Particle spectrograph

Wave operator and propagator

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

	$\mathcal{A}^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\mathcal{A}^{\#1}_{0^-}$
$\mathcal{A}^{\#1}_{0^+}\dagger$	t_3	$-i\sqrt{2}\,k\,t_3$	0	0
$f^{\#1}_{0^+}\dagger$	$i\sqrt{2}\,k\,t_3$	$2k^2 t_3$	0	0
$f^{\#2}_{0^+}\dagger$	0	0	0	0
$\mathcal{A}^{\#1}_{0^-}\dagger$	0	0	0	$-t_1$

	$\mathcal{A}^{\#1}_{2^+\,\alpha\beta}$	$f^{\#1}_{2^+\,\alpha\beta}$	$\mathcal{A}^{\#1}_{2^-\,\alpha\beta\chi}$
$\mathcal{A}^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	$k^2 t_1$	0
$\mathcal{A}^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

Source constraints

SO(3) irreps	Fundamental fields	Multiplicities
$\tau^{\#2}_{0^+} == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == 0$	1
$\tau^{\#1}_{0^+} - 2i\,k\,\sigma^{\#1}_{0^+} == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == \partial_\beta\partial^\beta\tau^\alpha{}_\alpha + 2\,\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}{}_\alpha$	1
$\tau^{\#2\,\alpha}_{1^-} + 2i\,k\,\sigma^{\#2\,\alpha}_{1^-} == 0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta} + 2\,\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	3
$\tau^{\#1\,\alpha}_{1^-} == 0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\beta\alpha}$	3
$\tau^{\#1\,\alpha\beta}_{1^+} + i\,k\,\sigma^{\#2\,\alpha\beta}_{1^+} == 0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi} + \partial_\chi\partial^\beta\tau^{\chi\alpha} + \partial_\chi\partial^\chi\tau^{\alpha\beta} + 2\,\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta} + 2\,\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi} == \partial_\chi\partial^\alpha\tau^{\chi\beta} + \partial_\chi\partial^\beta\tau^{\alpha\chi} + \partial_\chi\partial^\chi\tau^{\beta\alpha} + 2\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
$\tau^{\#1\,\alpha\beta}_{2^+} - 2i\,k\,\sigma^{\#1\,\alpha\beta}_{2^+} == 0$	$-i\,(4\,\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta} + 2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\chi\beta} - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi} - 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha} + 4\,i\,k^\chi\,\partial_\epsilon\partial_\chi\partial^\beta\partial^\alpha\sigma^{\delta\epsilon}{}_\delta - 6\,i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\delta\epsilon} - 6\,i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\delta\epsilon} + 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta} + 6\,i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\alpha\delta\beta} + 6\,i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\beta\delta\alpha} - 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi - 4\,i\,\eta^{\alpha\beta}\,k^\chi\,\partial_\phi\partial^\phi\partial_\epsilon\partial_\chi\sigma^{\delta\epsilon}{}_\delta) == 0$	5
Total constraints/gauge generators:		16

	$\mathcal{A}^{\#1}_{1^+\,\alpha\beta}$	$\mathcal{A}^{\#2}_{1^+\,\alpha\beta}$	$f^{\#1}_{1^+\,\alpha\beta}$	$\mathcal{A}^{\#1}_{1^-\,\alpha}$	$\mathcal{A}^{\#2}_{1^-\,\alpha}$	$f^{\#1}_{1^-\,\alpha}$	$f^{\#2}_{1^-\,\alpha}$
$\mathcal{A}^{\#1}_{1^+}\dagger^{\alpha\beta}$	$k^2 r_5 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$\mathcal{A}^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\mathcal{A}^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{1}{6}(6k^2 r_5 + t_1 + 4t_3)$	$\frac{t_1 - 2t_3}{3\sqrt{2}}$	0	$\frac{1}{3}ik(t_1 - 2t_3)$
$\mathcal{A}^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{t_1 - 2t_3}{3\sqrt{2}}$	$\frac{t_1 + t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}\,k(t_1 + t_3)$
$f^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{1}{3}ik(t_1 - 2t_3)$	$-\frac{1}{3}i\sqrt{2}\,k(t_1 + t_3)$	0	$\frac{2}{3}k^2(t_1 + t_3)$

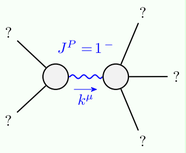
	$\sigma^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\tau^{\#1}_{0^+}$	$\sigma^{\#1}_{0^+}$
$\sigma^{\#1}_{0^+}\dagger$	0	0	0	$-\frac{1}{t_1}$
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\tau^{\#1}_{0^+}\dagger$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0
$\sigma^{\#1}_{0^+}\dagger$	$\frac{1}{(1+2k^2)^2 t_3}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	0	0

