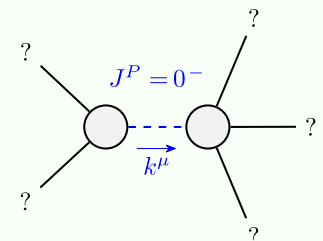


Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau^{#2}_0 == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == 0$	1
$\tau^{#1}_0 - 2 \, i \, k \, \sigma^{#1}_0 = 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha_\alpha + 2 \, \partial_\chi \partial^\chi \partial_\beta \sigma^{\alpha\beta}_\alpha$	1
$\tau^{#2\alpha}_1 + 2 \, i \, k \, \sigma^{#2\alpha}_{1^-} = 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta} + 2 \, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$	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
$\tau^{#1\alpha\beta}_{2^+} - 2 \, i \, k \, \sigma^{#1\alpha\beta}_{2^+} == 0$	$-i \, (4 \, \partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2 \, \partial_\delta \partial^\delta \partial^\beta \partial^\alpha \tau^{\chi\chi} -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\alpha\beta} + 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $4 \, i \, k^\chi \, \partial_\epsilon \partial_\chi \partial^\beta \partial^\sigma \sigma^{\delta\epsilon}_\delta -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\sigma \sigma^{\beta\delta\epsilon}_\epsilon -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon}_\epsilon +$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta}_\beta +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha}_\alpha -$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \tau^{\chi\chi}_\chi -$ $4 \, i \, \eta^{\alpha\beta} \, k^\chi \, \partial_\phi \partial^\phi \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}_\delta) = 0$	5
Total constraints/gauge generators:		16

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

(No massless particles)

Unitarity conditions

$r_2 < 0 \ \&\& \ t_1 < 0$

Quadratic (free) action

$$S = \int \int \int \int (\frac{1}{6} (2 \, \omega^{\alpha i}_\alpha (t_1 \, \omega^{\theta}_{\prime \, \theta} - 2 \, t_3 \, \omega^{\kappa}_{\prime \, \kappa}) + 6 \, f^{\alpha\beta} \, \tau_{\alpha\beta} + 6 \, \omega^{\alpha\beta\chi} \, \sigma_{\alpha\beta\chi} -$$
$$4 \, t_1 \, \omega^{\theta}_{\theta} \partial_{\prime} f^{\alpha i} + 8 \, t_3 \, \omega^{\kappa}_{\kappa} \partial_{\prime} f^{\alpha i} + 4 \, t_1 \, \omega^{\theta}_{\prime \, \theta} \partial_{\prime} f^{\alpha}_{\alpha} -$$
$$8 \, t_3 \, \omega^{\kappa}_{\prime \, \kappa} \partial_{\prime} f^{\alpha}_{\alpha} - 2 \, t_1 \partial_{\prime} f^{\theta}_{\theta} \partial_{\prime} f^{\alpha}_{\alpha} + 4 \, t_1 \partial_{\prime} f^{\alpha}_{\alpha} \partial_{\theta} f^{\theta}_{\prime} - 6 \, t_1 \partial_{\omega} f_{\prime \theta} \partial^{\theta} f^{\alpha i} -$$
$$2 \, t_1 \partial_{\prime} f^{\alpha i} \partial_{\theta} f^{\theta}_{\alpha} + 4 \, t_1 \partial_{\prime} f^{\alpha}_{\alpha} \partial_{\theta} f^{\theta}_{\prime} + 3 \, t_1 \partial_{\theta} f^{\alpha i} \partial^{\theta} f^{\alpha i} +$$
$$3 \, t_1 \partial_{\theta} f_{\prime \alpha} \partial^{\theta} f^{\alpha i} + 6 \, t_1 \, \omega_{\alpha\theta \prime} ( \omega^{\alpha i\theta} + 2 \, \partial^{\theta} f^{\alpha i}) +$$
$$8 \, r_2 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta i} - 4 \, r_2 \partial_\beta \omega_{\alpha\theta \prime} \partial^\theta \omega^{\alpha\beta i} +$$
$$4 \, r_2 \partial_\beta \omega_{\prime \theta \alpha} \partial^\theta \omega^{\alpha\beta i} - 2 \, r_2 \partial_{\prime} \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta i} +$$
$$2 \, r_2 \partial_\theta \omega_{\alpha\beta \prime} \partial^\theta \omega^{\alpha\beta i} - 4 \, r_2 \partial_\theta \omega_{\alpha\prime \beta} \partial^\theta \omega^{\alpha\beta i} +$$
$$4 \, t_3 \partial_{\prime} f^{\alpha i} \partial_{\kappa} f^{\kappa}_{\alpha} - 8 \, t_3 \partial_{\prime} f^{\alpha}_{\alpha} \partial_{\kappa} f^{\kappa}_{\prime}) [t, x, y, z] dz dy dx dt$$

