Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\sigma_0^{\#1}$ == 0	$\partial_\beta \sigma^{\alpha\beta}{}_\alpha == 0$	1
$\tau_0^{\#1}$ == 0	$\partial_\beta \tau_\alpha{}^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha$	1
$\tau_0^{\#2}$ == 0	$\partial_\beta \tau^{\alpha\beta} == 0$	1
$\tau_1^{\#2\,\alpha} + 2\,i\,k\,\sigma_1^{\#1\,\alpha} == 0$	$\partial_\chi \partial_\beta \sigma^{\alpha\beta} \tau^\chi + 2\,(\partial_\beta \partial^\alpha \partial_\chi \sigma^{\beta\chi}{}_\delta - \partial_\delta \partial^\delta \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi} + \partial_\delta \partial^\delta \partial_\chi \partial^\chi \sigma^{\alpha\beta}{}_\beta) == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta}$	3
$\tau_1^{\#1\,\alpha} == 0$	$\partial_\chi \partial_\beta \sigma^{\alpha\chi}{}_\alpha == \partial_\chi \partial^\chi \partial_\beta \tau^\alpha$	3
$\sigma_1^{\#1\,\alpha} == \sigma_1^{\#2\,\alpha}$	$\partial_\chi \partial^\alpha \sigma^{\beta\chi}{}_\beta + \partial_\chi \partial^\chi \sigma^{\alpha\beta}{}_\beta == 0$	3
$\tau_1^{\#1\,\alpha\beta} + i\,k\,\sigma_1^{\#2\,\alpha\beta} == 0$	$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\alpha\chi} + \partial_\chi \partial^\chi \tau^{\alpha\beta} + 2\,\partial_\delta \partial^\alpha \partial^\beta \sigma^{\chi\delta}{}_\chi + 2\,\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} == \partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} + \partial_\chi \partial^\chi \tau^{\beta\alpha} + 2\,\partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\tau_2^{\#1\,\alpha\beta} - 2\,i\,k\,\sigma_2^{\#1\,\alpha\beta} == 0$	$-i\,(4\,\partial_\delta \partial_\chi \partial^\delta \partial^\alpha \tau^{\chi\beta} + 2\,\partial_\delta \partial^\beta \partial^\alpha \tau^\chi{}_\chi - 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} - 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\alpha\beta} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\chi \partial^\alpha \tau^{\beta\alpha} + 4\,i\,k^\chi\,\partial_\epsilon \partial_\chi \partial^\beta \partial^\alpha \sigma^{\delta\epsilon}{}_\delta - 6\,i\,k^\chi\,\partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon} - 6\,i\,k^\chi\,\partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} + 2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} + 6\,i\,k^\chi\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} + 6\,i\,k^\chi\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} - 2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial^\delta \partial^\chi \tau_\chi{}^\chi + 4\,i\,\eta^{\alpha\beta}\,k^\chi\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\chi\epsilon}{}_\delta) == 0$	5
Total constraints/gauge generators:		20