	$\sigma^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#2}_{1^+\,\alpha\beta}$	$\tau^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#1}_{1^-\,\alpha}$	$\sigma^{\#2}_{1^-\,\alpha}$	$\tau^{\#1}_{1^-\,\alpha}$	$\tau^{\#2}_{1^-\,\alpha}$
$\sigma^{\#1}_{1^+}\dagger^{\alpha\beta}$	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
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1 + k^2 t_1}$	$\frac{-2k^2 r_5 + t_1}{(1+k^2)^2 t_1{}^2}$	$-\frac{i(2k^3 r_5 - kt_1)}{(1+k^2)^2 t_1{}^2}$	0	0	0	0
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{i\sqrt{2}\,k}{t_1 + k^2 t_1}$	$\frac{i(2k^3 r_5 - kt_1)}{(1+k^2)^2 t_1{}^2}$	$\frac{-2k^4 r_5 + k^2 t_1}{(1+k^2)^2 t_1{}^2}$	0	0	0	0
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2(t_1 + t_3)}{3t_1 t_3 + 2k^2 r_5 (t_1 + t_3)}$	$-\frac{\sqrt{2}\,(t_1 - 2t_3)}{(1+2k^2)(3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$	0	$-\frac{2ik(t_1 - 2t_3)}{(1+2k^2)(3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{\sqrt{2}\,(t_1 - 2t_3)}{(1+2k^2)(3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$	$\frac{6k^2 r_5 + t_1 + 4t_3}{(1+2k^2)^2 (3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$	0	$\frac{i\sqrt{2}\,k(6k^2 r_5 + t_1 + 4t_3)}{(1+2k^2)^2 (3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$
$\tau^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$\tau^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2ik(t_1 - 2t_3)}{(1+2k^2)(3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$	$-\frac{i\sqrt{2}\,k(6k^2 r_5 + t_1 + 4t_3)}{(1+2k^2)^2 (3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$	0	$\frac{2k^2 (6k^2 r_5 + t_1 + 4t_3)}{(1+2k^2)^2 (3t_1 t_3 + 2k^2 r_5 (t_1 + t_3))}$

Quadratic (free) action

$$S == \int\int\int\int (\tfrac{1}{6}(2(t_1 - 2t_3)\,\mathcal{A}^{\alpha\nu}{}_\alpha{}^\theta\,\mathcal{A}_\nu{}^\theta{}_\theta + 6\,f^{\alpha\beta}{}_\alpha{}^\theta\,\tau_{\alpha\beta} + 6\,\mathcal{A}^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 4t_1\,\mathcal{A}_\alpha{}^\theta{}_\theta\,\partial_\nu f^{\alpha\nu} + 8t_3\,\mathcal{A}_\alpha{}^\theta{}_\theta\,\partial_\nu f^{\alpha\nu} + 4t_1\,\mathcal{A}_\nu{}^\theta{}_\theta\,\partial^\nu f^\alpha{}_\alpha - 8t_3\,\mathcal{A}_\nu{}^\theta{}_\theta\,\partial^\nu f^\alpha{}_\alpha - 2t_1\,\partial_\nu f^\theta{}_\theta\,\partial^\nu f^\alpha{}_\alpha + 4t_3\,\partial_\nu f^\theta{}_\theta\,\partial^\nu f^\alpha{}_\alpha + 4t_3\,\partial_\nu f^{\alpha\nu}{}_\theta\,\partial_\theta f^\alpha{}_\alpha + 4t_1\,\partial^\nu f^{\alpha\nu}{}_\theta\,\partial_\theta f^\alpha{}_\alpha - 8t_3\,\partial^\nu f^{\alpha\nu}{}_\theta\,\partial_\theta f^\alpha{}_\alpha + 6t_1\,\partial_\alpha f_{\nu\theta}\,\partial^\theta f^{\alpha\nu} - 3t_1\,\partial_\alpha f_{\nu\theta}\,\partial^\theta f^{\alpha\nu} + 3t_1\,\partial_\nu f_{\alpha\theta}\,\partial^\theta f^{\alpha\nu} + 3t_1\,\partial_\theta f_{\alpha\nu}\,\partial^\theta f^{\alpha\nu} + 6t_1\,\mathcal{A}_{\alpha\theta\nu}\,(\mathcal{A}^{\alpha\nu\theta} + 2\,\partial^\theta f^{\alpha\nu}) + 6r_5\,\partial_\nu\mathcal{A}_\theta{}^\kappa\,\partial^\theta\mathcal{A}^{\alpha\nu}{}_\alpha - 6r_5\,\partial_\theta\mathcal{A}_\nu{}^\kappa\,\partial^\theta\mathcal{A}^{\alpha\nu}{}_\alpha - 6r_5\,\partial_\alpha\mathcal{A}^{\alpha\nu\theta}\,\partial_\kappa\mathcal{A}_\nu{}^\kappa{}_\theta + 12r_5\,\partial^\theta\mathcal{A}^{\alpha\nu}{}_\alpha\,\partial_\kappa\mathcal{A}_\nu{}^\kappa{}_\theta - 12r_5\,\partial^\theta\mathcal{A}^{\alpha\nu}{}_\alpha\,\partial_\kappa\mathcal{A}_\theta{}^\kappa{}_\nu))[t, x, y, z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra



Massive particle

Pole residue:	$\frac{6t_1 t_3 (t_1 + t_3) - 3r_5 (t_1{}^2 + 2t_3{}^2)}{2r_5 (t_1 + t_3)(-3t_1 t_3 + r_5 (t_1 + t_3))} > 0$
Polarisations:	3
Square mass:	$-\frac{3t_1 t_3}{2r_5 t_1 + 2r_5 t_3} > 0$
Spin:	1
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_5 < 0$ && $(t_1 < 0$ && $0 < t_3 < -t_1) \,||\, (t_1 > 0$ && $(t_3 < -t_1 \,||\, t_3 > 0))$