Particle spectrograph

Wave operator and propagator

Spin-parity form	Covariant form	Multiplicities
0^+ τ ==0	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}$ == 0	1
0^+ τ -2 i k 0^+ σ ==0	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}$ == $\partial_\beta\partial^\beta\tau^\alpha{}_\alpha$ +2 $\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}{}_\alpha$	1
1^- τ^α +2 i k 1^- σ^α == 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^- τ^α == 0	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi}$ == $\partial_\chi\partial^\chi\partial_\beta\tau^{\beta\alpha}$	3
1^+ $\tau^{\alpha\beta}$ + i k 1^+ $\sigma^{\alpha\beta}$ == 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^- $\sigma^{\alpha\beta\chi}$ == 0 3	$\partial_\epsilon\partial_\delta\partial^\chi\partial^\alpha\sigma^{\beta\delta\epsilon}$ +3 $\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\alpha\sigma^{\beta\delta}{}_\delta$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\chi\delta}$ + 4 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\delta\chi}$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\delta\beta}$ +4 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\beta\delta}$ + 2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\delta\beta}$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha}$ +3 $\eta^{\beta\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial^\alpha\sigma^{\delta\epsilon}{}_\delta$ + 3 $\eta^{\alpha\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\beta\delta\epsilon}$ +3 $\eta^{\beta\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\alpha\delta}{}_\delta$ == 3 $\partial_\epsilon\partial_\delta\partial^\chi\partial^\beta\sigma^{\alpha\delta\epsilon}$ +3 $\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\beta\sigma^{\alpha\delta}{}_\delta$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\chi\delta}$ + 4 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\delta\chi}$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\chi\delta\beta}$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\beta\delta\alpha}$ + 4 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi}$ +2 $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\chi\beta}$ +3 $\eta^{\alpha\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial^\beta\sigma^{\delta\epsilon}{}_\delta$ + 3 $\eta^{\beta\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\alpha\delta\epsilon}$ +3 $\eta^{\alpha\chi}$ $\partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\beta\delta}{}_\delta$	5
2^+ $\tau^{\alpha\beta}$ == 0 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 $\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}$ +3 $\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha}$ + 2 $\eta^{\alpha\beta}$ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta}$ == 3 $\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi}$ +3 $\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}$ + 3 $\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi}$ +3 $\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha}$ +2 $\eta^{\alpha\beta}$ $\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi$	5
Total expected gauge generators:		21

