Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S == \iiint (\mathcal{A}^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi} - 2\, r_3\, (\partial_\beta \mathcal{A}_{\iota\ \theta}^{\ \theta}\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha} + \partial_\iota \mathcal{A}_{\beta\ \theta}^{\ \theta}\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha} + \partial_\alpha \mathcal{A}^{\alpha\beta\iota}\, \partial_\theta \mathcal{A}_{\beta\ \iota}^{\ \theta} - 2\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \mathcal{A}_{\iota\ \beta}^{\ \theta} - 2\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \mathcal{A}_{\iota\ \beta}^{\ \theta} + 2\, \partial_\beta \mathcal{A}_{\iota\theta\alpha}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota}) + \frac{2}{3} r_1\, (3\, \partial_\beta \mathcal{A}_{\iota\ \theta}^{\ \theta}\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha} + 3\, \partial_\iota \mathcal{A}_{\beta\ \theta}^{\ \theta}\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha} + 3\, \partial_\alpha \mathcal{A}^{\alpha\beta\iota}\, \partial_\theta \mathcal{A}_{\beta\ \iota}^{\ \theta} - 6\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \mathcal{A}_{\beta\ \iota}^{\ \theta} + 3\, \partial_\alpha \mathcal{A}^{\alpha\beta\iota}\, \partial_\theta \mathcal{A}_{\iota\ \beta}^{\ \theta} - 6\, \partial^{\prime} \mathcal{A}^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \mathcal{A}_{\beta\ \iota}^{\ \theta} - 2\, \partial_\beta \mathcal{A}_{\alpha\iota\theta} + \partial^\theta \mathcal{A}^{\alpha\beta\iota} + \partial_\beta \mathcal{A}_{\alpha\theta\iota}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + 2\, \partial_\beta \mathcal{A}_{\iota\theta\alpha}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} - \partial_\iota \mathcal{A}_{\alpha\beta\theta}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota} + \partial_\theta \mathcal{A}_{\alpha\beta\iota}\, \partial^\theta \mathcal{A}^{\alpha\beta\iota}) + r_5\, (\partial_\iota \mathcal{A}_{\theta\ \kappa}^{\ \kappa}\, \partial^\theta \mathcal{A}^{\alpha\iota}_{\ \ \alpha} - \partial_\theta \mathcal{A}_{\iota\ \kappa}^{\ \kappa}\, \partial^\theta \mathcal{A}^{\alpha\iota}_{\ \ \alpha} - (\partial_\alpha \mathcal{A}^{\alpha\iota\theta} - 2\, \partial^\theta \mathcal{A}^{\alpha\iota}_{\ \ \alpha})\, (\partial_\kappa \mathcal{A}_{\iota\ \theta}^{\ \kappa} - \partial_\kappa \mathcal{A}_{\theta\ \iota}^{\ \kappa}))) [t, x, y, z]\, dl\, z\, dl\, y\, dl\, x\, dl\, t$$

Source constraints

Fundamental fields	Multiplicities
$\epsilon\, \eta_{\alpha\beta\chi\delta}\, \partial^\delta \sigma^{\alpha\beta\chi} == 0$	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
$3\, \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 3\, \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + 2\, \eta^{\alpha\beta}\, \partial_\epsilon \partial^\epsilon \partial_\delta \sigma^{\chi\delta} == {}_{\chi}$	5
$2\, \partial_\delta \partial^\beta \partial^\alpha \sigma^{\chi\delta}{}_{\chi} + 3\, (\partial_\delta \partial^\beta \partial_\chi \sigma^{\alpha\chi\beta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\beta\chi\alpha})$	12

SO(3) irreps	Total constraints/gauge generators:
$\sigma_{0^-}^{\#1} == 0$	$\mathcal{A}_{0^+}^{\#1} \dagger$
$\sigma_{1^-}^{\#2\,\alpha} == 0$	$\sigma_{1^+}^{\#1\,\alpha\beta} \dagger$
$\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	$\sigma_{1^-}^{\#1\,\alpha} \dagger$
$\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	$\sigma_{1^-}^{\#2\,\alpha} \dagger$

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

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

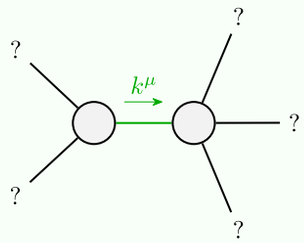
	$\sigma_{0^+}^{\#1}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1} \dagger$	$\frac{1}{6\, k^2\, (-r_1 + r_3)}$	0
$\sigma_{0^-}^{\#1} \dagger$	0	0

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

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

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

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