Particle spectrograph

Wave operator and propagator

Spin-parity form	Covariant form	Multiplicities
$\overset{\#1}{0^-}\sigma == 0$	$\epsilon\eta_{\alpha\beta\chi\delta}\ \partial^\delta\sigma^{\alpha\beta\chi} == 0$	1
$\overset{\#2}{0^+}\tau == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == 0$	1
$\overset{\#1}{0^+}\tau - 2\,i\,k\,\overset{\#1}{0^+}\sigma == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == \partial_\beta\partial^\beta\tau^\alpha{}_\alpha + 2\,\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}{}_\alpha$	1
$\overset{\#2}{1^-}\tau^\alpha + 2\,i\,k\,\overset{\#2}{1^-}\sigma^\alpha == 0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta} + 2\,\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	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
$\overset{\#1}{1^+}\tau^{\alpha\beta} == 0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi} + \partial_\chi\partial^\beta\tau^{\chi\alpha} + \partial_\chi\partial^\chi\tau^{\alpha\beta} == \partial_\chi\partial^\alpha\tau^{\chi\beta} + \partial_\chi\partial^\beta\tau^{\alpha\chi} + \partial_\chi\partial^\chi\tau^{\beta\alpha}$	3
$\overset{\#2}{1^+}\sigma^{\alpha\beta} == 0$	$\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta} + \partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi} == \partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
$\overset{\#1}{2^-}\sigma^{\alpha\beta\chi} == 0$	$\partial_\epsilon\partial_\delta\partial^\chi\partial^\alpha\sigma^{\beta\delta\epsilon} + 3\,\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\alpha\sigma^{\beta\delta}{}_\delta + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\chi\delta} +$ $4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\delta\chi} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\chi\delta\alpha} + 4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\beta\delta} +$ $2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\delta\beta} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha} + 3\,\eta^{\beta\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial^\alpha\sigma^{\delta\epsilon}{}_\delta +$ $3\,\eta^{\alpha\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\beta\delta\epsilon} + 3\,\eta^{\beta\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\alpha\delta}{}_\delta ==$ $3\,\partial_\epsilon\partial_\delta\partial^\chi\partial^\beta\sigma^{\alpha\delta\epsilon} + 3\,\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\beta\sigma^{\alpha\delta}{}_\delta + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\chi\delta} +$ $4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\delta\chi} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\chi\delta\beta} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\beta\delta\alpha} +$ $4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\chi\beta} + 3\,\eta^{\alpha\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial^\beta\sigma^{\delta\epsilon}{}_\delta +$ $3\,\eta^{\beta\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\alpha\delta\epsilon} + 3\,\eta^{\alpha\chi}\ \partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\beta\delta}{}_\delta$	5
3		
$\overset{\#1}{2^+}\tau^{\alpha\beta} == 0$	$\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta} + 2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha} +$ $2\,\eta^{\alpha\beta}\ \partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta} == 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\chi\beta} +$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha} + 2\,\eta^{\alpha\beta}\ \partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi$	5
4		
Total expected gauge generators:		25

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

	$\overset{\#1}{2^+}\mathcal{A}_{\alpha\beta}$	$\overset{\#1}{2^+}f_{\alpha\beta}$	$\overset{\#1}{2^-}\mathcal{A}_{\alpha\beta\chi}$
$\overset{\#1}{2^+}\mathcal{A}^\dagger{}^{\alpha\beta}$	$-\frac{3k^2r_3}{2}$	0	0
$\overset{\#1}{2^+}f^\dagger{}^{\alpha\beta}$	0	0	0
$\overset{\#1}{2^-}\mathcal{A}^\dagger{}^{\alpha\beta\chi}$	0	0	0

	$\overset{\#1}{2^+}\sigma_{\alpha\beta}$	$\overset{\#1}{2^+}\tau_{\alpha\beta}$	$\overset{\#1}{2^-}\sigma_{\alpha\beta\chi}$
$\overset{\#1}{2^+}\sigma^\dagger{}^{\alpha\beta}$	$-\frac{2}{3k^2r_3}$	0	0
$\overset{\#1}{2^+}\tau^\dagger{}^{\alpha\beta}$	0	0	0
$\overset{\#1}{2^-}\sigma^\dagger{}^{\alpha\beta\chi}$	0	0	0

