

Particle spectrograph

Wave operator and propagator

Source constraints		Fundamental fields	Multiplicities
SO(3) irreps			
$\tau_{0+}^{\#2} == 0$		$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == 0$	1
$\tau_{0+}^{\#1} == 0$		$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha_\alpha$	1
$\tau_{1-}^{\#2\alpha} == 0$		$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta}$	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
$\sigma_{1-}^{\#2\alpha} == 0$		$\partial_\chi \partial_\beta \sigma^{\alpha\beta\chi} == 0$	3
$\tau_{1+}^{\#1\alpha\beta} + i k \sigma_{1+}^{\#1\alpha\beta} == 0$		$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^\chi{}_\alpha + \partial_\chi \partial^\chi \tau^{\alpha\beta} + \partial_\beta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha} == \partial_\chi \partial^\alpha \tau^\chi{}_\beta + \partial_\chi \partial^\beta \tau^\alpha{}_\chi + \partial_\chi \partial^\chi \tau^{\beta\alpha} + \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta}$	
$\sigma_{1+}^{\#1\alpha\beta} == \sigma_{1+}^{\#2\alpha\beta}$		$3 \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 2 \partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^\chi{}_X + 2 \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta} == 3 \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha}$	3
$\tau_{2+}^{\#1\alpha\beta} == 0$		$4 \partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \partial^\alpha \tau^\chi{}_X + 3 \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\alpha} + 2 \eta^{\alpha\beta} \partial_\varepsilon \partial_\delta \partial_\chi \tau^{\chi\delta} == 3 \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} + 3 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^\alpha{}_\chi + 3 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} + 2 \eta^{\alpha\beta} \partial_\varepsilon \partial_\delta \partial^\delta \tau^\chi{}_X$	5
$\sigma_{2+}^{\#1\alpha\beta} == 0$		$3 \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 3 \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + 2 \eta^{\alpha\beta} \partial_\varepsilon \partial_\delta \sigma^{\alpha\chi\delta} == 2 \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\delta} + 3 (\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha})$	5
Total constraints/gauge generators:			27

Quadratic (free) action

$$S = \iiint \left(\frac{1}{6} \tau_{\alpha\beta} f^{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + 12 r_1 \partial_\beta \omega^\theta{}_\theta \partial' \omega^{\alpha\beta}{}_\alpha - 24 r_3 \partial_\beta \omega^\theta{}_\theta \partial' \omega^{\alpha\beta}{}_\alpha + 12 r_1 \partial_\chi \omega^\theta{}_\beta \partial' \omega^{\alpha\beta}{}_\alpha + 12 r_1 \partial_\alpha \omega^{\alpha\beta\chi} \partial_\theta \omega_{\beta\chi}{}^\theta - 24 r_1 \partial_\chi \omega^{\alpha\beta}{}_\alpha \partial_\theta \omega_{\beta\chi}{}^\theta + 12 r_1 \partial_\alpha \omega^{\alpha\beta\chi} \partial_\theta \omega_{\beta\chi}{}^\theta - 24 r_3 \partial_\alpha \omega^{\alpha\beta\chi} \partial_\theta \omega_{\beta\chi}{}^\theta - 24 r_1 \partial_\chi \omega^{\alpha\beta}{}_\alpha \partial_\theta \omega_{\beta\chi}{}^\theta + 48 r_3 \partial_\chi \omega^{\alpha\beta}{}_\alpha \partial_\theta \omega_{\beta\chi}{}^\theta + 4 t_2 \omega_{\theta\alpha} \partial^\theta f^{\alpha\chi} + 2 t_2 \partial_\alpha f_{\theta\chi} \partial^\theta f^{\alpha\chi} - t_2 \partial_\alpha f_{\theta\chi} \partial^\theta f^{\alpha\chi} - t_2 \partial_\chi f_{\alpha\theta} \partial^\theta f^{\alpha\chi} + t_2 \partial_\theta f_{\alpha\chi} \partial^\theta f^{\alpha\chi} - t_2 \partial_\theta f_{\alpha\chi} \partial^\theta f^{\alpha\chi} - 4 t_2 \omega_{\alpha\theta\chi} (\omega^{\alpha\theta\beta} + \partial^\theta f^{\alpha\chi}) + 2 t_2 \omega_{\alpha\theta\beta} (\omega^{\alpha\theta\beta} + 2 \partial^\theta f^{\alpha\chi}) - 8 r_1 \partial_\beta \omega_{\alpha\theta\beta} \partial^\theta \omega^{\alpha\beta\chi} + 8 r_2 \partial_\beta \omega_{\alpha\theta\beta} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_\beta \omega_{\alpha\theta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_2 \partial_\beta \omega_{\alpha\theta\chi} \partial^\theta \omega^{\alpha\beta\chi} + 8 r_1 \partial_\beta \omega_{\theta\alpha\chi} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_2 \partial_\beta \omega_{\theta\alpha\chi} \partial^\theta \omega^{\alpha\beta\chi} - 24 r_3 \partial_\beta \omega_{\theta\alpha\chi} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_1 \partial_\chi \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta\chi} - 2 r_2 \partial_\chi \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_\theta \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} + 2 r_2 \partial_\theta \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_\theta \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_2 \partial_\theta \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi}) [t, x, y, z] dz dy dx dt$$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2}$
$\frac{2t_2}{3}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{kt_2}{3}$	0	0	0	0
$\omega_{1-}^{\#1} \dagger^\alpha$	0	0	$-k^2r_1$	0	0	0
$\omega_{1-}^{\#2} \dagger^\alpha$	0	0	0	0	0	0
$f_{1-}^{\#1} \dagger^\alpha$	0	0	0	0	0	0
$f_{1-}^{\#2} \dagger^\alpha$	0	0	0	0	0	0

