Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_{0^+}^{\#2} == 0$	$\partial_\beta \sigma_\alpha{}^{\alpha\beta} == 0$	1
$\tau_{0^+}^{\#1} == 0$	$\partial_\beta \sigma_\alpha{}^{\alpha\beta} == \partial_\theta \tau^{\beta}{}_{\alpha}$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	$\partial_\chi \partial_\theta \tau^{\beta\chi} == \partial_\chi \sigma^{\chi}{}_{\theta\beta}{}^{\alpha\beta}$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	$\partial_\chi \partial_\theta \sigma^{\alpha\beta\chi} == \partial_\chi \sigma^{\chi}{}_{\theta\beta}{}^{\alpha}$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	$\partial_\chi \partial_\beta \sigma^{\alpha\beta\chi} == 0$	3
$\sigma_{1^-}^{\#1\,\alpha} == 0$	$\partial_\chi \partial^\alpha \sigma^{\beta\chi} + \partial_\chi \partial^\chi \sigma^{\alpha\beta}{}_{\beta} == \partial_\chi \partial_\theta \sigma^{\alpha\beta\chi}$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	$\partial_\chi \sigma^{\alpha\chi} \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\chi\alpha} + \partial_\chi \partial^\chi \tau^{\alpha\beta} +$ $2\,\partial_\theta \partial_\chi \partial^\alpha \sigma^{\beta\chi}{}_{\theta} + 2\,\partial_\theta \partial^\beta \sigma^{\alpha\chi}{}_{\chi} ==$ $\partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} +$ $\partial_\chi \partial^\chi \tau^{\beta\alpha} + 2\,\partial_\theta \partial_\chi \partial^\beta \sigma^{\alpha\chi\theta}$	3
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	$3\,\partial_\epsilon \partial_\theta \partial^\chi \sigma^{\beta\delta\epsilon} + 3\,\partial_\epsilon \partial^\epsilon \partial^\chi \sigma^{\beta\delta}{}_{\delta} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\beta \sigma^{\alpha\chi\delta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\beta \sigma^{\alpha\delta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\chi \sigma^{\alpha\delta\beta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\chi \sigma^{\beta\delta\alpha} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\chi \sigma^{\alpha\delta\beta} + 2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\delta \sigma^{\beta\chi\alpha} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\alpha\delta}{}_{\delta} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial_\theta \sigma^{\beta\delta\epsilon} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\alpha\delta}{}_{\delta} ==$ $3\,\partial_\epsilon \partial_\theta \partial^\chi \partial^\beta \sigma^{\alpha\delta\epsilon} + 3\,\partial_\epsilon \partial^\epsilon \partial^\chi \partial^\beta \sigma^{\alpha\delta}{}_{\delta} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\alpha \sigma^{\beta\chi\delta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\alpha \sigma^{\beta\delta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\alpha \sigma^{\chi\delta\beta} + 2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\beta \sigma^{\alpha\delta\chi} +$ $4\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\delta \sigma^{\alpha\beta\chi} + 2\,\partial_\epsilon \partial^\epsilon \partial_\theta \partial^\delta \sigma^{\alpha\chi\beta} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\beta \sigma^{\delta\epsilon}{}_{\delta} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\theta \partial_\epsilon \sigma^{\alpha\delta\epsilon} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\beta\delta}{}_{\delta}$	5
$\tau_{2^+}^{\#1\,\alpha\beta} == 0$	$4\,\partial_\delta \partial_\chi \partial^\delta \partial^\alpha \tau^{\chi\delta} + 2\,\partial_\theta \partial^\delta \partial^\beta \partial^\alpha \tau^{\chi}{}_{\chi} +$ $3\,\partial_\delta \partial^\delta \partial_\chi \tau^{\alpha\beta} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\chi \tau^{\beta\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} ==$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} +$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \tau^{\chi}{}_{\chi}$	5
Total constraints/gauge generators:		27

Quadratic (free) action

$$S == \int\int\int\int \frac{1}{6} (6\, f^{\alpha\beta}{}_{\tau_{\alpha\beta}} + 6\, \omega^{\alpha\beta\chi}{}_{\sigma_{\alpha\beta\chi}} + 4\, t_2\, \omega_{\iota\theta\alpha}\, \partial^\theta f^{\alpha\iota} + 2\, t_2\, \partial_\alpha f_{\iota\theta} \partial^\theta f^{\alpha\iota} - t_2\, \partial_\alpha f_{\theta\iota} \partial^\theta f^{\alpha\iota} - t_2\, \partial_\theta f_{\alpha\iota} \partial^\theta f^{\alpha\iota} - t_2\, \partial_\theta f_{\iota\alpha} \partial^\theta f^{\alpha\iota} - 4\, t_2\, \omega_{\alpha\theta\iota} (\omega^{\alpha\iota\theta} + \partial^\theta f^{\alpha\iota}) + 2\, t_2\, \omega_{\alpha\iota\theta} (\omega^{\alpha\iota\theta} + 2\, \partial^\theta f^{\alpha\iota}) + 8\, r_2\, \partial_\beta \omega_{\alpha\iota\theta} \partial^\theta \omega^{\alpha\beta\iota} - 4\, r_2\, \partial_\beta \omega_{\alpha\theta\iota} \partial^\theta \omega^{\alpha\beta\iota} + 4\, r_2\, \partial_\beta \omega_{\iota\theta\alpha} \partial^\theta \omega^{\alpha\beta\iota} - 2\, r_2\, \partial_\iota \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta\iota} + 2\, r_2\, \partial_\theta \omega_{\alpha\iota\beta} \partial^\theta \omega^{\alpha\beta\iota} - 4\, r_2\, \partial_\theta \omega_{\alpha\iota\beta} \partial^\theta \omega^{\alpha\beta\iota} - 12\, r_4\, \partial_\theta \omega_{\kappa}{}^{\lambda} \partial^\kappa \omega^{\alpha\theta}{}_{\alpha} - 12\, r_4\, \partial_\omega \omega^{\alpha\theta\kappa} \partial_\lambda \omega_{\kappa}{}^{\lambda}{}_{\theta} + 24\, r_4\, \partial^\kappa \omega^{\alpha\theta}{}_{\alpha} \partial_\lambda \omega_{\kappa}{}^{\lambda}{}_{\theta} - 24\, r_3\, \partial_\beta \omega_{\iota\lambda\alpha} \partial^\lambda \omega^{\alpha\beta\iota}))[t,\, x,\, y,\, z]\, dz\, dy\, dx\, dt$$

