Particle spectrograph

Wave operator and propagator

Spin-parity form	Covariant form	Multiplicities
${}^{\#2}_{}0^{+}\tau == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == 0$	1
${}^{\#1}_{}0^{+}\tau == 0$	$\partial_\beta\partial^\beta\tau^\alpha{}_\alpha == \partial_\beta\partial_\alpha\tau^{\alpha\beta}$	1
${}^{\#2}_{}1^{-}\tau^{\alpha} + 2\,i\,k\,{}^{\#2}_{}1^{-}\sigma^{\alpha} == 0$	$\partial_\chi\partial^\alpha\partial_\beta\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta} + 2\,\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	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
${}^{\#1}_{}1^{+}\tau^{\alpha\beta} + i\,k\,{}^{\#2}_{}1^{+}\sigma^{\alpha\beta} == 0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi} + \partial_\chi\partial^\chi\tau^{\alpha\beta} + 2\,\partial_\delta\partial^\alpha\partial_\chi\sigma^{\beta\chi\delta} + 2\,\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi} == \partial_\chi\partial^\beta\tau^{\alpha\chi} + \partial_\chi\partial^\beta\tau^{\chi\alpha} + \partial_\chi\partial^\chi\tau^{\beta\alpha} + 2\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
${}^{\#1}_{}2^{+}\tau^{\alpha\beta} - 2\,i\,k\,{}^{\#1}_{}2^{+}\sigma^{\alpha\beta} == 0$	$-i(4\,\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta} + 2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi} - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\chi\beta} - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi} - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha} + 4\,i\,k^\chi\,\partial_\epsilon\partial_\chi\partial^\beta\partial^\alpha\sigma^{\delta\epsilon}{}_\delta - 6\,i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\delta\epsilon} - 6\,i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\delta\epsilon} + 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta} + 6\,i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\alpha\delta\beta} + 6\,i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\beta\delta\alpha} - 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi - 4\,i\,\eta^{\alpha\beta}\,k^\chi\,\partial_\phi\partial^\phi\partial_\epsilon\partial_\chi\sigma^{\delta\epsilon}{}_\delta) == 0$	5
Total expected gauge generators:		16

	${}^{\#1}_{}1^{+}\sigma_{\alpha\beta}$	${}^{\#2}_{}1^{+}\sigma_{\alpha\beta}$	${}^{\#1}_{}1^{+}\tau_{\alpha\beta}$	${}^{\#1}_{}1^{-}\sigma_{\alpha}$	${}^{\#2}_{}1^{-}\sigma_{\alpha}$	${}^{\#1}_{}1^{-}\tau_{\alpha}$	${}^{\#2}_{}1^{-}\tau_{\alpha}$
${}^{\#1}_{}1^{+}\sigma\dagger^{\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$-\frac{i\sqrt{2}k}{t_1+k^2 t_1}$	0	0	0	0
${}^{\#2}_{}1^{+}\sigma\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{-2k^2(2r_3+r_5)+t_1}{(1+k^2)^2 t_1^2}$	$\frac{-2i k^3(2r_3+r_5)+i k t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
${}^{\#1}_{}1^{+}\tau\dagger^{\alpha\beta}$	$\frac{i\sqrt{2}k}{t_1+k^2 t_1}$	$\frac{i(2k^3(2r_3+r_5)+k t_1)}{(1+k^2)^2 t_1^2}$	$\frac{-2k^4(2r_3+r_5)+k^2 t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
${}^{\#1}_{}1^{-}\sigma\dagger^{\alpha}$	0	0	0	$\frac{1}{k^2(2r_3+r_5)}$	$-\frac{1}{\sqrt{2}(k^2+2k^4)(2r_3+r_5)}$	0	$-\frac{i}{k(1+2k^2)(2r_3+r_5)}$
${}^{\#2}_{}1^{-}\sigma\dagger^{\alpha}$	0	0	0	$-\frac{1}{\sqrt{2}(k^2+2k^4)(2r_3+r_5)}$	$\frac{6k^2(2r_3+r_5)+t_1}{2(k+2k^3)^2(2r_3+r_5)t_1}$	0	$\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}k(1+2k^2)^2(2r_3+r_5)t_1}$
${}^{\#1}_{}1^{-}\tau\dagger^{\alpha}$	0	0	0	0	0	0	0
${}^{\#2}_{}1^{-}\tau\dagger^{\alpha}$	0	0	0	$\frac{i}{k(1+2k^2)(2r_3+r_5)}$	$-\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}k(1+2k^2)^2(2r_3+r_5)t_1}$	0	$\frac{6k^2(2r_3+r_5)+t_1}{(1+2k^2)^2(2r_3+r_5)t_1}$

