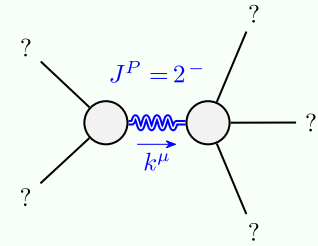


Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_{0+}^{#2} == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == 0$	1
$\tau_{0+}^{#1} - 2 \, i \, k \, \sigma_0^{#1} == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha_\alpha + 2 \, \partial_\chi \partial^\chi \partial_\beta \sigma^{\alpha\beta}_\alpha$	1
$\tau_{1-}^{#2\alpha} + 2 \, i \, k \, \sigma_1^{#2\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta} + 2 \, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$	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
$\tau_{2+}^{#1\alpha\beta} - 2 \, i \, k \, \sigma_2^{#1\alpha\beta} == 0$	$-i \, (4 \, \partial_\delta \partial_\chi \partial_\beta \partial^\alpha \tau^{\chi\delta} + 2 \, \partial_\delta \partial^\delta \partial_\beta \partial^\alpha \tau^\chi_\chi -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\alpha\beta} + 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $4 \, i \, k^\chi \, \partial_\epsilon \partial_\chi \partial_\beta \partial^\alpha \sigma^{\delta\epsilon}_\delta -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon}_- -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} -$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \tau^\chi_\chi -$ $4 \, i \, \eta^{\alpha\beta} \, k^\chi \, \partial_\phi \partial^\phi \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}_\delta) == 0$	5
Total constraints/gauge generators:		16

Massive and massless spectra



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

(No massless particles)

Unitarity conditions

$r_1 < 0 \ \&\& \ t_1 > 0$

Quadratic (free) action

$$S == \iiint \! \! \! \int ( f^{\alpha\beta} \, \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \, \sigma_{\alpha\beta\chi} +$$
$$\frac{1}{2} t_1 ( 2 \, \omega^\alpha_\alpha \, \omega^\theta_{\phantom{\theta},\theta} - 4 \, \omega^\theta_\alpha \, \partial_\theta f^{\alpha\chi} + 4 \, \omega^\theta_{\phantom{\theta},\theta} \, \partial^\chi f^\alpha_\alpha -$$
$$2 \, \partial_\chi f^\theta_\theta \, \partial^\chi f^\alpha_\alpha - 2 \, \partial_\chi f^{\alpha\chi} \, \partial_\theta f^\theta_\alpha + 4 \, \partial^\chi f^\alpha_\alpha \, \partial_\theta f^\theta_{\phantom{\theta},\theta} - 2 \, \partial_\omega f_{\phantom{\omega},\theta} \, \partial^\theta f^{\alpha\chi} - \partial_\omega f_{\phantom{\omega},\theta\chi} \, \partial^\theta f^{\alpha\chi} + \partial_\chi f_{\phantom{\chi},\alpha\theta} \, \partial^\theta f^{\alpha\chi} + \partial_\chi f_{\phantom{\chi},\alpha\theta} \, \partial^\theta f^{\alpha\chi} ) -$$
$$\frac{2}{3} r_1 ( 3 \, \partial_\beta \omega^\theta_{\phantom{\theta},\theta} \, \partial^\chi \omega^{\alpha\beta}_\alpha - 3 \, \partial_\chi \omega^\theta_\beta \, \partial^\chi \omega^{\alpha\beta}_\alpha - 3 \, \partial_\alpha \omega^{\alpha\beta\chi} \, \partial_\theta \omega^\theta_{\phantom{\theta},\beta} +$$
$$6 \, \partial^\chi \omega^{\alpha\beta}_\alpha \, \partial_\theta \omega^\theta_{\phantom{\theta},\beta} + 3 \, \partial_\alpha \omega^{\alpha\beta\chi} \, \partial_\theta \omega^\theta_{\phantom{\theta},\beta} -$$
$$6 \, \partial^\chi \omega^{\alpha\beta}_\alpha \, \partial_\theta \omega^\theta_{\phantom{\theta},\beta} + 2 \, \partial_\beta \omega_{\alpha\theta} \, \partial^\theta \omega^{\alpha\beta\chi} - \partial_\beta \omega_{\alpha\theta\chi} \, \partial^\theta \omega^{\alpha\beta\chi} +$$
$$4 \, \partial_\beta \omega_{\phantom{\beta},\theta\alpha} \, \partial^\theta \omega^{\alpha\beta\chi} + \partial_\chi \omega_{\alpha\beta\theta} \, \partial^\theta \omega^{\alpha\beta\chi} - \partial_\theta \omega_{\alpha\beta\chi} \, \partial^\theta \omega^{\alpha\beta\chi} -$$
$$\partial_\theta \omega_{\alpha\beta\theta} \, \partial^\theta \omega^{\alpha\beta\chi} ) [ t, x, y, z ] d^3z \, dy \, dx \, dt$$

