Particle spectrograph

Wave operator and propagator

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

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$k^2 (2 r_3 + r_5) - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$k^2 (-r_1 + 2 r_3 + r_5) + \frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{i k t_1}{3}$
$\omega_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3} i \sqrt{2}\, k t_1$
$f_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$-\frac{1}{3} i k t_1$	$-\frac{1}{3} i \sqrt{2}\, k t_1$	0	$\frac{2 k^2 t_1}{3}$

Source constraints

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

	$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	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
$\sigma_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{\sqrt{2}}{t_1 + k^2 t_1}$	$-\frac{2 k^2 (2 r_3 + r_5) + t_1}{(1 + k^2)^2 t_1^2}$	$-\frac{2 i k^3 (2 r_3 + r_5) + i k t_1}{(1 + k^2)^2 t_1^2}$	0	0	0	0
$\tau_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$-\frac{i\sqrt{2}\,k}{t_1 + k^2 t_1}$	$-\frac{2 i k^3 (2 r_3 + r_5) + i k t_1}{(1 + k^2)^2 t_1^2}$	$-\frac{2 k^4 (2 r_3 + r_5) + k^2 t_1}{(1 + k^2)^2 t_1^2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$\frac{1}{\sqrt{2}\,(k^2 + 2 k^4)(r_1 - 2 r_3 - r_5)}$	$\frac{1}{\frac{-r_1 + 2 r_3 + r_5}{2 (k + 2 k^3)^2} + \frac{6 k^2}{t_1}}$	0	$\frac{i (6 k^2 (r_1 - 2 r_3 - r_5) - t_1)}{\sqrt{2}\, k (1 + 2 k^2)^2 (r_1 - 2 r_3 - r_5) t_1}$
$\sigma_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{1}{\sqrt{2}\,(k^2 + 2 k^4)(r_1 - 2 r_3 - r_5)}$	$\frac{1}{\frac{-r_1 + 2 r_3 + r_5}{2 (k + 2 k^3)^2} + \frac{6 k^2}{t_1}}$	0	$\frac{i (6 k^2 (r_1 - 2 r_3 - r_5) - t_1)}{\sqrt{2}\, k (1 + 2 k^2)^2 (r_1 - 2 r_3 - r_5) t_1}$
$\tau_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$\frac{1}{k^2 (-r_1 + 2 r_3 + r_5)}$	$\frac{1}{\sqrt{2}\,(k^2 + 2 k^4)(r_1 - 2 r_3 - r_5)}$	0	$\frac{i}{k (1 + 2 k^2)(-r_1 + 2 r_3 + r_5)}$
$\tau_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{i}{k (1 + 2 k^2)(r_1 - 2 r_3 - r_5)}$	$\frac{i (6 k^2 (r_1 - 2 r_3 - r_5) - t_1)}{\sqrt{2}\, k (1 + 2 k^2)^2 (r_1 - 2 r_3 - r_5) t_1}$	0	$\frac{1}{\frac{-r_1 + 2 r_3 + r_5}{(1 + 2 k^2)^2} + \frac{6 k^2}{t_1}}$