$$\mathcal{S} == \iiint\!\!\int \left(\tfrac{1}{6}\,(-4\,t_3\,\mathcal{A}^{\alpha\prime}{}_{\alpha}\;\mathcal{A}_{\prime}{}^{\theta}{}_{\theta} + 6\;f^{\alpha\beta}\;\tau_{\alpha\beta} + 6\;\mathcal{A}^{\alpha\beta\chi}\;\sigma_{\alpha\beta\chi} + 8\,t_3\,\mathcal{A}_{\alpha}{}^{\theta}{}_{\theta}\;\partial_\prime f^{\alpha\prime}{}_{\alpha} - 8\,t_3\,\mathcal{A}_{\prime}{}^{\theta}{}_{\theta}\;\partial^\prime f^{\alpha}{}_{\alpha} + 4\,t_3\,\partial_\prime f^{\theta}{}_{\theta}\,\partial^\prime f^{\alpha}{}_{\alpha} - 3\,r_3\,\partial_\beta\mathcal{A}_{\prime}{}^{\theta}{}_{\theta}\;\partial^\prime\mathcal{A}^{\alpha\beta}{}_{\alpha} - 3\,r_3\,\partial_\prime\mathcal{A}_{\beta}{}^{\theta}{}_{\theta}\;\partial^\prime\mathcal{A}^{\alpha\beta}{}_{\alpha} + 4\,t_3\,\partial_\prime f^{\alpha\prime}\;\partial_\theta f_{\alpha}{}^{\theta} - 8\,t_3\,\partial^\prime f^{\alpha}{}_{\alpha}\;\partial_\theta f_{\prime}{}^{\theta} - 3\,r_3\,\partial_\alpha\mathcal{A}^{\alpha\beta\prime}\;\partial_\theta\mathcal{A}_{\beta}{}^{\theta}{}_{\prime} + 6\,r_3\,\partial^\prime\mathcal{A}^{\alpha\beta}{}_{\alpha}\;\partial_\theta\mathcal{A}_{\beta}{}^{\theta}{}_{\prime} - 3\,r_3\,\partial_\alpha\mathcal{A}^{\alpha\beta\prime}\;\partial_\theta\mathcal{A}_{\prime}{}^{\theta}{}_{\beta} + 6\,r_3\,\partial^\prime\mathcal{A}^{\alpha\beta}{}_{\alpha}\;\partial_\theta\mathcal{A}_{\prime}{}^{\theta}{}_{\beta} + 4\,t_2\;\mathcal{A}_{\prime\theta\alpha}\;\partial^\theta f^{\alpha\prime} + 2\,t_2\,\partial_\alpha f_{\prime\theta}\;\partial^\theta f^{\alpha\prime} - t_2\,\partial_\alpha f_{\theta\prime}\;\partial^\theta f^{\alpha\prime} - t_2\,\partial_\prime f_{\alpha\theta}\;\partial^\theta f^{\alpha\prime} + t_2\,\partial_\theta f_{\alpha\prime}\;\partial^\theta f^{\alpha\prime} - t_2\,\partial_\theta f_{\prime\alpha}\;\partial^\theta f^{\alpha\prime} - 4\,t_2\;\mathcal{A}_{\alpha\theta\prime}\;(\mathcal{A}^{\alpha\prime\theta} + \partial^\theta f^{\alpha\prime}) + 2\,t_2\;\mathcal{A}_{\alpha\prime\theta}\;(\mathcal{A}^{\alpha\prime\theta} + 2\;\partial^\theta f^{\alpha\prime}) + 8\,r_2\,\partial_\beta\mathcal{A}_{\alpha\prime\theta}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} - 4\,r_2\,\partial_\beta\mathcal{A}_{\alpha\theta\prime}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} + 4\,r_2\,\partial_\beta\mathcal{A}_{\prime\theta\alpha}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} - 24\,r_3\,\partial_\beta\mathcal{A}_{\prime\theta\alpha}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} - 2\,r_2\,\partial_\prime\mathcal{A}_{\alpha\beta\theta}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} + 2\,r_2\,\partial_\theta\mathcal{A}_{\alpha\beta\prime}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} - 4\,r_2\,\partial_\theta\mathcal{A}_{\alpha\prime\beta}\;\partial^\theta\mathcal{A}^{\alpha\beta\prime} + 6\,r_5\,\partial_\prime\mathcal{A}_{\theta}{}^{\kappa}{}_{\kappa}\;\partial^\theta\mathcal{A}^{\alpha\prime}{}_{\alpha} - 6\,r_5\,\partial_\theta\mathcal{A}_{\prime}{}^{\kappa}{}_{\kappa}\;\partial^\theta\mathcal{A}^{\alpha\prime}{}_{\alpha} + 12\,r_5\,\partial^\theta\mathcal{A}^{\alpha\prime}{}_{\alpha}\;\partial_\kappa\mathcal{A}_{\prime}{}^{\kappa}{}_{\theta} + 6\,r_5\,\partial_\alpha\mathcal{A}^{\alpha\prime\theta}\;\partial_\kappa\mathcal{A}_{\prime}{}^{\kappa}{}_{\theta} - 12\,r_5\,\partial^\theta\mathcal{A}^{\alpha\prime}{}_{\alpha}\;\partial_\kappa\mathcal{A}_{\theta}{}^{\kappa}{}_{\prime})\right)[t, x, y, z]\,dt\;dz\;dy\;dx\;dt$$

	$1^+\,\sigma_{\alpha\beta}$	$2^+\,\sigma_{\alpha\beta}$	$1^+\,\tau_{\alpha\beta}$	$1^-\,\sigma_\alpha$	$2^-\,\sigma_\alpha$	$1^-\,\tau_\alpha$	$2^-\,\tau_\alpha$
$1^+\,\sigma^\dagger{}^{\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3+r_5)}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)(2\,r_3+r_5)}$	$-\frac{i\,\sqrt{2}}{k\,(1+k^2)(2\,r_3+r_5)}$	0	0	0	0
$2^+\,\sigma^\dagger{}^{\alpha\beta}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)(2\,r_3+r_5)}$	$\frac{3\,k^2\,(2\,r_3+r_5)+2\,t_2}{(k+k^3)^2\,(2\,r_3+r_5)\,t_2}$	$-\frac{i\,(3\,k^2\,(2\,r_3+r_5)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	0	0	0
$1^+\,\tau^\dagger{}^{\alpha\beta}$	$\frac{i\,\sqrt{2}}{k\,(1+k^2)(2\,r_3+r_5)}$	$-\frac{i\,(3\,k^2\,(2\,r_3+r_5)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	$\frac{3\,k^2\,(2\,r_3+r_5)+2\,t_2}{(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	0	0	0
$1^-\,\sigma^\dagger{}^{\alpha}$	0	0	0	$\frac{2}{k^2\,(r_3+2\,r_5)}$	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)(r_3+2\,r_5)}$	0	$\frac{4\,i}{k\,(1+2\,k^2)(r_3+2\,r_5)}$
$2^-\,\sigma^\dagger{}^{\alpha}$	0	0	0	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)(r_3+2\,r_5)}$	$\frac{3\,k^2\,(r_3+2\,r_5)+4\,t_3}{(k+2\,k^3)^2\,(r_3+2\,r_5)\,t_3}$	0	$\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$
$1^-\,\tau^\dagger{}^{\alpha}$	0	0	0	0	0 0		0
$2^-\,\tau^\dagger{}^{\alpha}$	0	0	0	$-\frac{4\,i}{k\,(1+2\,k^2)(r_3+2\,r_5)}$	$-\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$	0	$\frac{6\,k^2\,(r_3+2\,r_5)+8\,t_3}{(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$

