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	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha{}_\alpha$	1
$\sigma_0^{\#1}$ == 0	$\partial_\beta \sigma^{\alpha\beta}{}_\alpha$ == 0	1
$\tau_1^{\#2\,\alpha}$ == 0	$\partial_\chi \partial_\beta \sigma^{\alpha\chi} \tau^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\alpha\beta}$	3
$\tau_1^{\#1\,\alpha}$ == 0	$\partial_\chi \partial_\beta \tau^{\alpha\chi} == \partial_\chi \partial^\chi \partial_\beta \tau^{\beta\alpha}$	3
$\sigma_1^{\#2\,\alpha}$ == 0	$\partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$ == 0	3
$\sigma_1^{\#1\,\alpha}$ == 0	$\partial_\chi \sigma^{\alpha\chi}{}_\beta + \partial_\chi \partial^\chi \sigma^{\alpha\beta}{}_\beta == \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$	3
$\tau_1^{\#1\,\alpha\beta} + i\,k\,\sigma_1^{\#2\,\alpha\beta}$ == 0	$\partial_\chi \tau^{\alpha\chi} + \partial_\chi \partial^\chi \tau^{\alpha\chi} + \partial_\chi \partial^\chi \tau^{\alpha\beta} +$ $2\,\partial_\alpha \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 2\,\partial_\alpha \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} ==$ $\partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} +$ $\partial_\chi \partial^\chi \tau^{\beta\alpha} + 2\,\partial_\alpha \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\sigma_2^{\#1\,\alpha\beta\chi}$ == 0	$3\,\partial_\epsilon \partial_\delta \partial^\chi \sigma^{\alpha\delta} \sigma^{\beta\delta\epsilon} + 3\,\partial_\epsilon \partial^\epsilon \partial^\chi \sigma^{\alpha\delta} \sigma^{\beta\delta}{}_\delta +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\chi\delta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\delta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\chi\delta\alpha} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\alpha\delta\delta} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\alpha\delta\beta} + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\beta\chi\alpha} +$ $3\,\eta^{\beta\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\delta\epsilon} +$ $3\,\eta^{\alpha\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\beta \sigma^{\delta\delta\epsilon} +$ $3\,\eta^{\beta\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\epsilon \sigma^{\alpha\delta}{}_\delta ==$ $3\,\partial_\epsilon \partial^\epsilon \partial^\chi \partial^\beta \sigma^{\alpha\delta\epsilon} + 3\,\partial_\epsilon \partial^\epsilon \partial^\chi \partial^\beta \sigma^{\alpha\delta}{}_\delta +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\beta\chi\delta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\beta\delta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\chi\delta\beta} + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\beta\delta\alpha} +$ $4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\beta\chi} + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\chi\beta} +$ $3\,\eta^{\alpha\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\beta \sigma^{\delta\epsilon}{}_\delta +$ $3\,\eta^{\beta\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\delta\epsilon} +$ $3\,\eta^{\alpha\chi}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\epsilon \sigma^{\alpha\beta\delta}{}_\delta$	5
$\tau_2^{\#1\,\alpha\beta}$ == 0	$4\,\partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2\,\partial_\delta \partial^\delta \partial^\beta \partial^\alpha \tau^\chi{}_\chi +$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\alpha\beta} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} ==$ $3\,\partial_\delta \partial^\delta \partial_\alpha \partial^\alpha \tau^{\beta\chi} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} +$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \tau^\chi{}_\chi$	5
Total constraints/gauge generators:		28

Quadratic (free) action

$S ==$

$$\int\int\int\int \tfrac{1}{6}\,(6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\mathcal{R}^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 6\,r_3\,\partial_\beta \mathcal{R}_\theta{}^{\theta}{}_\alpha{}^{\alpha\beta} - 6\,r_3\,\partial_\alpha \mathcal{R}^{\alpha\beta\prime}{}_{\theta\beta}\,\partial_\theta \mathcal{R}_\prime{}^\theta{}_\beta +$$
$$12\,r_3\,\partial^\prime \mathcal{R}^{\alpha\beta}{}_\alpha\,\partial_\theta \mathcal{R}_\prime{}^\theta{}_\beta + 4\,t_2\,\mathcal{R}_{\prime\theta\alpha}\,\partial^\theta f^{\alpha\prime} + 2\,t_2\,\partial_{\alpha\prime}\,f_{\prime\theta} -$$
$$\partial^\theta f^{\alpha\prime} - t_2\,\partial_\alpha f_{\prime\theta}\,\partial^\theta f^{\alpha\prime} - t_2\,\partial_\prime f_{\alpha\theta}\,\partial^\theta f^{\alpha\prime} + t_2\,\partial_\theta f_{\alpha\prime}\,\partial^\theta f^{\alpha\prime} -$$
$$t_2\,\partial_\theta f_{\prime\alpha}\,\partial^\theta f^{\alpha\prime} - 4\,t_2\,\mathcal{R}_{\alpha\theta\prime}\,(\mathcal{R}^{\alpha\prime\theta} + \partial^\theta f^{\alpha\prime}) +$$
$$2\,t_2\,\mathcal{R}_{\alpha\prime\theta}\,(\mathcal{R}^{\alpha\prime\theta} + 2\,\partial^\theta f^{\alpha\prime}) + 8\,r_2\,\partial_\beta \mathcal{R}_{\alpha\prime\theta}\,\partial^\theta \mathcal{R}^{\alpha\beta\prime} -$$
$$4\,r_2\,\partial_\beta \mathcal{R}_{\alpha\theta\prime}\,\partial^\theta \mathcal{R}^{\alpha\beta\prime} + 4\,r_2\,\partial_\beta \mathcal{R}_{\prime\theta\alpha}\,\partial^\theta \mathcal{R}^{\alpha\beta\prime} - 24\,r_3\,\partial_\beta \mathcal{R}_{\prime\theta\alpha}$$
$$\partial^\beta \mathcal{R}^{\alpha\beta\prime} - 2\,r_2\,\partial_\prime \mathcal{R}_{\alpha\beta\theta}\,\partial^\beta \mathcal{R}^{\alpha\beta\prime} + 2\,r_2\,\partial_\theta \mathcal{R}_{\alpha\beta\prime}\,\partial^\beta \mathcal{R}^{\alpha\beta\prime} -$$
$$4\,r_2\,\partial_\theta \mathcal{R}_{\alpha\prime\beta}\,\partial^\beta \mathcal{R}^{\alpha\beta\prime}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

