

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

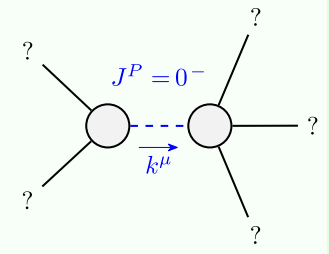
$\sigma_{1+}^{\#1} + \alpha\beta$	$\sigma_{1+}^{\#2}$	$\tau_{1+}^{\#1} + \alpha\beta$	$\sigma_{1+}^{\#1}$	$\sigma_{1+}^{\#2}$	$\tau_{1+}^{\#1}$	$\tau_{1+}^{\#2}$
$\sigma_{1+}^{\#1} + \alpha\beta$	0	$-\frac{\sqrt{2}}{t_1 + k^2} t_1$	0	0	0	0
$\sigma_{1+}^{\#2} + \alpha\beta$	$-\frac{\sqrt{2}}{t_1 + k^2} t_1$	$-\frac{i(2k^3 r_5 + t_1)}{(1 + k^2)^2} t_1^2$	0	0	0	0
$\tau_{1+}^{\#1} + \alpha\beta$	$\frac{i\sqrt{2}k}{t_1 + k^2} t_1$	$\frac{-2k^4 r_5 + k^2 t_1}{(1 + k^2)^2} t_1^2$	0	0	0	0
$\sigma_{1-}^{\#1} + \alpha$	0	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2} t_1$	0	$\frac{2ik}{t_1 + 2k^2} t_1$
$\sigma_{1-}^{\#2} + \alpha$	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2} t_1$	$\frac{-2k^2 r_5 + t_1}{(t_1 + 2k^2)^2} t_1^2$	0	$-\frac{i\sqrt{2}k(2k^2 r_5 + t_1)}{(t_1 + 2k^2)^2} t_1^2$
$\tau_{1-}^{\#1} + \alpha$	0	0	0	0	0	0
$\tau_{1-}^{\#2} + \alpha$	0	0	$-\frac{2ik}{t_1 + 2k^2} t_1$	$\frac{i\sqrt{2}k(2k^2 r_5 + t_1)}{(t_1 + 2k^2)^2} t_1^2$	0	$\frac{-4k^4 r_5 + 2k^2 t_1}{(t_1 + 2k^2)^2} t_1^2$

Quadratic (free) action

$$S = \iiint (f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + \frac{1}{2} t_1 (2 \omega^{\alpha\chi} \omega_{\alpha\chi} - 4 \omega_{\alpha\chi} \partial_\theta f^{\alpha\chi} + 4 \omega_{\alpha\chi} \partial_\theta f^{\alpha\chi} - 2 \partial_\theta f^{\alpha\chi} \partial_\theta f^{\alpha\chi} - 2 \partial_\theta f^{\alpha\chi} \partial_\theta f^{\alpha\chi} + \partial_\theta f^{\alpha\chi} \partial_\theta f^{\alpha\chi} + \partial_\theta f^{\alpha\chi} \partial_\theta f^{\alpha\chi} + \partial_\theta f^{\alpha\chi} \partial_\theta f^{\alpha\chi} + 2 \omega_{\alpha\theta\chi} (\omega^{\alpha\theta\chi} + 2 \partial^\theta f^{\alpha\chi})) + \frac{1}{3} r_2 (4 \partial_\beta \omega_{\alpha\theta} - 2 \partial_\beta \omega_{\alpha\theta\chi} + 2 \partial_\beta \omega_{\alpha\theta\chi} - \partial_\alpha \omega_{\alpha\theta\beta} + \partial_\theta \omega_{\alpha\beta\chi} - 2 \partial_\theta \omega_{\alpha\beta\chi}) \partial^\theta \omega_{\alpha\beta\chi} + r_5 (\partial_\alpha \omega_{\theta\chi} \partial^\theta \omega^{\alpha\chi} - \partial_\theta \omega_{\alpha\chi} \partial^\theta \omega^{\alpha\chi} - (\partial_\alpha \omega^{\alpha\theta\chi} - 2 \partial^\theta \omega^{\alpha\chi}) (\partial_\chi \omega_{\alpha\theta} - \partial_\chi \omega_{\alpha\theta})) [t, x, y, z] dz dy dx dt$$

$\omega_{1+}^{\#1} + \alpha\beta$	$\omega_{1+}^{\#2} + \alpha\beta$	$f_{1+}^{\#1} + \alpha\beta$	$\omega_{1-}^{\#1} + \alpha$	$\omega_{1-}^{\#2} + \alpha$	$f_{1-}^{\#1} + \alpha$	$f_{1-}^{\#2} + \alpha$
$\omega_{1+}^{\#1} + \alpha\beta$	$k^2 r_5 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0
$\omega_{1+}^{\#2} + \alpha\beta$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$f_{1+}^{\#1} + \alpha\beta$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0
$\omega_{1-}^{\#1} + \alpha$	0	0	$k^2 r_5 - \frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	ikt_1
$\omega_{1-}^{\#2} + \alpha$	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1-}^{\#1} + \alpha$	0	0	0	0	0	0
$f_{1-}^{\#2} + \alpha$	0	0	$-ikt_1$	0	0	0
$\sigma_{0+}^{\#1} + \alpha$	$\tau_{0+}^{\#1} + \alpha$	$\tau_{0+}^{\#2} + \alpha$	$\sigma_{0-}^{\#1} + \alpha\beta$	$\tau_{2+}^{\#1} + \alpha\beta$	$\sigma_{2+}^{\#1} + \alpha\beta$	$\sigma_{2-}^{\#1} + \alpha\beta\chi$
$\sigma_{0+}^{\#1} + \alpha$	$-\frac{1}{(1+2k^2)^2} t_1$	$\frac{i\sqrt{2}k}{(1+2k^2)^2} t_1$	$-\frac{1}{(1+2k^2)^2} t_1$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2} t_1$	0	0
$\tau_{0+}^{\#1} + \alpha$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2} t_1$	$-\frac{2k^2}{(1+2k^2)^2} t_1$	$-\frac{1}{(1+2k^2)^2} t_1$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2} t_1$	0	0
$\tau_{0+}^{\#2} + \alpha$	0	0	0	0	0	$\frac{2}{t_1}$
$\sigma_{0-}^{\#1} + \alpha$	0	0	0	0	0	0

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

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