

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S = \iiint \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - \frac{1}{2} r_3 (\partial_\beta \omega_{\beta}^\theta \partial'_\theta \omega_{\beta}^{\alpha\beta} + \partial'_\theta \omega_{\beta}^\theta \partial_\beta \omega_{\beta}^{\alpha\beta} + \partial_\alpha \omega^{\alpha\beta\gamma} \partial_\beta \omega_{\beta}^\theta - 2 \partial'_\theta \omega_{\beta}^{\alpha\beta} \partial_\alpha \omega_{\beta}^\theta - 2 \partial'_\theta \omega_{\beta}^{\alpha\beta} \partial_\alpha \omega_{\beta}^\theta + 8 \partial_\beta \omega_{\beta}^\theta \partial_\alpha \omega_{\beta}^{\alpha\beta\gamma} + r_5 (\partial_\theta \omega_{\beta}^\kappa \partial^\theta \omega_{\beta}^\alpha - \partial_\theta \omega_{\beta}^\kappa \partial^\theta \omega_{\beta}^\alpha)) [t, x, y, z] dz dy dx dt$$

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

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

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

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

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

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

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

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

$\omega_{1^+}^{\#1\alpha}$ $\omega_{1^+}^{\#2\alpha}$ $\omega_{1^+}^{\#1\alpha}$ $\omega_{1^+}^{\#2\alpha}$ $\omega_{1^+}^{\#1\alpha}$ $\omega_{1^+}^{\#2\alpha}$ $\omega_{1^+}^{\#1\alpha}$ $\omega_{1^+}^{\#2\alpha}$

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

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

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