Particle spectrograph

Wave operator and propagator

Source constraints

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

Quadratic (free) action

$$S == \iiint\!\!\int (\mathcal{A}^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + \tfrac{1}{3}\,r_2\,(4\,\partial_\beta \mathcal{A}_{\alpha\iota\theta} - 2\,\partial_\beta \mathcal{A}_{\alpha\theta\iota} + 2\,\partial_\beta \mathcal{A}_{\iota\theta\alpha} - \partial_\iota \mathcal{A}_{\alpha\beta\theta} + \partial_\theta \mathcal{A}_{\alpha\beta\iota} - 2\,\partial_\theta \mathcal{A}_{\alpha\iota\beta})\,\partial^\theta \mathcal{A}^{\alpha\beta\iota} -$$
$$\tfrac{1}{2}\,r_3\,(\partial_\beta \mathcal{A}_\iota{}^\theta{}_\theta\,\partial' \mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\iota \mathcal{A}_\beta{}^\theta{}_\theta\,\partial' \mathcal{A}^{\alpha\beta}{}_\alpha + \partial_\alpha \mathcal{A}^{\alpha\beta\iota}\,\partial_\theta \mathcal{A}_\beta{}^\theta{}_\iota -$$
$$2\,\partial' \mathcal{A}^{\alpha\beta}{}_\alpha\,\partial_\theta \mathcal{A}_\beta{}^\theta{}_\iota + \partial_\alpha \mathcal{A}^{\alpha\beta\iota}\,\partial_\theta \mathcal{A}_\iota{}^\theta{}_\beta -$$
$$2\,\partial' \mathcal{A}^{\alpha\beta}{}_\alpha\,\partial_\theta \mathcal{A}_\iota{}^\theta{}_\beta + 8\,\partial_\beta \mathcal{A}_{\iota\theta\alpha}\,\partial^\theta \mathcal{A}^{\alpha\beta\iota}) +$$
$$r_5\,(\partial_\iota \mathcal{A}_\theta{}^\kappa{}_\kappa\,\partial^\theta \mathcal{A}^{\alpha\iota}{}_\alpha - \partial_\theta \mathcal{A}_\iota{}^\kappa{}_\kappa\,\partial^\theta \mathcal{A}^{\alpha\iota}{}_\alpha - (\partial_\alpha \mathcal{A}^{\alpha\iota\theta} - 2\,\partial^\theta \mathcal{A}^{\alpha\iota}{}_\alpha)$$
$$(\partial_\kappa \mathcal{A}_\iota{}^\kappa{}_\theta - \partial_\kappa \mathcal{A}_\theta{}^\kappa{}_\iota))[t,\,x,\,y,\,z]\,dt\,dx\,dy\,dz$$

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

$\mathcal{A}_{2^+}^{\#1}{}^\dagger{}^{\alpha\beta}$	$-\frac{3\,k^2\,r_3}{2}$	0
$\mathcal{A}_{2^-}^{\#1}{}^\dagger{}^{\alpha\beta\chi}$	0	0

$\mathcal{A}_{0^+}^{\#1}$ $\mathcal{A}_{0^-}^{\#1}$

$\mathcal{A}_{0^+}^{\#1}{}^\dagger$	0	$k^2\,r_2$
$\mathcal{A}_{0^-}^{\#1}{}^\dagger$	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

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

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

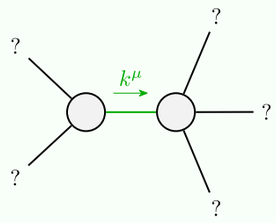
$\sigma_{2^+}^{\#1\,\alpha\beta}$ $\sigma_{2^-}^{\#1\,\alpha\beta\chi}$

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

$\mathcal{A}_{1^+}^{\#1\,\alpha\beta}$ $\mathcal{A}_{1^+}^{\#2\,\alpha\beta}$ $\mathcal{A}_{1^-}^{\#1\,\alpha}$ $\mathcal{A}_{1^-}^{\#2\,\alpha}$

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

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