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2}$	$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
$\frac{6}{(3+k^2)^2t_2}$	$\frac{3\sqrt{2}}{(3+k^2)^2t_2}$	$\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$	0	0	0	0
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$\frac{3\sqrt{2}}{(3+k^2)^2t_2}$	$\frac{3}{(3+k^2)^2t_2}$	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$	$-\frac{3ik}{(3+k^2)^2t_2}$	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^\alpha$	0	0	$-\frac{1}{k^2r_1}$	0	0	0
$\sigma_{1-}^{\#2} \dagger^\alpha$	0	0	0	0	0	0
$\tau_{1-}^{\#1} \dagger^\alpha$	0	0	0	0	0	0
$\tau_{1-}^{\#2} \dagger^\alpha$	0	0	0	0	0	0

$\omega_{0+}^{\#1} \dagger$	$f_{0+}^{\#1}$	$f_{0+}^{\#2}$	$\omega_0^{\#1}$
$6k^2(-r_1+r_3)$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$k^2r_2+t_2$

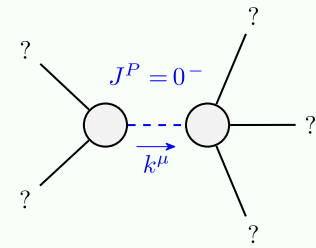
$\sigma_{0+}^{\#1}$	$\tau_{0+}^{\#1}$	$\tau_{0+}^{\#2}$	$\sigma_0^{\#1}$
$\frac{1}{6k^2(-r_1+r_3)}$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$\frac{1}{k^2r_2+t_2}$

$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2-}^{\#1} \alpha\beta\chi$
0	0	0
0	0	0
0	0	$\frac{1}{k^2r_1}$

$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{2-}^{\#1} \alpha\beta\chi$
0	0	0
0	0	0
0	0	$\frac{1}{k^2r_1}$

$\omega_{2+}^{\#1} \alpha\beta$	$f_{2+}^{\#1} \alpha\beta$	$\omega_{2-}^{\#1} \alpha\beta\chi$
0	0	0
0	0	0
0	0	k^2r_1

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

No massless particles (sawtooth)

Unitarity conditions

$r_2 < 0 \ \&\& \ t_2 > 0$