

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
$\tau_{0+}^{\#1} - 2\,i\,k\,\sigma_{0+}^{\#1} == 0$			$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha_\alpha + 2\,\partial_\chi \partial^\chi \partial_\beta \sigma^{\alpha\beta}_\alpha$	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
$\tau_{1+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1+}^{\#1\,\alpha\beta} == 0$			$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\chi\alpha} + \partial_\chi \partial^\chi \tau^{\alpha\beta} +$ $\partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha} ==$ $\partial_\chi \partial^\alpha \tau^\chi_\beta + \partial_\chi \partial^\beta \tau^\alpha_\chi + \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta}$	3
$\sigma_{1+}^{\#1\,\alpha\beta} == \sigma_{1+}^{\#2\,\alpha\beta}$			$3\,\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} +$ $2\,\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta} ==$ $3\,\partial_\delta \partial_\chi \partial_\beta \sigma^{\alpha\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha}$	3
$\tau_{2+}^{\#1\,\alpha\beta} == 0$			$4\,\partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2\,\partial_\delta \partial^\delta \partial_\beta \partial^\alpha \tau^\chi_\chi +$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\alpha\beta} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\beta\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} ==$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\alpha\chi} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial_\beta \tau^{\chi\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \tau^\chi_\chi$	5
$\sigma_{2+}^{\#1\,\alpha\beta} == 0$			$3\,\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 3\,\partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \sigma^{\chi\delta}_\chi == 2\,\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\delta} +$ $3\,(\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\chi\beta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha})$	5
Total constraints/gauge generators:				24

Quadratic (free) action

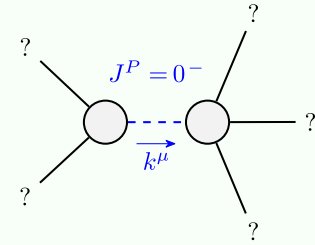
$$S = \int \int \int \int (\frac{1}{6} (-4\,t_3\,\omega^\alpha_\alpha\,\omega^\kappa_{\,\,\kappa} + 6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + 8\,t_3\,\omega^\kappa_\alpha\,\omega^\kappa_\kappa\,\partial_\iota f^{\alpha\iota} - 8\,t_3\,\omega_{\,\,\kappa}^\kappa\,\partial_\iota f^\alpha_\alpha + 4\,t_3\,\partial_\iota f^\kappa_\kappa\,\partial_\iota f^\alpha_\alpha - 12\,r_1\,\partial_\beta \omega^\theta_{\,\,\theta} - 12\,r_1\,\partial_\beta \omega^\theta_{\,\,\theta}\,\partial_\iota \omega^{\alpha\beta}_\alpha + 12\,r_1\,\partial_\iota \omega^\theta_\beta\,\partial_\iota \omega^{\alpha\beta}_\beta + 12\,r_1\,\partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega^\theta_{\,\,\beta} - 24\,r_1\,\partial_\iota \omega^{\alpha\beta}_\alpha\,\partial_\theta \omega^\theta_{\,\,\beta} - 12\,r_1\,\partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega^\theta_{\,\,\beta} + 24\,r_1\,\partial_\iota \omega^{\alpha\beta}_\beta\,\partial_\theta \omega^\theta_{\,\,\alpha} + 4\,t_2\,\omega_{\theta\alpha}\,\partial^\theta f^{\alpha\iota} + 2\,t_2\,\partial_\alpha f_{\,\,\theta}\,\partial^\theta f^{\alpha\iota} - t_2\,\partial_\alpha f_{\theta\iota}\,\partial^\theta f^{\alpha\iota} - t_2\,\partial_\iota f_{\alpha\theta}\,\partial^\theta f^{\alpha\iota} + t_2\,\partial_\theta f_{\alpha\iota}\,\partial^\theta f^{\alpha\iota} - t_2\,\partial_\theta f_{\,\,\alpha}\,\partial^\theta f^{\alpha\iota} - 4\,t_2\,\omega_{\alpha\theta\iota}\,(\omega^{\alpha\iota\theta} + \partial^\theta f^{\alpha\iota}) + 2\,t_2\,\omega_{\alpha\iota\theta}\,(\omega^{\alpha\iota\theta} + 2\,\partial^\theta f^{\alpha\iota}) - 8\,r_1\,\partial_\beta \omega_{\alpha\iota\theta}\,\partial^\theta \omega^{\alpha\beta\iota} + 8\,r_2\,\partial_\beta \omega_{\alpha\iota\theta}\,\partial^\theta \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\beta \omega_{\alpha\theta\iota}\,\partial^\theta \omega^{\alpha\beta\iota} - 4\,r_1\,\partial_\beta \omega_{\iota\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\iota} - 16\,r_1\,\partial_\beta \omega_{\iota\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\iota} + 4\,r_2\,\partial_\beta \omega_{\iota\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\iota} - 4\,r_1\,\partial_\iota \omega_{\alpha\beta\theta}\,\partial^\theta \omega^{\alpha\beta\iota} - 2\,r_2\,\partial_\iota \omega_{\alpha\beta\theta}\,\partial^\theta \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\theta \omega_{\alpha\beta\iota}\,\partial^\theta \omega^{\alpha\beta\iota} + 2\,r_2\,\partial_\theta \omega_{\alpha\beta\iota}\,\partial^\theta \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\theta \omega_{\alpha\iota\beta}\,\partial^\theta \omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\theta \omega_{\alpha\iota\beta}\,\partial^\theta \omega^{\alpha\beta\iota} + 4\,t_3\,\partial_\iota f^{\alpha\iota}\,\partial_\kappa f^\kappa_\alpha - 8\,t_3\,\partial_\iota f^\alpha_\alpha\,\partial_\kappa f^\kappa_\iota)) [t,\,x,\,y,\,z] d^3z\,dy\,dx\,dt$$