$$S == \iiiint (f^{\alpha\beta}\tau_{\alpha\beta} + \mathcal{A}^{\alpha\beta\chi}\sigma_{\alpha\beta\chi} + \tfrac{1}{6}t_1(2\mathcal{A}^{\alpha\iota}{}_\alpha\mathcal{A}_{\iota\theta}{}^\theta - 4\mathcal{A}_{\iota\theta}{}^\theta\partial_\alpha f^{\alpha\iota} + 4\mathcal{A}_{\iota\theta}{}^\theta\partial^\iota f^\alpha{}_\alpha - 2\partial_\iota f^\theta{}_\theta\partial^\iota f^\alpha{}_\alpha - 2\partial_\theta f^\theta{}_\alpha\partial^\iota f^\alpha{}_\iota + 4\partial^\iota f^\alpha{}_\alpha\partial_\theta f_\iota{}^\theta - 6\partial_\alpha f_{\iota\theta}\partial^\theta f^{\alpha\iota} - 3\partial_\alpha f_{\theta\iota}\partial^\theta f^{\alpha\iota} + 3\partial_\iota f_{\alpha\theta}\partial^\theta f^{\alpha\iota} + 3\partial_\theta f_{\alpha\iota}\partial^\theta f^{\alpha\iota} + 3\partial_\theta f_{\iota\alpha}\partial^\theta f^{\alpha\iota} + 6\mathcal{A}_{\alpha\theta\iota}(\mathcal{A}^{\alpha\iota\theta} + 2\partial^\theta f^{\alpha\iota})) - 2r_3(\partial_\beta\mathcal{A}_\iota{}^\theta{}_\theta\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\iota\mathcal{A}_\beta{}^\theta{}_\theta\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\alpha\mathcal{A}^{\alpha\beta\iota}\partial_\theta\mathcal{A}_{\beta\iota}{}^\theta - 2\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha\partial_\theta\mathcal{A}_{\beta\iota}{}^\theta + \partial_\alpha\mathcal{A}^{\alpha\beta\iota}\partial_\theta\mathcal{A}_{\iota\beta}{}^\theta - 2\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha\partial_\theta\mathcal{A}_{\iota\beta}{}^\theta + 2\partial_\beta\mathcal{A}_{\iota\theta\alpha}\partial^\theta\mathcal{A}^{\alpha\beta\iota}) + r_5(\partial_\theta\mathcal{A}_{\iota\kappa}{}^\kappa\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - \partial_\theta\mathcal{A}_{\iota\kappa}{}^\kappa\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - (\partial_\alpha\mathcal{A}^{\alpha\iota\theta} - 2\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha)(\partial_\kappa\mathcal{A}_{\iota\theta}{}^\kappa - \partial_\kappa\mathcal{A}_{\theta\iota}{}^\kappa)))[t,x,y,z]\,dz\,dy\,dx\,dt$$

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

	${}^{\#1}_{}2^{+}\mathcal{A}_{\alpha\beta}$	${}^{\#1}_{}2^{+}f_{\alpha\beta}$	${}^{\#1}_{}2^{-}\mathcal{A}_{\alpha\beta\chi}$
${}^{\#1}_{}2^{+}\mathcal{A}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0
${}^{\#1}_{}2^{+}f\dagger^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
${}^{\#1}_{}2^{-}\mathcal{A}\dagger^{\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

	${}^{\#1}_{}1^{+}\mathcal{A}_{\alpha\beta}$	${}^{\#2}_{}1^{+}\mathcal{A}_{\alpha\beta}$	${}^{\#1}_{}1^{+}f_{\alpha\beta}$	${}^{\#1}_{}1^{-}\mathcal{A}_{\alpha}$	${}^{\#2}_{}1^{-}\mathcal{A}_{\alpha}$	${}^{\#1}_{}1^{-}f_{\alpha}$	${}^{\#2}_{}1^{-}f_{\alpha}$
${}^{\#1}_{}1^{+}\mathcal{A}\dagger^{\alpha\beta}$	$k^2(2r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
${}^{\#2}_{}1^{+}\mathcal{A}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
${}^{\#1}_{}1^{+}f\dagger^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0	0
${}^{\#1}_{}1^{-}\mathcal{A}\dagger^{\alpha}$	0	0	0	$k^2(2r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{i k t_1}{3}$
${}^{\#2}_{}1^{-}\mathcal{A}\dagger^{\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}k t_1$
${}^{\#1}_{}1^{-}f\dagger^{\alpha}$	0	0	0	0	0	0	0
${}^{\#2}_{}1^{-}f\dagger^{\alpha}$	0	0	0	$-\frac{1}{3}i k t_1$	$-\frac{1}{3}i\sqrt{2}k t_1$	0	$\frac{2k^2 t_1}{3}$

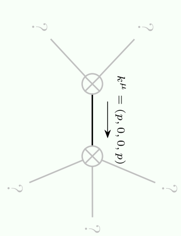
	${}^{\#1}_{}0^{+}\sigma$	${}^{\#1}_{}0^{+}\tau$	${}^{\#2}_{}0^{+}\tau$	${}^{\#1}_{}0^{-}\sigma$
${}^{\#1}_{}0^{+}\sigma\dagger$	$\frac{1}{6k^2 r_3}$	0	0	0
${}^{\#1}_{}0^{+}\tau\dagger$	0	0	0	0
${}^{\#2}_{}0^{+}\tau\dagger$	0	0	0	0
${}^{\#1}_{}0^{-}\sigma\dagger$	0	0	0	$-\frac{1}{t_1}$

	${}^{\#1}_{}0^{+}\mathcal{A}$	${}^{\#1}_{}0^{+}f$	${}^{\#2}_{}0^{+}f$	${}^{\#1}_{}0^{-}\mathcal{A}$
${}^{\#1}_{}0^{+}\mathcal{A}\dagger$	$6k^2 r_3$	0	0	0
${}^{\#1}_{}0^{+}f\dagger$	0	0	0	0
${}^{\#2}_{}0^{+}f\dagger$	0	0	0	0
${}^{\#1}_{}0^{-}\mathcal{A}\dagger$	0	0	0	$-t_1$

Massive and massless spectra

Massless particle

Pole residue:	$-\frac{1}{(2r_3+r_5)t_1^2} > 0$
Polarisations:	2



(No particles)

Unitarity conditions