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

Quadratic (free) action

$$S == \int\int\int\int (\tfrac{1}{6}\,(6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + 12\,r_1\,\partial_\rho \omega_\iota{}^\theta\,\partial^\rho \omega^{\iota\alpha\beta}{}_\alpha - 24\,r_3\,\partial_\rho \omega_\iota{}^\theta\,\partial^\rho \omega^{\iota\alpha\beta}{}_\alpha + 12\,r_1\,\partial_\iota \omega_\beta{}^\theta\,\partial^\iota \omega^{\alpha\beta}{}_\alpha + 12\,r_1\,\partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega_\beta{}^\theta{}_\iota - 24\,r_1\,\partial^\iota \omega^{\alpha\beta}{}_\alpha\,\partial_\theta \omega_\beta{}^\theta{}_\iota + 12\,r_1\,\partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega_\iota{}^\theta{}_\beta - 24\,r_3\,\partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega_\iota{}^\theta{}_\beta + 24\,r_1\,\partial^\iota \omega^{\alpha\beta}{}_\alpha\,\partial_\theta \omega_\iota{}^\theta{}_\beta + 48\,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\iota\theta}\,(\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_\rho \omega_{\alpha\iota\theta}\,\partial^\rho \omega^{\alpha\beta\iota} + 8\,r_2\,\partial_\rho \omega_{\alpha\iota\theta}\,\partial^\rho \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\rho \omega_{\alpha\theta\iota}\,\partial^\rho \omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\rho \omega_{\alpha\theta\iota}\,\partial^\rho \omega^{\alpha\beta\iota} + 8\,r_1\,\partial_\rho \omega_{\iota\theta\alpha}\,\partial^\rho \omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\rho \omega_{\iota\theta\alpha}\,\partial^\rho \omega^{\alpha\beta\iota} - 24\,r_3\,\partial_\rho \omega_{\iota\theta\alpha}\,\partial^\rho \omega^{\alpha\beta\iota} - 4\,r_1\,\partial_\iota \omega_{\alpha\beta\theta}\,\partial^\rho \omega^{\alpha\beta\iota} + 2\,r_2\,\partial_\iota \omega_{\alpha\beta\theta}\,\partial^\rho \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\theta \omega_{\alpha\beta\iota}\,\partial^\rho \omega^{\alpha\beta\iota} + 2\,r_2\,\partial_\theta \omega_{\alpha\beta\iota}\,\partial^\rho \omega^{\alpha\beta\iota} + 4\,r_1\,\partial_\theta \omega_{\alpha\iota\beta}\,\partial^\rho \omega^{\alpha\beta\iota} - 4\,r_2\,\partial_\theta \omega_{\alpha\iota\beta}\,\partial^\rho \omega^{\alpha\beta\iota}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

$\omega_{1^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$

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

$\omega_{0^+}^{\#1}\,\dagger$

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^+}^{\#1}$
$\omega_{0^+}^{\#1}\,\dagger$	0	0	0	$k^2\,r_2 + t_2$
$f_{0^+}^{\#1}\,\dagger$	0	0	0	0
$f_{0^+}^{\#2}\,\dagger$	0	0	0	0
$\omega_{0^+}^{\#1}\,\dagger$	0	0	0	0

$\sigma_{0^+}^{\#1}\,\dagger$

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

$\sigma_{2^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$

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

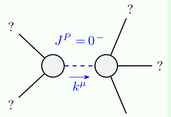
$\omega_{2^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$

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

$\sigma_{1^+}^{\#1\,\alpha\beta}$ $\sigma_{1^+}^{\#2\,\alpha\beta}$ $\tau_{1^+}^{\#1\,\alpha\beta}$ $\sigma_{1^-}^{\#1\,\alpha}$ $\sigma_{1^-}^{\#2\,\alpha}$ $\tau_{1^-}^{\#1\,\alpha}$ $\tau_{1^-}^{\#2\,\alpha}$

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

Massive and massless spectra



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

(No massless particles)

Unitarity conditions

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