Particle spectrograph

Wave operator and propagator

Quadratic (free) action

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

Source constraints

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

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

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

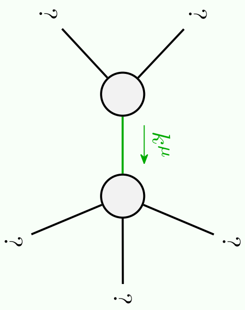
	$\sigma^{\#1}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}{}^{\dagger}$	$\frac{1}{6 k^2 (-r_1 + r_3)}$	0
$\sigma^{\#1}_{0^-}{}^{\dagger}$	0	0

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

	$\omega^{\#1}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}{}^{\dagger}$	$6 k^2 (-r_1 + r_3)$	0
$\omega^{\#1}_{0^-}{}^{\dagger}$	0	0

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

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

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