$\sigma_1^{#1} + \alpha\beta$	$\sigma_1^{#2} + \alpha\beta$	$\tau_1^{#1} + \alpha\beta$	$\sigma_1^{#1} - \alpha$	$\sigma_1^{#2} - \alpha$	$\tau_1^{#2} - \alpha$
0	$-\frac{\sqrt{2}}{t_1 + k^2} t_1$	$-\frac{i \sqrt{2} k}{t_1 + k^2} t_1$	0	0	0
$-\frac{\sqrt{2}}{t_1 + k^2} t_1$	$-\frac{1}{(1 + k^2)^2} t_1$	$\frac{ik}{(1 + k^2)^2} t_1$	0	0	0
$\frac{i \sqrt{2} k}{t_1 + k^2} t_1$	$-\frac{ik}{(1 + k^2)^2} t_1$	$\frac{k^2}{(1 + k^2)^2} t_1$	0	0	0
0	0	0	$\frac{\sqrt{2}}{t_1 + 2 k^2} t_1$	$\frac{\sqrt{2}}{t_1 + 2 k^2} t_1$	$\frac{2 i k}{t_1 + 2 k^2} t_1$
0	0	0	$\frac{\sqrt{2}}{t_1 + 2 k^2} t_1$	0	$\frac{i \sqrt{2} k (2 k^2 r_1 + t_1)}{(t_1 + 2 k^2 t_1)^2}$
0	0	0	0	0	0
0	0	0	$-\frac{2 i k}{t_1 + 2 k^2} t_1$	$-\frac{i \sqrt{2} k (2 k^2 r_1 + t_1)}{(t_1 + 2 k^2 t_1)^2}$	$\frac{2 k^2 (2 k^2 r_1 + t_1)}{(t_1 + 2 k^2 t_1)^2}$

$\omega_1^{#1} + \alpha\beta$	$\omega_1^{#2} + \alpha\beta$	$f_1^{#1} + \alpha\beta$	$\omega_1^{#1} - \alpha$	$\omega_1^{#2} - \alpha$	$f_1^{#2} - \alpha$
$-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ik t_1}{\sqrt{2}}$	0	0	0
$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$\frac{ik t_1}{\sqrt{2}}$	0	0	0	0	0
0	0	0	$-k^2 r_1 - \frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	$i k t_1$
0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0
0	0	0	0	0	0
0	0	0	$-i k t_1$	0	0

$\sigma_2^{#1} + \alpha\beta$	$\tau_2^{#1} + \alpha\beta$	$\sigma_2^{#1} - \alpha\beta\chi$
$\frac{2}{(1 + 2 k^2)^2} t_1$	$-\frac{2 i \sqrt{2} k}{(1 + 2 k^2)^2} t_1$	0
$\frac{2 i \sqrt{2} k}{(1 + 2 k^2)^2} t_1$	$\frac{4 k^2}{(1 + 2 k^2)^2} t_1$	0
0	0	$\frac{2}{2 k^2 r_1 + t_1}$

$\omega_0^{#1} +$	$f_0^{#1} +$	$f_0^{#2} +$	$\omega_0^{#1} -$	$\omega_2^{#1} + \alpha\beta$	$f_2^{#1} + \alpha\beta$	$\omega_2^{#1} - \alpha\beta\chi$
$-t_1$	$i \sqrt{2} k t_1$	0	0	$\frac{t_1}{2}$	$-\frac{ik t_1}{\sqrt{2}}$	0
$-i \sqrt{2} k t_1$	$-2 k^2 t_1$	0	0	$\frac{ik t_1}{\sqrt{2}}$	$k^2 t_1$	0
0	0	0	0	0	0	$k^2 r_1 + \frac{t_1}{2}$
0	0	0	$-t_1$	$\omega_2^{#1} + \alpha\beta\chi$		