac{i}{\sqrt{2}(k+k^3)(2r_1+r_5)}$	$-\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	$\frac{6k^2(2r_1+r_5)+t_1}{2(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0
$1^-_1\ \sigma\dagger^\alpha$	0	0	0 0		$\frac{\sqrt{2}}{t_1+2k^2t_1}$	0	$\frac{2ik}{t_1+2k^2t_1}$
$1^-_2\ \sigma\dagger^\alpha$	0	0	0	$\frac{\sqrt{2}}{t_1+2k^2t_1}$	$\frac{-2k^2(r_1+r_5)+t_1}{(t_1+2k^2t_1)^2}$	0	$-\frac{i\sqrt{2}k(2k^2(r_1+r_5)+t_1)}{(t_1+2k^2t_1)^2}$
$1^-_1\ \tau\dagger^\alpha$	0	0	0 0		0	0	0
$1^-_2\ \tau\dagger^\alpha$	0	0	0	$-\frac{2ik}{t_1+2k^2t_1}$	$\frac{i\sqrt{2}k(2k^2(r_1+r_5)+t_1)}{(t_1+2k^2t_1)^2}$	0	$\frac{-4k^4(r_1+r_5)+2k^2t_1}{(t_1+2k^2t_1)^2}$

$$\mathcal{S} == \int\int\int\int (\tfrac{1}{3}(3t_1\,\mathcal{A}^{\alpha\iota}{}_\alpha\,\mathcal{A}_\iota{}^\theta{}_\theta + 3\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 3\,\mathcal{A}^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 6t_1\,\mathcal{A}_\alpha{}^\theta{}_\theta\,\partial_\iota f^{\alpha\iota} + 6t_1\,\mathcal{A}_\iota{}^\theta{}_\theta\,\partial^\iota f^\alpha{}_\alpha - 3t_1\partial_\iota f^\theta{}_\theta\,\partial^\iota f^\alpha{}_\alpha - 3t_1\partial_\iota f^{\alpha\iota}\,\partial_\theta f_\alpha{}^\theta + 6t_1\partial^\iota f^\alpha{}_\alpha\,\partial_\theta f_\iota{}^\theta + 2t_1\,\mathcal{A}_{\iota\theta\alpha}\,\partial^\theta f^{\alpha\iota} - 2t_1\partial_\alpha f_{\iota\theta}\,\partial^\theta f^{\alpha\iota} - 2t_1\partial_\alpha f_{\theta\iota}\,\partial^\theta f^{\alpha\iota} + t_1\partial_\theta f_{\alpha\iota}\,\partial^\theta f^{\alpha\iota} + 2t_1\partial_\theta f_{\alpha\iota}\,\partial^\theta f^{\alpha\iota} + t_1\partial_\theta f_{\iota\alpha}\,\partial^\theta f^{\alpha\iota} + t_1\,\mathcal{A}_{\alpha\iota\theta}\,(\mathcal{A}^{\alpha\iota\theta} + 2\,\partial^\theta f^{\alpha\iota}) + t_1\,\mathcal{A}_{\alpha\theta\iota}\,(\mathcal{A}^{\alpha\iota\theta} + 4\,\partial^\theta f^{\alpha\iota}) - 4r_1\partial_\beta\mathcal{A}_{\alpha\iota\theta}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} + 2r_1\partial_\beta\mathcal{A}_{\alpha\theta\iota}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} - 8r_1\partial_\beta\mathcal{A}_{\iota\theta\alpha}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} - 2r_1\partial_\iota\mathcal{A}_{\alpha\beta\theta}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} + 2r_1\partial_\theta\mathcal{A}_{\alpha\beta\iota}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} + 2r_1\partial_\theta\mathcal{A}_{\alpha\iota\beta}\,\partial^\theta\mathcal{A}^{\alpha\beta\iota} + 3r_5\partial_\iota\mathcal{A}_\theta{}^\kappa{}_\kappa\,\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - 3r_5\partial_\theta\mathcal{A}_\iota{}^\kappa{}_\kappa\,\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - 3r_5\partial_\alpha\mathcal{A}^{\alpha\iota\theta}\,\partial_\kappa\mathcal{A}_\iota{}^\kappa{}_\theta + 6r_5\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha\,\partial_\kappa\mathcal{A}_\iota{}^\kappa{}_\theta + 3r_5\partial_\alpha\mathcal{A}^{\alpha\iota\theta}\,\partial_\kappa\mathcal{A}_\theta{}^\kappa{}_\iota - 6r_5\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha\,\partial_\kappa\mathcal{A}_\theta{}^\kappa{}_\iota))[t, x, y, z]\,dt\,dz\,dy\,dx\,dt$$

