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

Quadratic (free) action

$$S == \iiint\int (f^{\alpha\beta}\,\tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + \frac{1}{2}\,t_1\,(2\,\omega^{\alpha\prime}{}_\alpha{}^\theta{}_{,\theta}\,\omega^{\alpha\prime}{}_\alpha{}^\theta{}_{,\theta} - 4\,\omega^\theta{}_{,\theta}\,\partial_\prime f^{\alpha\prime} + 4\,\omega^\theta{}_{,\theta}\,\partial^\prime f^\alpha{}_\alpha{}^\theta - 2\,\partial_\prime f^\theta{}_\theta\,\partial^\prime f^\alpha{}_\alpha{}^\theta - 2\,\partial_\theta f^{\alpha\prime}{}_\alpha{}^\theta\,\partial_\theta f^\prime{}_\alpha{}^\theta + 4\,\partial^\prime f^\alpha{}_\alpha{}^\theta\,\partial_\theta f^\prime{}_\theta - 2\,\partial_\alpha f^\theta{}_{\iota\theta}\,\partial^\theta f^{\alpha\prime}{}_\iota{}^\theta - \partial_\alpha f_{\theta\iota}\,\partial^\theta f^{\alpha\prime\iota} - \partial_\theta f^{\alpha\prime}{}_\alpha{}^\theta + 2\,\partial^\theta f^{\alpha\prime\prime})) - \frac{1}{3}\,r_1\,(3\,\partial_\beta \omega^\prime{}_\alpha{}^\theta{}_\theta\,\partial^\prime \omega^{\alpha\beta}{}_\alpha{}^\theta - 3\,\partial_\prime \omega^\theta{}_\alpha{}^{\alpha\beta}\,\partial_\theta \omega^\prime{}_\beta{}^\theta + 6\,\partial^\prime \omega^{\alpha\beta}{}_\alpha{}^\theta\,\partial_\theta \omega^\prime{}_\beta{}^\theta + 3\,\partial_\alpha \omega^{\alpha\beta\prime}{}_\beta{}^\theta\,\partial_\theta \omega^\prime{}_\alpha{}^\theta - 6\,\partial^\prime \omega^{\alpha\beta}{}_\alpha{}^\theta\,\partial_\theta \omega^\prime{}_{\beta\,,\theta} + 2\,\partial_\beta \omega^\theta{}_{,\theta}\,\partial^\theta \omega^{\alpha\beta\prime} - 2\,\partial_\beta \omega_{\alpha\theta\prime}\,\partial^\theta \omega^{\alpha\beta\prime} + 8\,\partial_\beta \omega_{\prime\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\prime} + 2\,\partial_\prime \omega_{\alpha\beta\theta}\,\partial^\theta \omega^{\alpha\beta\prime} - 2\,\partial_\theta \omega_{\alpha\beta\prime}\,\partial^\theta \omega^{\alpha\beta\prime} - 2\,\partial_\theta \omega_{\alpha\prime\beta}\,\partial^\theta \omega^{\alpha\beta\prime}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

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

$\sigma_{1^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2\,t_1}$	0	0	0	0
$\sigma_{1^+}^{\#2\,\alpha\beta}\,\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$-\frac{2\,k^2\,r_1+t_1}{(1+k^2)^2\,t_1^2}$	$-\frac{i\,(2\,k^3\,r_1+k\,t_1)}{(1+k^2)^2\,t_1^2}$	0	0	0	0
$\tau_{1^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	$\frac{i\sqrt{2}\,k}{t_1+k^2\,t_1}$	$\frac{i\,(2\,k^3\,r_1+k\,t_1)}{(1+k^2)^2\,t_1^2}$	$\frac{-2\,k^4\,r_1+k^2\,t_1}{(1+k^2)^2\,t_1^2}$	0	0	0	0
$\sigma_{1^-}^{\#1\,\alpha}\,\dagger^\alpha$	0	0	0	0	$\frac{\sqrt{2}}{t_1+2\,k^2\,t_1}$	0	$\frac{2\,i\,k}{t_1+2\,k^2\,t_1}$
$\sigma_{1^-}^{\#2\,\alpha}\,\dagger^\alpha$	0	0	0	$\frac{\sqrt{2}}{t_1+2\,k^2\,t_1}$	$\frac{1}{(1+2\,k^2)^2\,t_1}$	0	$\frac{i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$
$\tau_{1^-}^{\#1\,\alpha}\,\dagger^\alpha$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#2\,\alpha}\,\dagger^\alpha$	0	0	0	$-\frac{2\,i\,k}{t_1+2\,k^2\,t_1}$	$-\frac{i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	0	$\frac{2\,k^2}{(1+2\,k^2)^2\,t_1}$

$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$-\frac{1}{(1+2\,k^2)^2\,t_1}$	$\frac{i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	0	0
$-\frac{i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	$-\frac{2\,k^2}{(1+2\,k^2)^2\,t_1}$	0	0
0	0	0	0
0	0	0	$-\frac{1}{t_1}$

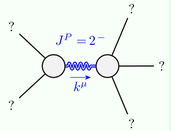
$\sigma_{2^+}^{\#1\,\alpha\beta}$	$\tau_{2^+}^{\#1\,\alpha\beta}$	$\sigma_{2^-}^{\#1\,\alpha\beta\chi}$
$\frac{2}{(1+2\,k^2)^2\,t_1}$	$-\frac{2\,i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	0
$\frac{2\,i\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	$\frac{4\,k^2}{(1+2\,k^2)^2\,t_1}$	0
0	0	$\frac{2}{2\,k^2\,r_1+t_1}$

$\omega_{1^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	$k^2\,r_1 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$\frac{i\,k\,t_1}{\sqrt{2}}$	0	$-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$-i\,k\,t_1$
$\omega_{1^+}^{\#2\,\alpha\beta}\,\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	$-\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	$\frac{i\,k\,t_1}{\sqrt{2}}$	0	0	0	0	0	0	0
$\omega_{1^-}^{\#1\,\alpha}\,\dagger^\alpha$	0	0	0	0	$i\,k\,t_1$	0	0	0
$\omega_{1^-}^{\#2\,\alpha}\,\dagger^\alpha$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0	0
$f_{1^-}^{\#1\,\alpha}\,\dagger^\alpha$	0	0	0	0	0	0	0	0
$f_{1^-}^{\#2\,\alpha}\,\dagger^\alpha$	0	0	0	0	0	0	0	0

$\omega_{0^+}^{\#1}\,\dagger$	$-t_1$	$i\sqrt{2}\,k\,t_1$	0	0
$f_{0^+}^{\#1}\,\dagger$	$-i\sqrt{2}\,k\,t_1$	$-2\,k^2\,t_1$	0	0
$f_{0^+}^{\#2}\,\dagger$	0	0	0	0
$\omega_{0^-}^{\#1}\,\dagger$	0	0	0	$-t_1$

$\omega_{2^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i\,k\,t_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1\,\alpha\beta}\,\dagger^{\alpha\beta}$	$\frac{i\,k\,t_1}{\sqrt{2}}$	$k^2\,t_1$	0
$\omega_{2^-}^{\#1\,\alpha\beta\chi}\,\dagger^{\alpha\beta\chi}$	0	0	$k^2\,r_1 + \frac{t_1}{2}$

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_1} > 0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2\,r_1} > 0$
Spin:	2
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_1 < 0$ && $t_1 > 0$