Particle spectrograph

Wave operator and propagator

Quadratic (free) action

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

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

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

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

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

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

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

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

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

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

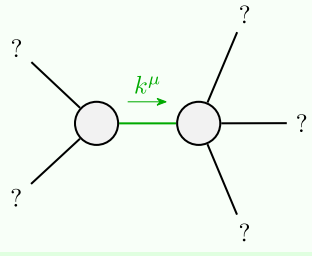
$\omega_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$-\frac{3k^2 r_3}{2}$	0
$\omega_{2^-}^{\#1}{}^{\dagger\alpha\beta\chi}$	0	0

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

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma_{0^-}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	5
Total constraints:	13

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

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