Particle spectrograph

Wave operator and propagator

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

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

$$S == \iiiint \Big(\tfrac{1}{6}\big(2\, t_1\, \mathcal{A}^{\alpha\iota}{}_{\alpha}\, \mathcal{A}_{\iota}{}^{\theta}{}_{\theta} + 6\, f^{\alpha\beta}\, \tau_{\alpha\beta} + 6\, \mathcal{A}^{\alpha\beta\chi}\, \sigma_{\alpha\beta\chi} - 4\, t_1\, \mathcal{A}_{\alpha}{}^{\theta}{}_{\theta}\, \partial_\iota f^{\alpha\iota} + 4\, t_1\, \mathcal{A}_{\iota}{}^{\theta}{}_{\theta}\, \partial^\iota f^{\alpha}{}_{\alpha} - 2\, t_1\, \partial_\iota f^{\theta}{}_{\theta}\, \partial^\iota f^{\alpha}{}_{\alpha} - 2\, t_1\, \partial_\iota f^{\alpha\iota}\, \partial_\theta f_{\alpha}{}^{\theta} + 4\, t_1\, \partial^\iota f^{\alpha}{}_{\alpha}\, \partial_\theta f^{\theta}{}_{\iota} - 6\, t_1\, \partial_\alpha f_{\iota\theta}\, \partial^\theta f^{\alpha\iota} - 3\, t_1\, \partial_\alpha f_{\theta\iota}\, \partial^\theta f^{\alpha\iota} + 3\, t_1\, \partial_\iota f_{\alpha\theta}\, \partial^\theta f^{\alpha\iota} + 3\, t_1\, \partial_\theta f_{\alpha\iota}\, \partial^\theta f^{\alpha\iota} + 3\, t_1\, \partial_\theta f_{\iota\alpha}\, \partial^\theta f^{\alpha\iota} + 6\, t_1\, \mathcal{A}_{\alpha\theta\iota}\, (\mathcal{A}^{\alpha\iota\theta} + 2\, \partial^\theta f^{\alpha\iota}) - 8\, r_1\, \partial_\beta \mathcal{A}_{\alpha\iota\theta}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + 4\, r_1\, \partial_\beta \mathcal{A}_{\alpha\theta\iota}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} - 16\, r_1\, \partial_\beta \mathcal{A}_{\iota\theta\alpha}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} - 4\, r_1\, \partial_\iota \mathcal{A}_{\alpha\beta\theta}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + 4\, r_1\, \partial_\theta \mathcal{A}_{\alpha\beta\iota}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + 4\, r_1\, \partial_\theta \mathcal{A}_{\alpha\iota\beta}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + 6\, r_5\, \partial_\iota \mathcal{A}_{\theta}{}^{\kappa}{}_{\kappa}\, \partial^\theta \mathcal{A}^{\alpha\iota}{}_{\alpha} - 6\, r_5\, \partial_\theta \mathcal{A}_{\iota}{}^{\kappa}{}_{\kappa}\, \partial^\theta \mathcal{A}^{\alpha\iota}{}_{\alpha} - 6\, r_5\, \partial_\alpha \mathcal{A}^{\alpha\iota\theta}\, \partial_\kappa \mathcal{A}_{\iota}{}^{\kappa}{}_{\theta} + 12\, r_5\, \partial^\theta \mathcal{A}^{\alpha\iota}{}_{\alpha}\, \partial_\kappa \mathcal{A}_{\iota}{}^{\kappa}{}_{\theta} + 6\, r_5\, \partial_\alpha \mathcal{A}^{\alpha\iota\theta}\, \partial_\kappa \mathcal{A}_{\theta}{}^{\kappa}{}_{\iota} - 12\, r_5\, \partial^\theta \mathcal{A}^{\alpha\iota}{}_{\alpha}\, \partial_\kappa \mathcal{A}_{\theta}{}^{\kappa}{}_{\iota}\big)\Big)[t,x,y,z]\, dz\, dy\, dx\, dt$$

	$\overset{\#1}{2^{+}}\mathcal{A}_{\alpha\beta}$	$\overset{\#1}{2^{+}}f_{\alpha\beta}$	$\overset{\#1}{2^{-}}\mathcal{A}_{\alpha\beta\chi}$
$\overset{\#1}{2^{+}}\mathcal{A}^{\dagger\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0
$\overset{\#1}{2^{+}}f^{\dagger\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\overset{\#1}{2^{-}}\mathcal{A}^{\dagger\alpha\beta\chi}$	0	0	$k^2 r_1 + \frac{t_1}{2}$

	$\overset{\#1}{0^{+}}\sigma$	$\overset{\#1}{0^{+}}\tau$	$\overset{\#2}{0^{+}}\tau$	$\overset{\#1}{0^{-}}\sigma$
$\overset{\#1}{0^{+}}\sigma^{\dagger}$	0	0	0	0
$\overset{\#1}{0^{+}}\tau^{\dagger}$	0	0	0	0
$\overset{\#2}{0^{+}}\tau^{\dagger}$	0	0	0	0
$\overset{\#1}{0^{-}}\sigma^{\dagger}$	0	0	0	$-\frac{1}{t_1}$

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

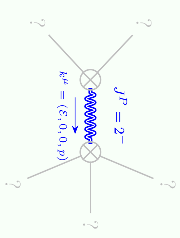
	$\overset{\#1}{0^{+}}\mathcal{A}$	$\overset{\#1}{0^{+}}f$	$\overset{\#2}{0^{+}}f$	$\overset{\#1}{0^{-}}\mathcal{A}$
$\overset{\#1}{0^{+}}\mathcal{A}^{\dagger}$	0	0	0	0
$\overset{\#1}{0^{+}}f^{\dagger}$	0	0	0	0
$\overset{\#2}{0^{+}}f^{\dagger}$	0	0	0	0
$\overset{\#1}{0^{-}}\mathcal{A}^{\dagger}$	0	0	0	$-t_1$

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

Massive and massless spectra

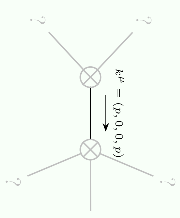
Massive particle

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



Massless particle

Pole residue:	$\frac{1}{(r_1+r_5) t_1^2} > 0$
Polarisations:	2



Unitarity conditions