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

$\omega^{#1}_{1^+} + \alpha\beta$	$\omega^{#2}_{1^+} + \alpha\beta$	$f^{#1}_{1^+} + \alpha\beta$	$\omega^{#1}_{1^-} - \alpha$	$\omega^{#2}_{1^-} - \alpha$	$f^{#1}_{1^-} - \alpha$	$f^{#2}_{1^-} - \alpha$
$\omega^{#1}_{1^+} + \alpha\beta$	$-\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
$\omega^{#2}_{1^+} + \alpha\beta$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$f^{#1}_{1^+} + \alpha\beta$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0
$\omega^{#1}_{1^-} + \alpha$	0	0	$\frac{1}{6} (t_1 + 4 t_3)$	$\frac{t_1 - 2 t_3}{3 \sqrt{2}}$	0	$\frac{1}{3} i k (t_1 - 2 t_3)$
$\omega^{#2}_{1^-} + \alpha$	0	0	$\frac{t_1 - 2 t_3}{3 \sqrt{2}}$	$\frac{t_1 + t_3}{3}$	0	$\frac{1}{3} i \sqrt{2} k (t_1 + t_3)$
$f^{#1}_{1^-} + \alpha$	0	0	0	0	0	0
$f^{#2}_{1^-} + \alpha$	0	0	$-\frac{1}{3} i k (t_1 - 2 t_3)$	$-\frac{1}{3} i \sqrt{2} k (t_1 + t_3)$	0	$\frac{2}{3} k^2 (t_1 + t_3)$

$\sigma^{#1}_{0^+} + \alpha\beta$	$\sigma^{#2}_{0^+} + \alpha\beta$	$\tau^{#1}_{0^+} + \alpha\beta$	$\sigma^{#1}_{0^+}$	$\omega^{#1}_{0^+} + \alpha\beta$	$f^{#1}_{0^+} + \alpha\beta$	$\omega^{#2}_{0^+} + \alpha\beta$	$f^{#2}_{0^+} + \alpha\beta$	$\omega^{#1}_{0^+}$
$\sigma^{#1}_{0^+} + \alpha\beta$	$\frac{1}{(1 + 2 k^2)^2 t_3}$	$-\frac{i \sqrt{2} k}{(1 + 2 k^2)^2 t_3}$	0	0	0	0	0	0
$\tau^{#1}_{0^+} + \alpha\beta$	$\frac{i \sqrt{2} k}{(1 + 2 k^2)^2 t_3}$	$\frac{2 k^2}{(1 + 2 k^2)^2 t_3}$	0	0	0	0	0	0
$\sigma^{#2}_{0^+} + \alpha\beta$	0	0	0	0	0	0	0	0
$\tau^{#2}_{0^+} + \alpha\beta$	0	0	0	0	0	0	0	0
$\omega^{#1}_{0^+} + \alpha\beta$	0	0	0	$k^2 r_2 - t_1$	0	0	0	0

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