Particle spectrograph

Wave operator and propagator

Source constraints

SO(3) irreps	Fundamental fields	Multiplicities
$\tau^{\#2}_{0^+} == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == 0$	1
$\tau^{\#1}_{0^+} == 0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta} == \partial_\beta\partial^\beta\tau^\alpha{}_\alpha$	1
$\sigma^{\#1}_{0^+} == 0$	$\partial_\beta\sigma^{\alpha\beta}{}_\alpha == 0$	1
$\tau^{\#2\,\alpha}_{1^-} == 0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta}$	3
$\tau^{\#1\,\alpha}_{1^-} == 0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\tau^{\beta\alpha}$	3
$\sigma^{\#2\,\alpha}_{1^-} == 0$	$\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi} == 0$	3
$\tau^{\#1\,\alpha\beta}_{1^+} + i\,k\,\sigma^{\#1\,\alpha\beta}_{1^+} == 0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi} + \partial_\chi\partial^\beta\tau^{\chi\alpha} + \partial_\chi\partial^\chi\tau^{\alpha\beta} + \partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta} + \partial_\delta\partial^\delta\partial_\chi\sigma^{\beta\chi\alpha} == \partial_\chi\partial^\alpha\tau^{\chi\beta} + \partial_\chi\partial^\beta\tau^{\alpha\chi} + \partial_\chi\partial^\chi\tau^{\beta\alpha} + \partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta} + \partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\chi\beta}$	3
$\sigma^{\#1\,\alpha\beta}_{1^+} == \sigma^{\#2\,\alpha\beta}_{1^+}$	$3\,\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta} + 2\,\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi} + \partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\chi\beta} == 3\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta} + \partial_\delta\partial^\delta\partial_\chi\sigma^{\beta\chi\alpha}$	3
$\sigma^{\#1\,\alpha\beta\chi}_{2^-} == 0$	$3\,\partial_\epsilon\partial_\delta\partial^\chi\partial^\alpha\sigma^{\beta\delta\epsilon} + 3\,\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\alpha\sigma^{\beta\delta}{}_\delta + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\chi\delta} + 4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\beta\sigma^{\alpha\delta\chi} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\beta\delta\alpha} + 4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\alpha\beta\delta} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha} + 3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\alpha\sigma^{\delta\epsilon}{}_\delta + 3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\beta\delta\epsilon} + 3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\alpha\delta}{}_\delta == 3\,\partial_\epsilon\partial_\delta\partial^\chi\partial^\beta\sigma^{\alpha\delta\epsilon} + 3\,\partial_\epsilon\partial^\epsilon\partial^\chi\partial^\beta\sigma^{\alpha\delta}{}_\delta + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\chi\delta} + 4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\beta\delta\chi} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\chi\sigma^{\beta\delta\alpha} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\alpha\sigma^{\chi\delta\beta} + 2\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\chi\beta} + 4\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi} + 3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\beta\sigma^{\delta\epsilon}{}_\delta + 3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial_\delta\sigma^{\alpha\delta\epsilon} + 3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\epsilon\sigma^{\beta\delta}{}_\delta$	5
$\tau^{\#1\,\alpha\beta}_{2^+} == 0$	$4\,\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta} + 2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha} + 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta} == 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha} + 3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta} + 2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi$	5
Total constraints/gauge generators:		28

Quadratic (free) action

$$\mathcal{S} == \iiint\!\!\int\Big(\tfrac{1}{6}\,(6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 15\,r_3\,\partial_\beta\omega_\iota{}^\theta{}_\theta\,\partial^\iota\omega^{\alpha\beta}{}_\alpha + 9\,r_3\,\partial_\iota\omega_\beta{}^\theta{}_\theta\,\partial^\iota\omega^{\alpha\beta}{}_\alpha + 9\,r_3\,\partial_\alpha\omega^{\alpha\beta\iota}\,\partial_\theta\omega_\beta{}^\theta{}_\iota - 18\,r_3\,\partial^\iota\omega^{\alpha\beta}{}_\alpha\,\partial_\theta\omega_\beta{}^\theta{}_\iota - 15\,r_3\,\partial_\alpha\omega^{\alpha\beta\iota}\,\partial_\theta\omega_\iota{}^\theta{}_\beta + 30\,r_3\,\partial^\iota\omega^{\alpha\beta}{}_\alpha\,\partial_\theta\omega_\iota{}^\theta{}_\beta + 4\,t_2\,\omega_{\iota\theta\alpha}\,\partial^\theta f^{\alpha\iota} + 2\,t_2\,\partial_\alpha f_{\iota\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_{\iota\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_2\,\partial_\beta\omega_{\alpha\iota\theta}\,\partial^\theta\omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\beta\omega_{\alpha\theta\iota}\,\partial^\theta\omega^{\alpha\beta\iota} + 4\,r_2\,\partial_\beta\omega_{\iota\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\iota} - 24\,r_3\,\partial_\beta\omega_{\iota\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\iota} - 2\,r_2\,\partial_\iota\omega_{\alpha\beta\theta}\,\partial^\theta\omega^{\alpha\beta\iota} + 2\,r_2\,\partial_\theta\omega_{\alpha\beta\iota}\,\partial^\theta\omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\theta\omega_{\alpha\iota\beta}\,\partial^\theta\omega^{\alpha\beta\iota})\Big)[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