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

$\sigma_1^{\#1\,\alpha\beta}$	$\frac{2}{3\,k^2\,r_3}$	$-\frac{2\,\sqrt{2}}{3\,k^2\,r_3+3\,k^4\,r_3}$	$-\frac{2\,i\,\sqrt{2}}{3\,k\,r_3+3\,k^3\,r_3}$	0	0	0
$\sigma_1^{\#2\,\alpha\beta}$	$-\frac{2\,\sqrt{2}}{3\,k^2\,r_3+3\,k^4\,r_3}$	$\frac{9\,k^2\,r_3+4\,t_2}{3\,(k+k^3)^2\,r_3\,t_2}$	$\frac{i\,(9\,k^2\,r_3+4\,t_2)}{3\,k\,(1+k^2)^2\,r_3\,t_2}$	0	0	0
$\tau_1^{\#1\,\alpha\beta}$	$\frac{2\,i\,\sqrt{2}}{3\,k\,r_3+3\,k^3\,r_3}$	$-\frac{i\,(9\,k^2\,r_3+4\,t_2)}{3\,k\,(1+k^2)^2\,r_3\,t_2}$	$\frac{9\,k^2\,r_3+4\,t_2}{3\,(1+k^2)^2\,r_3\,t_2}$	0	0	0
$\sigma_1^{\#1\,\alpha}$	0	0	0	0	0	0
$\sigma_1^{\#2\,\alpha}$	0	0	0	0	0	0
$\tau_1^{\#1\,\alpha}$	0	0	0	0	0	0
$\tau_1^{\#2\,\alpha}$	0	0	0	0	0	0

$\mathcal{R}_1^{\#1}$

$\mathcal{R}_1^{\#1}{}_{\alpha\beta}$	$\frac{1}{6}\,(9\,k^2\,r_3+4\,t_2)$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0
$\mathcal{R}_1^{\#2}{}_{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0	0	0
$f_1^{\#1}{}_{\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{i\,k\,t_2}{3}$	$\frac{k^2\,t_2}{3}$	0	0	0
$\mathcal{R}_1^{\#1}{}^\alpha$	0	0	0	0	0	0
$\mathcal{R}_1^{\#2}{}^\alpha$	0	0	0	0	0	0
$f_1^{\#1}{}^\alpha$	0	0	0	0	0	0
$f_1^{\#2}{}^\alpha$	0	0	0	0	0	0

$\mathcal{R}_0^{\#1}$

$\mathcal{R}_0^{\#1}{}^\dagger$	0	0	0	0
$f_0^{\#1}{}^\dagger$	0	0	0	0
$f_0^{\#2}{}^\dagger$	0	0	0	0
$\sigma_0^{\#1}{}^\dagger$	0	0	0	$\frac{1}{k^2\,r_2+t_2}$

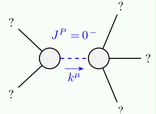
$\mathcal{R}_{2^+}^{\#1}$

$\mathcal{R}_{2^+}^{\#1}{}^\dagger$	$-\frac{3\,k^2\,r_3}{2}$	0	0
$f_{2^+}^{\#1}{}^\dagger$	0	0	0
$\sigma_{2^+}^{\#1}{}^\dagger$	0	0	0

$\sigma_{2^+}^{\#1}$

$\sigma_{2^+}^{\#1}{}^\dagger$	$-\frac{2}{3\,k^2\,r_3}$	0	0
$\tau_{2^+}^{\#1}{}^\dagger$	0	0	0
$\sigma_2^{\#1}{}^\dagger$	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

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