Particle spectrograph

Wave operator and propagator

$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0
$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
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
$\tau^{\#1}_{0^+} == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^{\alpha}{}_{\alpha}$	1
$\sigma^{\#1}_{0^+} == 0$	$\partial_\beta \sigma^{\alpha\beta}{}_{\alpha} == 0$	1
$\tau^{\#2}_{1^-}{}^{\alpha} + 2 i k\, \sigma^{\#2}_{1^-}{}^{\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta} + 2\, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$	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
$\tau^{\#1}_{1^+}{}^{\alpha\beta} + i k\, \sigma^{\#2}_{1^+}{}^{\alpha\beta} == 0$	$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\chi\alpha} + \partial_\chi \partial^\chi \tau^{\alpha\beta} +$ $2\, \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 2\, \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} ==$ $\partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} +$ $\partial_\chi \partial^\chi \tau^{\beta\alpha} + 2\, \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\tau^{\#1}_{2^+}{}^{\alpha\beta} - 2 i k\, \sigma^{\#1}_{2^+}{}^{\alpha\beta} == 0$	$-i\,(4\, \partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2\, \partial_\delta \partial^\delta \partial^\beta \partial^\alpha \tau^{\chi}{}_{\chi} -$ $3\, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} - 3\, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3\, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3\, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $3\, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\alpha\beta} + 3\, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $4 i\, k^\chi\, \partial_\epsilon \partial_\chi \partial^\beta \partial^\alpha \sigma^{\delta\epsilon}{}_{\delta} -$ $6 i\, k^\chi\, \partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon} -$ $6 i\, k^\chi\, \partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $2\, \eta^{\alpha\beta}\, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6 i\, k^\chi\, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} +$ $6 i\, k^\chi\, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} -$ $2\, \eta^{\alpha\beta}\, \partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \tau^{\chi}{}_{\chi} -$ $4 i\, \eta^{\alpha\beta}\, k^\chi\, \partial_\phi \partial^\phi \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}{}_{\delta}) == 0$	5
Total constraints/gauge generators:		17

Quadratic (free) action

$$
\begin{aligned}
S == \iiiint \Big(\tfrac{1}{6}\,(2 t_1\, \omega^{\alpha\iota}{}_{\alpha}\, \omega_{\iota}{}^{\theta}{}_{\theta} + 6\, f^{\alpha\beta}\, \tau_{\alpha\beta} + 6\, \omega^{\alpha\beta\chi}\, \sigma_{\alpha\beta\chi} - 4 t_1\, \omega_{\alpha}{}^{\theta}{}_{\theta}\, \partial_\iota f^{\alpha\iota} +{}\\
4 t_1\, \omega_{\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_{\iota}{}^{\theta} - 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\, \omega_{\alpha\theta\iota}\, (\omega^{\alpha\iota\theta} + 2\, \partial^\theta f^{\alpha\iota}) + 8 r_2\, \partial_\beta \omega_{\alpha\iota\theta}\, \partial^\theta \omega^{\alpha\beta\iota} -{}\\
4 r_2\, \partial_\beta \omega_{\alpha\theta\iota}\, \partial^\theta \omega^{\alpha\beta\iota} + 4 r_2\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota} -{}\\
2 r_2\, \partial_\iota \omega_{\alpha\beta\theta}\, \partial^\theta \omega^{\alpha\beta\iota} + 2 r_2\, \partial_\theta \omega_{\alpha\beta\iota}\, \partial^\theta \omega^{\alpha\beta\iota} -{}\\
4 r_2\, \partial_\theta \omega_{\alpha\iota\beta}\, \partial^\theta \omega^{\alpha\beta\iota} + 6 r_5\, \partial_\iota \omega_{\theta}{}^{\kappa}{}_{\kappa}\, \partial^\theta \omega^{\alpha\iota}{}_{\alpha} -{}\\
6 r_5\, \partial_\theta \omega_{\iota}{}^{\kappa}{}_{\kappa}\, \partial^\theta \omega^{\alpha\iota}{}_{\alpha} - 6 r_5\, \partial_\alpha \omega^{\alpha\iota\theta}\, \partial_\kappa \omega_{\iota}{}^{\kappa}{}_{\theta} +{}\\
12 r_5\, \partial^\theta \omega^{\alpha\iota}{}_{\alpha}\, \partial_\kappa \omega_{\iota}{}^{\kappa}{}_{\theta} + 6 r_5\, \partial_\alpha \omega^{\alpha\iota\theta}\, \partial_\kappa \omega_{\theta}{}^{\kappa}{}_{\iota} -{}\\
12 r_5\, \partial^\theta \omega^{\alpha\iota}{}_{\alpha}\, \partial_\kappa \omega_{\theta}{}^{\kappa}{}_{\iota})\Big)[t, x, y, z]\, dz\, dy\, dx\, dt
\end{aligned}
$$

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

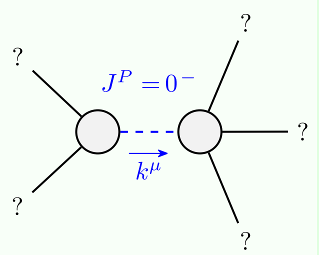
	$\sigma^{\#1}_{2^+}{}_{\alpha\beta}$	$\tau^{\#1}_{2^+}{}_{\alpha\beta}$	$\sigma^{\#1}_{2^-}{}_{\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	0
$\tau^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$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

	$\omega^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}\dagger$	0	0	0	0
$f^{\#1}_{0^+}\dagger$	0	0	0	0
$f^{\#2}_{0^+}\dagger$	0	0	0	0
$\omega^{\#1}_{0^-}\dagger$	0	0	0	$k^2 r_2 - t_1$

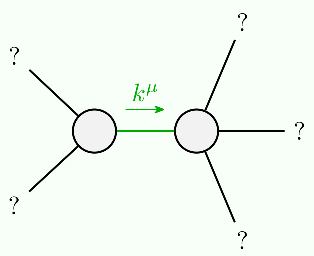
	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	0	0	0	0
$\tau^{\#1}_{0^+}\dagger$	0	0	0	0
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}\dagger$	0	0	0	$\frac{1}{k^2 r_2 - t_1}$

	$\omega^{\#1}_{1^+}{}_{\alpha\beta}$	$\omega^{\#2}_{1^+}{}_{\alpha\beta}$	$f^{\#1}_{1^+}{}_{\alpha\beta}$	$\omega^{\#1}_{1^-}{}_{\alpha}$	$\omega^{\#2}_{1^-}{}_{\alpha}$	$f^{\#1}_{1^-}{}_{\alpha}$	$f^{\#2}_{1^-}{}_{\alpha}$
$\omega^{\#1}_{1^+}\dagger^{\alpha\beta}$	$k^2 r_5 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
$\omega^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	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	$k^2 r_5 + \frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{i k t_1}{3}$
$\omega^{\#2}_{1^-}\dagger^{\alpha}$	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
$f^{\#2}_{1^-}\dagger^{\alpha}$	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:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$\frac{t_1}{r_2} > 0$
Spin:	0
Parity:	Odd



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

Unitarity conditions

$r_2 < 0$ && $r_5 < 0$ && $t_1 < 0$