	$\omega^{\#1}_{1^+\alpha\beta}$	$\omega^{\#2}_{1^+\alpha\beta}$	$f^{\#1}_{1^+\alpha\beta}$	$\omega^{\#1}_{1^-\alpha}$	$\omega^{\#2}_{1^-\alpha}$	$f^{\#1}_{1^-\alpha}$	$f^{\#2}_{1^-\alpha}$
$\omega^{\#1}_{1^+}{}^\dagger{}^{\alpha\beta}$	$\frac{2t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0	0
$\omega^{\#2}_{1^+}{}^\dagger{}^{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0	0	0	0
$f^{\#1}_{1^+}{}^\dagger{}^{\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{1}{3}\,i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0	0	0	0
$\omega^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	$-\frac{3\,k^2\,r_3}{2}$	0	0	0
$\omega^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0	0	0	0
$f^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0	0	0	0

0	0	$-\frac{3\,k^2\,r_3}{2}$	0
0	0	0	0
0	0	0	0

	$\omega^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}{}^\dagger$	0	0	0	0
$f^{\#1}_{0^+}{}^\dagger$	0	0	0	0
$f^{\#2}_{0^+}{}^\dagger$	0	0	0	0
$\omega^{\#1}_{0^-}{}^\dagger$	0	0	0	$k^2\,r_2 + t_2$

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}{}^\dagger$	0	0	0	0
$\tau^{\#1}_{0^+}{}^\dagger$	0	0	0	0
$\tau^{\#2}_{0^+}{}^\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}{}^\dagger$	0	0	0	$\frac{1}{k^2\,r_2 + t_2}$

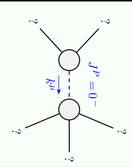
	$\sigma^{\#1}_{2^+\alpha\beta}$	$\tau^{\#1}_{2^+\alpha\beta}$	$\sigma^{\#1}_{2^-\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}{}^\dagger{}^{\alpha\beta}$	$-\frac{2}{3\,k^2\,r_3}$	0	0
$\tau^{\#1}_{2^+}{}^\dagger{}^{\alpha\beta}$	0	0	0
$\sigma^{\#1}_{2^-}{}^\dagger{}^{\alpha\beta\chi}$	0	0	0

	$\sigma^{\#1}_{1^-\alpha}$	$\sigma^{\#2}_{1^-\alpha}$	$\tau^{\#1}_{1^-\alpha}$	$\tau^{\#2}_{1^-\alpha}$
$\sigma^{\#1}_{1^+}{}^\dagger{}^{\alpha\beta}$	0	0	0	0
$\sigma^{\#2}_{1^+}{}^\dagger{}^{\alpha\beta}$	0	0	0	0
$\tau^{\#1}_{1^+}{}^\dagger{}^{\alpha\beta}$	0	0	0	0
$\sigma^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	$-\frac{2}{3\,k^2\,r_3}$
$\sigma^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0
$\tau^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0
$\tau^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	0	0	0	0

	$\sigma^{\#1}_{1^+\alpha\beta}$	$\sigma^{\#2}_{1^+\alpha\beta}$	$\tau^{\#1}_{1^+\alpha\beta}$
$\sigma^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	$-\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$	$\frac{3\,\sqrt{2}}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$
$\sigma^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	$-\frac{3\,i\,k}{(3+k^2)^2\,r_2}$	$\frac{3}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,k}{(3+k^2)^2\,r_2}$
$\tau^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	$\frac{3\,k^2}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,k}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$

	$\sigma^{\#1}_{1^+\alpha\beta}$	$\sigma^{\#2}_{1^+\alpha\beta}$	$\tau^{\#1}_{1^+\alpha\beta}$
$\sigma^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	$-\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$	$\frac{3\,\sqrt{2}}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$
$\sigma^{\#2}_{1^-}{}^\dagger{}^{\alpha}$	$-\frac{3\,i\,k}{(3+k^2)^2\,r_2}$	$\frac{3}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,k}{(3+k^2)^2\,r_2}$
$\tau^{\#1}_{1^-}{}^\dagger{}^{\alpha}$	$\frac{3\,k^2}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,k}{(3+k^2)^2\,r_2}$	$\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,r_2}$

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

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