Quadratic (free) action

$$S == \int\int\int \frac{1}{6} (2\,t_1\,\omega^{\alpha\prime}{}_\alpha{}^\theta\,\omega^{\alpha\prime}{}_\theta{}^\beta + 6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 4\,t_1\,\omega_\alpha{}^\theta\,\partial_\theta f^{\alpha\prime} + 4\,t_1\,\omega_\theta{}^\beta\,\partial^\prime f^\alpha{}_\alpha - 2\,t_1\,\partial_\theta f^{\alpha\prime}{}_\alpha{}^\theta\,\partial^\prime f^\alpha{}_\beta{}^\beta - 6\,r_1\,\partial_\theta \omega_\iota{}^\theta\,\partial^\prime \omega^{\alpha\beta}{}_\alpha + 6\,r_1\,\partial_\alpha \omega^{\alpha\beta\prime}{}_\beta{}^\theta\,\partial^\prime \omega^{\alpha\beta}{}_\theta{}^\iota - 2\,t_1\,\partial_\iota f^{\alpha\prime}{}_\alpha{}^\theta\,\partial_\theta f^\alpha{}_\beta{}^\beta + 4\,t_1\,\partial^\prime f^\alpha{}_\alpha{}^\theta\,\partial_\theta f^\iota{}_\beta{}^\beta + 6\,r_1\,\partial_\alpha \omega^{\alpha\beta\prime}{}_\beta{}^\theta\,\partial_\theta \omega^{\alpha\beta}{}_\theta{}^\iota - 12\,r_1\,\partial^\prime \omega^{\alpha\beta}{}_\alpha{}^\theta\,\partial_\theta \omega^\iota{}_\beta{}^\beta - 6\,r_1\,\partial_\alpha \omega^{\alpha\beta\prime}{}_\theta{}^\iota\,\partial_\theta \omega^{\alpha\beta}{}_\beta{}^\theta + 12\,r_1\,\partial^\prime \omega^{\alpha\beta}{}_\alpha{}^\theta\,\partial_\theta \omega^\iota{}_\beta{}^\beta - 6\,t_1\,\partial_\alpha f_\iota{}^\theta f^{\alpha\prime}{}_\theta{}^\iota - 3\,t_1\,\partial_\theta f^{\alpha\prime}{}_\alpha{}^\theta\,\partial^\theta f^{\alpha\prime}{}_\beta{}^\beta + 3\,t_1\,\partial_\theta f_\alpha{}^\theta\,\partial^\theta f^{\alpha\prime}{}_\beta{}^\beta + 6\,t_1\,\omega_{\alpha\theta\prime}\,(\omega^{\alpha\prime\theta} + 2\,\partial^\theta f^{\alpha\prime}) - 8\,r_1\,\partial_\beta \omega_{\alpha\prime\theta}\,\partial^\theta \omega^{\alpha\beta\prime} + 4\,r_1\,\partial_\beta \omega_{\alpha\theta\prime}\,\partial^\theta \omega^{\alpha\beta\prime} - 16\,r_1\,\partial_\beta \omega_{\prime\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\prime} + 4\,r_1\,\partial_\alpha \omega_{\alpha\beta\theta}\,\partial^\theta \omega^{\alpha\beta\prime} + 4\,r_1\,\partial_\theta \omega_{\alpha\beta}\,\partial^\theta \omega^{\alpha\beta\prime}) \mathrm{d}t\,\mathrm{d}x\,\mathrm{d}t\,\mathrm{d}z\,\mathrm{d}y$$

$\sigma_1^{\#1\,\dagger\,\alpha\beta}$

	$\sigma_1^{\#1\,\alpha\beta}$	$\sigma_1^{\#2\,\alpha\beta}$	$\tau_1^{\#1\,\alpha\beta}$	$\sigma_1^{\#1\,\alpha}$	$\sigma_1^{\#2\,\alpha}$	$\tau_1^{\#1\,\alpha}$	$\tau_1^{\#2\,\alpha}$
$\sigma_1^{\#1\,\dagger\,\alpha\beta}$	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
$\sigma_1^{\#2\,\dagger\,\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$\frac{-2\,k^2\,r_1+t_1}{(1+k^2)^2\,t_1^2}$	$-\frac{i\,(2\,k^3\,r_1+k\,t_1)}{(1+k^2)^2\,t_1^2}$	0	0	0	0
$\tau_1^{\#1\,\dagger\,\alpha\beta}$	$\frac{i\,\sqrt{2}\,k}{t_1+k^2\,t_1}$	$\frac{i\,(2\,k^3\,r_1+k\,t_1)}{(1+k^2)^2\,t_1^2}$	$\frac{-2\,k^4\,r_1+k^2\,t_1}{(1+k^2)^2\,t_1^2}$	0	0	0	0
$\sigma_1^{\#1\,\dagger\,\alpha}$	0	0	0	$\frac{6}{(3+4\,k^2)^2\,t_1}$	$\frac{6\,\sqrt{2}}{(3+4\,k^2)^2\,t_1}$	0	$\frac{12\,i\,k}{(3+4\,k^2)^2\,t_1}$
$\sigma_1^{\#2\,\dagger\,\alpha}$	0	0	0	$\frac{6\,\sqrt{2}}{(3+4\,k^2)^2\,t_1}$	$\frac{12}{(3+4\,k^2)^2\,t_1}$	0	$\frac{12\,i\,\sqrt{2}\,k}{(3+4\,k^2)^2\,t_1}$
$\tau_1^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$\tau_1^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{12\,i\,k}{(3+4\,k^2)^2\,t_1}$	$-\frac{12\,i\,\sqrt{2}\,k}{(3+4\,k^2)^2\,t_1}$	0	$\frac{24\,k^2}{(3+4\,k^2)^2\,t_1}$

