Particle spectrograph

Wave operator and propagator

Source constraints	Multiplicities
Fundamental fields	
$\partial_\beta \sigma^{\alpha\beta}{}_\alpha == 0$	1
$\partial_\chi \partial_\beta \sigma^{\alpha\beta\chi} == 0$	3
$\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} == \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$3\,\partial_\epsilon \partial_\delta \partial^\chi \partial^\alpha \sigma^{\beta\delta\epsilon} + 3\,\partial_\epsilon \partial^\epsilon \partial^\chi \partial^\alpha \sigma^{\beta\delta}{}_\delta +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\beta \sigma^{\alpha\chi\delta} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\beta \sigma^{\alpha\delta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\beta \sigma^{\chi\delta\alpha} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\alpha\beta\delta} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\alpha\delta\beta} + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\beta\chi\alpha} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\alpha \sigma^{\delta\epsilon}{}_\delta + 3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial_\delta \sigma^{\beta\delta\epsilon} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\alpha\delta}{}_\delta == 3\,\partial_\epsilon \partial_\delta \partial^\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $3\,\partial_\epsilon \partial^\epsilon \partial^\chi \partial^\beta \sigma^{\alpha\delta}{}_\delta + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\beta\chi\delta} +$ $4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\beta\delta\chi} + 2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\alpha \sigma^{\chi\delta\beta} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \sigma^{\beta\delta\alpha} + 4\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\beta\chi} +$ $2\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \sigma^{\alpha\chi\beta} + 3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\beta \sigma^{\delta\epsilon}{}_\delta +$ $3\,\eta^{\beta\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\epsilon \sigma^{\alpha\delta}{}_\delta + 3\,\eta^{\alpha\chi}\,\partial_\phi \partial^\phi \partial_\epsilon \partial^\delta \sigma^{\beta\delta}{}_\delta$	5
SO(3) irreps	
$\sigma_{0^+}^{\#1} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	5
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	12
Total constraints/gauge generators:	

Quadratic (free) action

$$S == \int\int\int (\omega^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi} + \frac{1}{3} r_2\,(4\,\partial_\beta \omega_{\alpha\iota\theta} - 2\,\partial_\beta \omega_{\alpha\theta\iota} + 2\,\partial_\beta \omega_{\iota\theta\alpha} - \partial_\iota \omega_{\alpha\beta\theta} + \partial_\theta \omega_{\alpha\beta\iota} - 2\,\partial_\theta \omega_{\alpha\iota\beta})\,\partial^\theta \omega^{\alpha\beta\iota} - \frac{1}{2} r_3\,(\partial_\beta \omega_\iota{}^\theta{}_\theta\,\partial^\prime \omega^{\alpha\beta}{}_\alpha + \partial_\iota \omega_\beta{}^\theta{}_\theta\,\partial^\prime \omega^{\alpha\beta}{}_\alpha + \partial_\alpha \omega^{\alpha\beta\iota}\,\partial_\theta \omega_\beta{}^\theta{}_\iota - 2\,\partial^\prime \omega^{\alpha\beta}{}_\alpha\,\partial_\theta \omega_\iota{}^\theta{}_\beta - 2\,\partial^\prime \omega^{\alpha\beta}{}_\alpha\,\partial_\theta \omega_\iota{}^\theta{}_\beta + 8\,\partial_\beta \omega_{\iota\theta\alpha}\,\partial^\theta \omega^{\alpha\beta\iota}) + r_5\,(\partial_\iota \omega_\theta{}^\kappa{}_\kappa\,\partial^\theta \omega^{\alpha\iota}{}_\alpha - \partial_\theta \omega_\iota{}^\kappa{}_\kappa\,\partial^\theta \omega^{\alpha\iota}{}_\alpha - (\partial_\alpha \omega^{\alpha\iota\theta} - 2\,\partial^\theta \omega^{\alpha\iota}{}_\alpha)\,(\partial_\kappa \omega_\iota{}^\kappa{}_\theta - \partial_\kappa \omega_\theta{}^\kappa{}_\iota))) [t, x, y, z]\,dt\,dx\,dy\,dz$$

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

$\omega_{2^+}^{\#1}{}^{\alpha\beta}$	$-\frac{3\,k^2\,r_3}{2}$	0
$\omega_{2^-}^{\#1}{}^{\alpha\beta\chi}$	0	0

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

$\sigma_{0^+}^{\#1}{}^\dagger$	0	$\frac{1}{k^2\,r_2}$
$\sigma_{0^-}^{\#1}{}^\dagger$	0	0

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

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

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

$\sigma_{2^+}^{\#1}{}^{\alpha\beta}$	$-\frac{2}{3\,k^2\,r_3}$	0
$\sigma_{2^-}^{\#1}{}^{\alpha\beta\chi}$	0	0

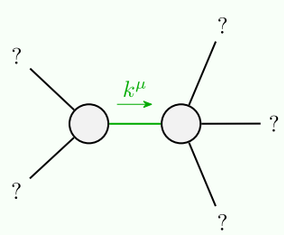
$\sigma_{1^+\,\alpha\beta}^{\#1}$ $\sigma_{1^+\,\alpha\beta}^{\#2}$ $\sigma_{1^-\,\alpha}^{\#1}$ $\sigma_{1^-\,\alpha}^{\#2}$

$\sigma_{1^+}^{\#1}{}^{\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3+r_5)}$	0	0	0
$\sigma_{1^+}^{\#2}{}^{\alpha\beta}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\alpha}$	0	0	$\frac{2}{k^2\,(r_3+2\,r_5)}$	0
$\sigma_{1^-}^{\#2}{}^{\alpha}$	0	0	0	0

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

$\omega_{1^+}^{\#1}{}^{\alpha\beta}$	$k^2\,(2\,r_3+r_5)$	0	0	0
$\omega_{1^+}^{\#2}{}^{\alpha\beta}$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\alpha}$	0	0	$\frac{1}{2}\,k^2\,(r_3+2\,r_5)$	0
$\omega_{1^-}^{\#2}{}^{\alpha}$	0	0	0	0

Massive and massless spectra



Quadratic pole

Pole residue:	$-\frac{1}{r_3\,(2\,r_3+r_5)\,(r_3+2\,r_5)} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$$r_3 < 0\ \&\&\ (r_5 < -\frac{r_3}{2}\ ||\ r_5 > -2\,r_3)\ ||\ r_3 > 0\ \&\&\ -2\,r_3 < r_5 < -\frac{r_3}{2}$$