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

	$\sigma_{1^+}^{\#1\,\alpha\beta}$	$\sigma_{1^+}^{\#2\,\alpha\beta}$	$\tau_{1^+}^{\#1\,\alpha\beta}$	$\sigma_1^{\#1\,\alpha}$	$\sigma_1^{\#2\,\alpha}$	$\tau_1^{\#1\,\alpha}$	$\tau_1^{\#2\,\alpha}$
$\sigma_{1^+}^{\#1\,\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3 - r_4)}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3 - r_4)}$	$-\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3 - r_4)}$	0	0	0	0
$\sigma_{1^+}^{\#2\,\alpha\beta}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3 - r_4)}$	$\frac{k^2\,(6\,r_3 - 3\,r_4) + 2\,t_2}{(k+k^3)^2\,(2\,r_3 - r_4)\,t_2}$	$\frac{i\,(k^2\,(6\,r_3 - 3\,r_4) + 2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3 - r_4)\,t_2}$	0	0	0	0
$\tau_{1^+}^{\#1\,\alpha\beta}$	$\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3 - r_4)}$	$-\frac{i\,(k^2\,(6\,r_3 - 3\,r_4) + 2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3 - r_4)\,t_2}$	$\frac{\frac{1}{r_3 - \frac{r_4}{2}} + \frac{3\,k^2}{t_2}}{(1+k^2)^2}$	0	0	0	0
$\sigma_1^{\#1\,\alpha}$	0	0	0	0	0	0	0
$\sigma_1^{\#2\,\alpha}$	0	0	0	0	0	0	0
$\tau_1^{\#1\,\alpha}$	0	0	0	0	0	0	0
$\tau_1^{\#2\,\alpha}$	0	0	0	0	0	0	0

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

	$\omega_{1^+}^{\#1\,\alpha\beta}$	$\omega_{1^+}^{\#2\,\alpha\beta}$	$f_{1^+}^{\#1\,\alpha\beta}$	$\omega_1^{\#1\,\alpha}$	$\omega_1^{\#2\,\alpha}$	$f_1^{\#1\,\alpha}$	$f_1^{\#2\,\alpha}$
$\omega_{1^+}^{\#1\,\alpha\beta}$	$k^2\,(2\,r_3 - r_4) + \frac{2\,t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0	0
$\omega_{1^+}^{\#2\,\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0	0	0	0
$f_{1^+}^{\#1\,\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{i\,k\,t_2}{3}$	$\frac{k^2\,t_2}{3}$	0	0	0	0
$\omega_1^{\#1\,\alpha}$	0	0	0	0	0	0	0
$\omega_1^{\#2\,\alpha}$	0	0	0	0	0	0	0
$f_1^{\#1\,\alpha}$	0	0	0	0	0	0	0
$f_1^{\#2\,\alpha}$	0	0	0	0	0	0	0

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

	$\omega_{2^+}^{\#1\,\alpha\beta}$	$f_{2^+}^{\#1\,\alpha\beta}$	$\omega_{2^-}^{\#1\,\alpha\beta\chi}$
$\omega_{2^+}^{\#1\,\alpha\beta}$	$k^2\,(-2\,r_3 + r_4)$	0	0
$f_{2^+}^{\#1\,\alpha\beta}$	0	0	0
$\omega_{2^-}^{\#1\,\alpha\beta\chi}$	0	0	0

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

	$\sigma_{2^+}^{\#1\,\alpha\beta}$	$\tau_{2^+}^{\#1\,\alpha\beta}$	$\sigma_{2^-}^{\#1\,\alpha\beta\chi}$
$\sigma_{2^+}^{\#1\,\alpha\beta}$	$\frac{1}{k^2\,(-2\,r_3 + r_4)}$	0	0
$\tau_{2^+}^{\#1\,\alpha\beta}$	0	0	0
$\sigma_{2^-}^{\#1\,\alpha\beta\chi}$	0	0	0

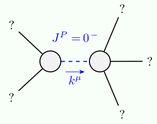
$\omega_{0^+}^{\#1}$

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}$	$-2\,k^2\,(r_3 - 2\,r_4)$	0	0	0
$f_{0^+}^{\#1}$	0	0	0	0
$f_{0^+}^{\#2}$	0	0	0	0
$\omega_{0^-}^{\#1}$	0	0	0	$k^2\,r_2 + t_2$

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

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}$	$\frac{1}{-2\,k^2\,r_3 + 4\,k^2\,r_4}$	0	0	0
$\tau_{0^+}^{\#1}$	0	0	0	0
$\tau_{0^+}^{\#2}$	0	0	0	0
$\sigma_{0^-}^{\#1}$	0	0	0	$\frac{1}{k^2\,r_2 + t_2}$

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

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