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2}$	$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1-}^{\#1}$	$\sigma_{1-}^{\#2}$	$\tau_{1-}^{\#1}$	$\tau_{1-}^{\#2}$
$\frac{6}{(3+k^2)^2}t_2$	$\frac{3\sqrt{2}}{(3+k^2)^2}t_2$	$\frac{3i\sqrt{2}k}{(3+k^2)^2}t_2$	0	0	0	0
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$\frac{3}{(3+k^2)^2}t_2$	$\frac{3ik}{(3+k^2)^2}t_2$	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{3i\sqrt{2}k}{(3+k^2)^2}t_2$	$\frac{3k^2}{(3+k^2)^2}t_2$	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^\alpha$	0	0	$-\frac{1}{k^2}r_1$	$-\frac{\sqrt{2}}{k^2r_1+2k^4}r_1$	0	$-\frac{2i}{kr_1+2k^3}r_1$
$\sigma_{1-}^{\#2} \dagger^\alpha$	0	0	$-\frac{\sqrt{2}}{k^2r_1+2k^4}r_1$	$\frac{3k^2r_1-2t_3}{(k+2k^3)^2}r_1t_3$	0	$\frac{i\sqrt{2}(3k^2r_1-2t_3)}{k(1+2k^2)^2}r_1t_3$
$\tau_{1-}^{\#1} \dagger^\alpha$	0	0	0	0	0	0
$\tau_{1-}^{\#2} \dagger^\alpha$	0	0	$\frac{2i}{kr_1+2k^3}r_1$	$-\frac{i\sqrt{2}(3k^2r_1-2t_3)}{k(1+2k^2)^2}r_1t_3$	0	$\frac{6k^2r_1-4t_3}{(1+2k^2)^2}r_1t_3$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1}$	$\omega_{1-}^{\#2}$	$f_{1-}^{\#1}$	$f_{1-}^{\#2}$
$\frac{2t_2}{3}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}kt_2$	$\frac{k^2t_2}{3}$	0	0	0	0
$\omega_{1-}^{\#1} \dagger^\alpha$	0	0	$-k^2r_1+\frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	0	$-\frac{2}{3}i\sqrt{2}kt_3$
$\omega_{1-}^{\#2} \dagger^\alpha$	0	0	$-\frac{\sqrt{2}t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_3$
$f_{1-}^{\#1} \dagger^\alpha$	0	0	0	0	0	0
$f_{1-}^{\#2} \dagger^\alpha$	0	0	$\frac{2ikt_3}{3}$	$-\frac{1}{3}i\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$

$\sigma_{0+}^{\#1} \dagger$	$\sigma_{0+}^{\#1}$	$\tau_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#1}$
$\frac{1}{(1+2k^2)^2}t_3$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2}t_3$	0	0
$\tau_{0+}^{\#1} \dagger$	$\frac{i\sqrt{2}k}{(1+2k^2)^2}t_3$	0	0
$\tau_{0+}^{\#2} \dagger$	0	0	0
$q_{0+}^{\#1} \dagger$	0	0	$\frac{1}{k^2r_2+t_2}$
$\omega_{0+}^{\#1} \dagger$	$\omega_{0+}^{\#1}$	$f_{0+}^{\#1} \dagger$	$f_{0+}^{\#1}$
0	0	$i\sqrt{2}kt_3$	$2k^2t_3$
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2+}^{\#1}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1}$
0	0	0	0
$\omega_{2+}^{\#1} \dagger^{\alpha\beta\chi}$	$\omega_{2+}^{\#1}$	$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{2+}^{\#1}$
0	0	0	0
$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1}$	$\tau_{2+}^{\#1}$	$\tau_{2+}^{\#1}$
0	0	0	0
$\sigma_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	$\sigma_{2-}^{\#1}$	$\sigma_{2-}^{\#1}$	$\sigma_{2-}^{\#1}$
0	0	0	$\frac{1}{k^2}r_1$

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)

Unitarity conditions

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