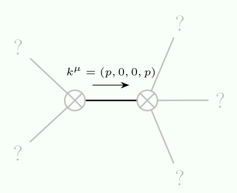
	$\overset{\#1}{1^+}\mathcal{A}_{\alpha\beta}$	$\overset{\#2}{1^+}\mathcal{A}_{\alpha\beta}$	$\overset{\#1}{1^+}f_{\alpha\beta}$	$\overset{\#1}{1^-}\mathcal{A}_\alpha$	$\overset{\#2}{1^-}\mathcal{A}_\alpha$	$\overset{\#1}{1^-}f_\alpha$	$\overset{\#2}{1^-}f_\alpha$
$\overset{\#1}{1^+}\mathcal{A}^\dagger{}^{\alpha\beta}$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

$$S == \iiiint(f^{\alpha\beta}\ \tau_{\alpha\beta} + \mathcal{A}^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi} - \tfrac{2}{3}t_3(\mathcal{A}^{\alpha\iota}{}_\alpha\ \mathcal{A}_\iota{}^\theta{}_\theta - 2\ \mathcal{A}_\alpha{}^\theta{}_\theta\ \partial_\iota f^{\alpha\iota} + 2\ \mathcal{A}_\iota{}^\theta{}_\theta\ \partial^\iota f^\alpha{}_\alpha - \partial_\iota f^\theta{}_\theta\ \partial^\iota f^\alpha{}_\alpha - \partial_\iota f^{\alpha\iota}\ \partial_\theta f_\alpha{}^\theta + 2\,\partial^\iota f^\alpha{}_\alpha\ \partial_\theta f_\iota{}^\theta) - \tfrac{1}{2}r_3(\partial_\beta\mathcal{A}_\iota{}^\theta{}_\theta\ \partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\iota\mathcal{A}_\beta{}^\theta{}_\theta\ \partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\alpha\mathcal{A}^{\alpha\beta\iota}\ \partial_\theta\mathcal{A}_{\beta\iota}{}^\theta - 2\,\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha\ \partial_\theta\mathcal{A}_{\beta\iota}{}^\theta + \partial_\alpha\mathcal{A}^{\alpha\beta\iota}\ \partial_\theta\mathcal{A}_{\iota\beta}{}^\theta - 2\,\partial^\iota\mathcal{A}^{\alpha\beta}{}_\alpha\ \partial_\theta\mathcal{A}_{\iota\beta}{}^\theta + 8\,\partial_\beta\mathcal{A}_{\iota\theta\alpha}\ \partial^\theta\mathcal{A}^{\alpha\beta\iota}) + r_5(\partial_\iota\mathcal{A}_\theta{}^\kappa{}_\kappa\ \partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - \partial_\theta\mathcal{A}_\iota{}^\kappa{}_\kappa\ \partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha - (\partial_\alpha\mathcal{A}^{\alpha\iota\theta} - 2\,\partial^\theta\mathcal{A}^{\alpha\iota}{}_\alpha)(\partial_\kappa\mathcal{A}_\iota{}^\kappa{}_\theta - \partial_\kappa\mathcal{A}_\theta{}^\kappa{}_\iota)))[t,x,y,z]\,dz\,dy\,dx\,dt$$

	$\overset{\#1}{0^+}\mathcal{A}$	$\overset{\#1}{0^+}f$	$\overset{\#2}{0^+}f$	$\overset{\#1}{0^-}\mathcal{A}$
$\overset{\#1}{0^+}\mathcal{A}^\dagger$	t_3	$-i\sqrt{2}\,k\,t_3$	0	0
$\overset{\#1}{0^+}f^\dagger$	$i\sqrt{2}\,k\,t_3$	$2k^2t_3$	0	0
$\overset{\#2}{0^+}f^\dagger$	0	0	0	0
$\overset{\#1}{0^-}\mathcal{A}^\dagger$	0	0	0	0

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

Massive and massless spectra



Massless particle

(No particles)

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

Unitarity conditions