Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S == \int\int\int (\omega^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi}\text{-}2\,r_3\,(\partial_\beta\omega_{\prime\ \theta}^{\ \theta}\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}+\partial_\prime\omega_\beta^{\ \theta}\,\partial^\prime\omega^{\alpha\beta}_{\ \ \theta}\text{-}2\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}\,\partial_\theta\omega_{\beta\ \prime}^{\ \theta}+\partial_\alpha\omega^{\alpha\beta\prime}\,\partial_\theta\omega_{\prime\ \beta}^{\ \theta}\text{-}2\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}\,\partial_\beta\omega_{\prime\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\prime})+\frac{2}{3}\,r_1\,(3\,\partial_\beta\omega_{\prime\ \theta}^{\ \theta}\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}+3\,\partial_\prime\omega_\beta^{\ \theta}\,\partial^\prime\omega^{\alpha\beta}_{\ \ \theta}+3\,\partial_\alpha\omega^{\alpha\beta\prime}\,\partial_\theta\omega_{\beta\ \prime}^{\ \theta}\text{-}6\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}\,\partial_\theta\omega_{\prime\ \beta}^{\ \theta}\text{-}6\,\partial^\prime\omega^{\alpha\beta}_{\ \ \alpha}\,\partial_\theta\omega_{\prime\ \beta}^{\ \theta}+3\,\partial_\alpha\omega^{\alpha\beta\prime}\,\partial_\theta\omega_{\prime\ \beta}^{\ \theta}\text{-}2\,\partial_\beta\omega_{\alpha\prime\theta}\,\partial^\theta\omega^{\alpha\beta\prime}+2\,\partial_\beta\omega_{\alpha\theta\prime}\,\partial^\theta\omega^{\alpha\beta\prime}+2\,\partial_\beta\omega_{\prime\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\prime}\text{-}\partial_\prime\omega_{\alpha\beta\theta}\,\partial^\theta\omega^{\alpha\beta\prime}+\partial_\theta\omega_{\alpha\prime\beta}\,\partial^\theta\omega^{\alpha\beta\prime})+r_5\,(\partial_\prime\omega_{\theta\ \kappa}^{\ \kappa}\,\partial^\theta\omega^{\alpha\prime}_{\ \ \alpha}\text{-}\partial_\theta\omega_{\prime\ \kappa}^{\ \kappa}\,\partial^\theta\omega^{\alpha\prime}_{\ \ \alpha}\text{-}(\partial_\alpha\omega^{\alpha\prime\theta}\text{-}2\,\partial^\theta\omega^{\alpha\prime}_{\ \ \alpha})(\partial_\kappa\omega_{\prime\ \theta}^{\ \kappa}\text{-}\partial_\kappa\omega_{\theta\ \prime}^{\ \kappa}))))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

Source constraints

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

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

$\omega_{2^+}^{\#1\,\alpha\beta}$	0	0
$\omega_{2^-}^{\#1\,\alpha\beta\chi}$	0	$k^2\,r_1$

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

$\sigma_{2^+}^{\#1\,\alpha\beta}$	0	0
$\sigma_{2^-}^{\#1\,\alpha\beta\chi}$	0	$\frac{1}{k^2\,r_1}$

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

$\sigma_{0^+}^{\#1}$	$\frac{1}{6\,k^2\,(\text{-}r_1+r_3)}$	0
$\sigma_{0^-}^{\#1}$	0	0

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

$\sigma_{1^+}^{\#1\,\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3+r_5)}$	0	0	0
$\sigma_{1^+}^{\#2\,\alpha\beta}$	0	0	0	0
$\sigma_{1^-}^{\#1\,\alpha}$	0	0	$\frac{1}{k^2\,(\text{-}r_1+2\,r_3+r_5)}$	0
$\sigma_{1^-}^{\#2\,\alpha}$	0	0	0	0

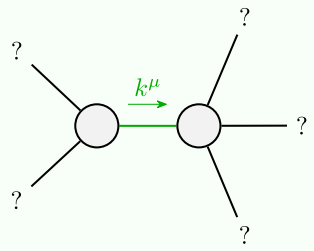
$\omega_{0^+}^{\#1}\,\dagger$, $\omega_{0^-}^{\#1}\,\dagger$

$\omega_{0^+}^{\#1}$	$6\,k^2\,(\text{-}r_1+r_3)$	0
$\omega_{0^-}^{\#1}$	0	0

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

$\omega_{1^+}^{\#1\,\alpha\beta}$	$k^2\,(2\,r_3+r_5)$	0	0	0
$\omega_{1^+}^{\#2\,\alpha\beta}$	0	0	0	0
$\omega_{1^-}^{\#1\,\alpha}$	0	0	$k^2\,(\text{-}r_1+2\,r_3+r_5)$	0
$\omega_{1^-}^{\#2\,\alpha}$	0	0	0	0

Massive and massless spectra



Quadratic pole

Pole residue:	$\frac{1}{r_1\,(r_1\text{-}2\,r_3\text{-}r_5)\,(2\,r_3+r_5)} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$$r_1 < 0\,\&\&\,(r_5 < r_1\text{-}2\,r_3\,||\,r_5 > \text{-}2\,r_3)\,\|\,r_1 > 0\,\&\&\,\text{-}2\,r_3 < r_5 < r_1\text{-}2\,r_3$$