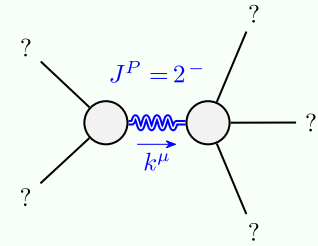


Particle spectrograph

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
$\tau_{2+}^{#1\alpha\beta} - 2 \, i \, k \, \sigma_{2+}^{#1\alpha\beta} == 0$	$-i \, (4 \, \partial_\delta \partial_\chi \partial_\beta \partial^\alpha \tau^{\chi\delta} + 2 \, \partial_\delta \partial^\delta \partial_\beta \partial^\alpha \tau^\chi_\chi -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\alpha\chi\delta} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\alpha\chi} - 3 \, \partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\chi\alpha} +$ $3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} + 3 \, \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\beta\alpha} +$ $4 \, i \, k^\chi \, \partial_\epsilon \partial_\chi \partial_\beta \partial^\alpha \sigma^{\delta\epsilon}_\delta -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon}_\epsilon -$ $6 \, i \, k^\chi \, \partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} +$ $6 \, i \, k^\chi \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} -$ $2 \, \eta^{\alpha\beta} \, \partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \tau^\chi_\chi -$ $4 \, i \, \eta^{\alpha\beta} \, k^\chi \, \partial_\phi \partial^\phi \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}_\delta) == 0$	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

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

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

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

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

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