$\omega_1^{\#1\,\dagger\,\alpha\beta}$

	$\omega_1^{\#1\,\alpha\beta}$	$\omega_1^{\#2\,\alpha\beta}$	$f_1^{\#1\,\alpha\beta}$	$\omega_1^{\#1\,\alpha}$	$\omega_1^{\#2\,\alpha}$	$f_1^{\#1\,\alpha}$	$f_1^{\#2\,\alpha}$
$\omega_1^{\#1\,\dagger\,\alpha\beta}$	$k^2\,r_1 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i\,k\,t_1}{\sqrt{2}}$	0	0	0	0
$\omega_1^{\#2\,\dagger\,\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_1^{\#1\,\dagger\,\alpha\beta}$	$\frac{i\,k\,t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_1^{\#1\,\dagger\,\alpha}$	0	0	0	$\frac{t_1}{6}$	$\frac{t_1}{3\,\sqrt{2}}$	0	$\frac{i\,k\,t_1}{3}$
$\omega_1^{\#2\,\dagger\,\alpha}$	0	0	0	$\frac{t_1}{3\,\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$
$f_1^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$f_1^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{1}{3}\,i\,k\,t_1$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$	0	$\frac{2\,k^2\,t_1}{3}$

$\sigma_0^{\#1\,\dagger}$

	$\sigma_0^{\#1}$	$\tau_0^{\#1}$	$\tau_0^{\#2}$	$\sigma_0^{\#1}$
$\sigma_0^{\#1\,\dagger}$	0	0	0	0
$\tau_0^{\#1\,\dagger}$	0	0	0	0
$\tau_0^{\#2\,\dagger}$	0	0	0	0
$\sigma_0^{\#1\,\dagger}$	0	0	0	$-\frac{1}{t_1}$

$\omega_0^{\#1\,\dagger}$

	$\omega_0^{\#1}$	$f_0^{\#1}$	$f_0^{\#2}$	$\omega_0^{\#1}$
$\omega_0^{\#1\,\dagger}$	0	0	0	0
$f_0^{\#1\,\dagger}$	0	0	0	0
$f_0^{\#2\,\dagger}$	0	0	0	0
$\omega_0^{\#1\,\dagger}$	0	0	0	$-t_1$

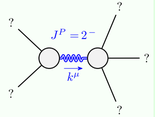
$\sigma_2^{\#1\,\dagger\,\alpha\beta\chi}$

	$\sigma_2^{\#1\,\alpha\beta}$	$\tau_2^{\#1\,\alpha\beta}$	$\sigma_2^{\#1\,\alpha\beta\chi}$
$\sigma_2^{\#1\,\dagger\,\alpha\beta}$	$\frac{2}{(1+2\,k^2)^2\,t_1}$	$-\frac{2\,i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	0
$\tau_2^{\#1\,\dagger\,\alpha\beta}$	$\frac{2\,i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	$\frac{4\,k^2}{(1+2\,k^2)^2\,t_1}$	0
$\sigma_2^{\#1\,\dagger\,\alpha\beta\chi}$	0	0	$\frac{2}{2\,k^2\,r_1+t_1}$

$\omega_2^{\#1\,\dagger\,\alpha\beta\chi}$

	$\omega_2^{\#1\,\alpha\beta\chi}$	$f_2^{\#1\,\alpha\beta}$	$\omega_2^{\#1\,\alpha\beta\chi}$
$\omega_2^{\#1\,\dagger\,\alpha\beta}$	0	$-\frac{i\,k\,t_1}{\sqrt{2}}$	0
$f_2^{\#1\,\dagger\,\alpha\beta}$	$-\frac{i\,k\,t_1}{\sqrt{2}}$	$k^2\,t_1$	0
$\omega_2^{\#1\,\dagger\,\alpha\beta\chi}$	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

$r_1 < 0 \;\&\&\; t_1 > 0$