Quadratic (free) action

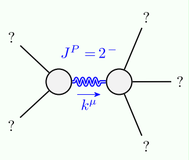
$$S == \int\int\int\int (f^{\alpha\beta}\, \tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\, \sigma_{\alpha\beta\chi} + \frac{1}{6} t_1 (2\, \omega^{\alpha\prime}{}_\alpha{}^\theta{}_{\iota\theta}\, \omega^{\iota}{}_\theta{}^{\theta\prime}{}_{\alpha\prime} - 4\, \omega^{\alpha}{}_\theta{}^{\theta\prime}{}_{\iota}\, \omega^{\iota}{}_{\theta\prime}{}^{\theta}{}_{\alpha\prime} - 2\, \partial_\iota f^{\alpha\prime}{}_\alpha{}^\theta{}_\theta + 4\, \omega^{\iota}{}_\theta{}^{\theta\prime}{}_{\alpha}\, \partial_\iota f^{\alpha\prime}{}_{\alpha\prime}{}^\theta{}_{\theta\prime} + 4\, \partial_\iota f^{\alpha\prime}{}_\alpha{}^\theta{}_\theta + 4\, \partial^\prime f^{\alpha\prime}{}_\alpha{}^\theta{}_\theta + 4\, \partial^\prime f^{\alpha\prime}{}_{\alpha\prime}{}^\theta{}_\theta - 6\, \partial_\alpha f_{\iota\theta}{}^{\alpha\prime}\, \partial^\theta f_{\iota}{}^{\theta}{}_{\alpha\prime} - 6\, \partial_\alpha f_{\iota\theta}{}^{\alpha\prime}\, \partial^\theta f_{\iota}{}^{\theta}{}_{\alpha\prime} + 3\, \partial_\theta f_{\alpha\iota}{}^{\alpha\prime}\, \partial^\theta f^{\alpha\prime}{}_{\alpha\prime}{}^{\iota\theta} + 3\, \partial_\theta f^{\alpha\prime}{}_{\alpha\prime}{}^{\iota\theta}\, \partial^\theta f_{\alpha\iota}{}^{\alpha\prime} + 3\, \partial_\theta f_{\alpha\iota}{}^{\alpha\prime}\, \partial^\theta f^{\alpha\prime}{}_{\alpha\prime}{}^{\iota\theta} + 6\, \omega_{\alpha\theta\iota}\, (\omega^{\alpha\prime\theta}{}_{\alpha\prime}{}^{\iota\alpha\prime} + \partial_\iota \omega_\beta{}^{\theta}{}_{\beta\prime}\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta} + 2\, \partial_\beta \omega_{\iota}{}^{\theta}{}_{\beta\prime}\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta} + \partial_\alpha \omega^{\alpha\beta\iota}{}_{\beta\prime}\, \partial_\theta \omega_\beta{}^{\theta}{}_{\iota} - 2\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta}\, \partial_\theta \omega_{\iota}{}^{\alpha\beta\iota}{}_{\beta\prime} + 2\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta}\, \partial_\theta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime}) + \frac{2}{3} r_1 (3\, \partial_\beta \omega_\iota{}^\theta{}_{\beta\prime}\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\iota\theta} + 3\, \partial_\iota \omega_\beta{}^\theta{}_{\beta\prime}\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\iota\theta} - 6\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta}\, \partial_\theta \omega_\iota{}^{\iota\beta}{}_{\beta\prime} + 3\, \partial_\alpha \omega^{\alpha\beta\iota}{}_{\beta\prime}\, \partial_\theta \omega_\iota{}^{\theta}{}_{\beta\prime} - 6\, \partial^\prime \omega^{\alpha\beta}{}_{\alpha\prime}{}^{\theta}\, \partial_\theta \omega_\iota{}^{\iota\beta}{}_{\beta\prime} + 3\, \partial_\alpha \omega^{\alpha\beta\iota}{}_{\beta\prime}\, \partial_\theta \omega_\iota{}^{\theta}{}_{\beta\prime} + 2\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime} + 2\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime} + 2\, \partial_\beta \omega_{\iota\alpha\theta}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime} + \partial_\theta \omega_{\alpha\beta\iota}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime} + \partial_\theta \omega_{\alpha\beta\iota}\, \partial^\theta \omega^{\alpha\beta\iota}{}_{\beta\prime}) + r_5 (\partial_\iota \omega_\theta{}^\kappa{}_{\theta\prime}\, \partial^\theta \omega^{\alpha\prime\iota}{}_{\alpha\prime}{}^\kappa - \partial_\theta \omega_\iota{}^\kappa{}_{\theta\prime}\, \partial^\theta \omega^{\alpha\prime\iota}{}_{\alpha\prime} - (\partial_\alpha \omega^{\alpha\prime\theta}{}_{\alpha\prime}{}^\kappa - 2\, \partial^\theta \omega^{\alpha\prime\iota}{}_{\alpha\prime})\, \partial_\kappa \omega_\iota{}^\kappa{}_{\theta\prime}))))[t, x, y, z]\, dz\, dy\, dx\, dt$$

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	$\frac{1}{6 k^2 (-r_1 + r_3)}$	0	0	0
$\tau_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$-\frac{1}{t_1}$

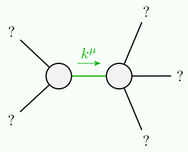
	$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{2}{(1 + 2 k^2)^2 t_1}$	$-\frac{2 i \sqrt{2}\, k}{(1 + 2 k^2)^2 t_1}$	0
$\tau_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{2 i \sqrt{2}\, k}{(1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

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	$6 k^2 (-r_1 + r_3)$	0	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$-t_1$

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_1} > 0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2 r_1} > 0$
Spin:	2
Parity:	Odd



Quadratic pole	
Pole residue:	$\frac{1}{(r_1 - 2 r_3 - r_5) {t_1}^2} > 0$
Polarisations:	2

Unitarity conditions

$r_1 < 0$ && $r_5 < r_1 - 2 r_3$ && $t_1 > 0$