	$1^+\,\mathcal{A}_{\alpha\beta}$	$2^+\,\mathcal{A}_{\alpha\beta}$	$1^+\,f_{\alpha\beta}$	$1^-\,\mathcal{A}_\alpha$	$2^-\,\mathcal{A}_\alpha$	$1^-\,f_\alpha$	$2^-\,f_\alpha$
$1^+\,\mathcal{A}^\dagger{}^{\alpha\beta}$	$k^2\,(2\,r_3+r_5)+\frac{2\,t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0 0		0	0
$2^+\,\mathcal{A}^\dagger{}^{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0 0		0	0
$1^+\,f^\dagger{}^{\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{1}{3}\,i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0 0		0	0
$1^-\,\mathcal{A}^\dagger{}^{\alpha}$	0 0	0		$k^2\,(\frac{r_3}{2}+r_5)+\frac{2\,t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	0	$-\frac{2}{3}\,i\,k\,t_2$
$2^-\,\mathcal{A}^\dagger{}^{\alpha}$	0 0	0		$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$
$1^-\,f^\dagger{}^{\alpha}$	0 0	0		0 0		0	0
$2^-\,f^\dagger{}^{\alpha}$	0 0	0		$\frac{2\,i\,k\,t_2}{3}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	$\frac{2\,k^2\,t_3}{3}$

	$2^+\,\mathcal{A}^\dagger{}^{\alpha\beta\chi}$	$2^+\,f^\dagger{}^{\alpha\beta}$	$2^+\,\mathcal{A}^\dagger{}^{\alpha\beta}$
$2^+\,\mathcal{A}_{\alpha\beta}$	0	0	$-\frac{3\,k^2\,r_3}{2}$
$2^+\,f_{\alpha\beta}$	0	0	0
$2^-\,\mathcal{A}_{\alpha\beta\chi}$	0	0	0

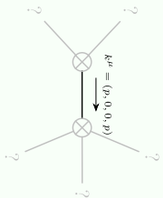
	$0^+\,\mathcal{A}$	$0^+\,f$	$0^+\,f$	$0^-\,\mathcal{A}$
$0^+\,\mathcal{A}^\dagger$	t_3	$-i\,\sqrt{2}\,k\,t_2$	0	0
$0^+\,f^\dagger$	$i\,\sqrt{2}\,k\,t_2$	$2\,k^2\,t_3$	0	0
$0^+\,f^\dagger$	0	0	0	0
$0^-\,\mathcal{A}^\dagger$	0	0	0	$k^2\,r_2+t_2$

	$0^+\,\sigma$	$0^+\,\tau$	$0^+\,\tau$	$0^-\,\sigma$
$0^+\,\sigma^\dagger$	$\frac{1}{(1+2\,k^2)^2\,t_3}$	$-\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_3}$	0	0
$0^+\,\tau^\dagger$	$\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_3}$	$\frac{2\,k^2}{(1+2\,k^2)^2\,t_3}$	0	0
$0^+\,\tau^\dagger$	0	0	0	0
$0^-\,\sigma^\dagger$	0	0	0	$\frac{1}{k^2\,r_2+t_2}$

	$2^+\,\sigma^\dagger{}^{\alpha\beta\chi}$	$2^+\,\tau^\dagger{}^{\alpha\beta}$	$2^+\,\sigma^\dagger{}^{\alpha\beta}$
$2^+\,\sigma_{\alpha\beta}$	0	0	$-\frac{2}{3\,k^2\,r_3}$
$2^+\,\tau_{\alpha\beta}$	0	0	0
$2^-\,\sigma_{\alpha\beta\chi}$	0	0	0

Massive and massless spectra

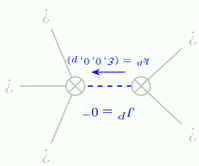
Massless particle



Pole residue: $\frac{1}{r_3\,(2\,r_3+r_5)(r_3+2\,r_5)\,p^2} > 0$

Polarisations: 2

Massive particle



Pole residue:	$-\frac{1}{r_2} > 0$
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

Unitarity conditions