	$1^+_1\ \mathcal{A}\dagger^{\alpha\beta}$	$1^+_2\ \mathcal{A}\dagger^{\alpha\beta}$	$1^+_1\ f\dagger^{\alpha\beta}$	$1^-_1\ \mathcal{A}\dagger^\alpha$	$1^-_2\ \mathcal{A}\dagger^\alpha$	$1^-_1\ f\dagger^\alpha$	$1^-_2\ f\dagger^\alpha$
$1^+_1\ \mathcal{A}^{\alpha\beta}$	$k^2(2r_1+r_5)+\frac{t_1}{6}$	$-\frac{t_1}{3\sqrt{2}}$	$-\frac{ikt}{3\sqrt{2}}$	0	0	0	0
$1^+_2\ \mathcal{A}^{\alpha\beta}$	$-\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	$\frac{ikt}{3}$	0	0	0	0
$1^+_1\ f^{\alpha\beta}$	$-\frac{ikt}{3\sqrt{2}}$	$\frac{ikt}{3}$	$\frac{k^2t_1}{3}$	0	0	0	0
$1^-_1\ \mathcal{A}^\alpha$	0	0	0	$k^2(r_1+r_5)-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$-ikt$
$1^-_2\ \mathcal{A}^\alpha$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$1^-_1\ f^\alpha$	0	0	0	0	0	0	0
$1^-_2\ f^\alpha$	0	0	0	0	0	0	0

	$0^+_1\ \mathcal{A}$	$0^+_2\ f$	$0^+_1\ f$	$0^-_1\ \mathcal{A}$
$0^+_1\ \mathcal{A}\dagger$	$-t_1$	$-i\sqrt{2}kt_1$	0	0
$0^+_2\ f\dagger$	$i\sqrt{2}kt_1$	$-2k^2t_1$	0	0
$0^+_1\ f\dagger$	0	0	0	0
$0^-_1\ \mathcal{A}\dagger$	0	0	0	0

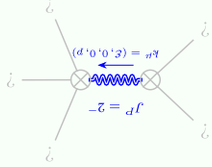
	$0^+_1\ \sigma$	$0^+_1\ \tau$	$0^+_2\ \tau$	$0^-_1\ \sigma$
$0^+_1\ \sigma\dagger$	$-\frac{1}{(1+2k^2)^2t_1}$	$\frac{i\sqrt{2}k}{(1+2k^2)^2t_1}$	0	0
$0^+_1\ \tau\dagger$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2t_1}$	$-\frac{2k^2}{(1+2k^2)^2t_1}$	0	0
$0^+_2\ \tau\dagger$	0	0 0		0
$0^-_1\ \sigma\dagger$	0	0 0		0

	$1^+_1\ \mathcal{A}_{\alpha\beta}$	$1^+_2\ \mathcal{A}_{\alpha\beta}$	$1^+_1\ f_{\alpha\beta}$	$1^-_1\ \mathcal{A}_\alpha$	$1^-_2\ \mathcal{A}_\alpha$	$1^-_1\ f_\alpha$	$1^-_2\ f_\alpha$
$1^+_1\ \mathcal{A}\dagger^{\alpha\beta}$	$k^2(2r_1+r_5)+\frac{t_1}{6}$	$-\frac{t_1}{3\sqrt{2}}$	$-\frac{ikt}{3\sqrt{2}}$	0	0	0	0
$1^+_2\ \mathcal{A}\dagger^{\alpha\beta}$	$-\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	$\frac{ikt}{3}$	0	0	0	0
$1^+_1\ f\dagger^{\alpha\beta}$	$-\frac{ikt}{3\sqrt{2}}$	$\frac{ikt}{3}$	$\frac{k^2t_1}{3}$	0	0	0	0
$1^-_1\ \mathcal{A}\dagger^\alpha$	0	0	0	$k^2(r_1+r_5)-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$-ikt$
$1^-_2\ \mathcal{A}\dagger^\alpha$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$1^-_1\ f\dagger^\alpha$	0	0	0	0	0	0	0
$1^-_2\ f\dagger^\alpha$	0	0	0	0	0	0	0

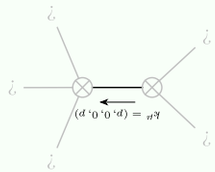
	$2^+_1\ \sigma_{\alpha\beta}$	$2^+_1\ \tau_{\alpha\beta}$	$2^-_1\ \sigma_{\alpha\beta\chi}$
$2^+_1\ \sigma\dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2t_1}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	0
$2^+_1\ \tau\dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	$\frac{4k^2}{(1+2k^2)^2t_1}$	0
$2^-_1\ \sigma\dagger^{\alpha\beta\chi}$	0	$\frac{2}{2k^2r_1+t_1}$	0

	$2^+_1\ \mathcal{A}_{\alpha\beta}$	$2^+_1\ f_{\alpha\beta}$	$2^-_1\ \mathcal{A}_{\alpha\beta\chi}$
$2^+_1\ \mathcal{A}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt}{\sqrt{2}}$	0
$2^+_1\ f\dagger^{\alpha\beta}$	$\frac{ikt}{\sqrt{2}}$	k^2t_1	0
$2^-_1\ \mathcal{A}\dagger^{\alpha\beta\chi}$	0	0	$k^2r_1+\frac{t_1}{2}$

Massive and massless spectra



Pole residue:	$\frac{1}{r_1} > 0$
Square mass:	$-\frac{t_1}{2r_1} > 0$
Spin:	2
Parity:	Odd



Polaresidue:	$\frac{1}{(2r_1+r_5)t_1r_1^2p^2} > 0$
Polarisations:	2

Unitarity conditions