

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S = \int \int \int \int \left(\frac{1}{6} f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 12 r_1 \partial_\beta \omega^{\theta}_{\beta} \partial'_\theta \omega^{\alpha\beta}_{\alpha} + 12 r_1 \partial_\beta \omega^{\theta}_{\beta} \partial'_\theta \omega^{\alpha\beta}_{\alpha} + 12 r_1 \partial_\alpha \omega^{\alpha\beta\iota}_{\beta} \partial_\theta \omega^{\theta}_{\beta} - 24 r_1 \partial'_1 \omega^{\alpha\beta}_{\beta} - 12 r_1 \partial_\alpha \omega^{\alpha\beta\iota}_{\beta} \partial_\theta \omega^{\theta}_{\beta} + 24 r_1 \partial'_1 \omega^{\alpha\beta}_{\alpha} \partial_\theta \omega^{\theta}_{\beta} + 4 t_2 \omega_{\beta} \partial^\theta f^{\alpha\iota} + 2 t_2 \partial_\alpha f^{\alpha\iota} \partial^\theta f^{\alpha\iota} - t_2 \partial_\theta f^{\alpha\iota} \partial^\theta f^{\alpha\iota} - 4 t_2 \omega_{\beta} \partial^\theta f^{\alpha\iota} + \partial^\theta f^{\alpha\iota} + t_2 \partial_\theta f^{\alpha\iota} + t_2 \partial_\theta f^{\alpha\iota} \partial^\theta f^{\alpha\iota} - t_2 \partial_\theta f^{\alpha\iota} \partial^\theta f^{\alpha\iota} - 4 t_2 \omega_{\beta} \partial^\theta f^{\alpha\iota} + \partial^\theta f^{\alpha\iota} + 2 t_2 \omega_{\beta} \partial^\theta f^{\alpha\iota} + 2 \partial^\theta f^{\alpha\iota} - 8 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 8 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 4 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 4 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 16 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 4 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 4 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 2 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 4 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 2 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} + 4 r_1 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 4 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota} - 4 r_2 \partial_\beta \omega_{\beta} \partial^\theta \omega^{\alpha\beta\iota}) [t, x, y, z] dz dy dx dt$$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \dagger^{\alpha\beta}$	$f_{1-}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#2} \dagger^{\alpha\beta}$	$f_{1-}^{\#2} \dagger^{\alpha\beta}$
$\frac{2t_2}{3}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\frac{\sqrt{2}t_2}{3}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{1}{3}ikt_2$	$\frac{k^2t_2}{3}$	0	0	0	0
0	0	0	$-k^2r_1$	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

$\omega_{0+}^{\#1} \dagger$	$f_{0+}^{\#1} \dagger$	$f_{0+}^{\#2} \dagger$	$\omega_{0-}^{\#1} \dagger$
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$k^2r_2+t_2$

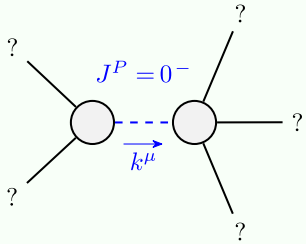
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2-}^{\#1} \dagger^{\alpha\beta\chi}$
0	0	0
0	0	0
0	0	k^2r_1

$\sigma_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#2} \dagger$	$\sigma_{0-}^{\#1} \dagger$
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$\frac{1}{k^2r_2+t_2}$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} == 0$	1
$\sigma_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\sigma_{1-}^{\#2\alpha} == 0$	3
$\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#1\alpha\beta} == 0$	3
$\sigma_{1+}^{\#1\alpha\beta} == \sigma_{1+}^{\#2\alpha\beta}$	3
$\tau_{2+}^{\#1\alpha\beta} == 0$	5
$\sigma_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	28

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

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_2 < 0 \&\& t_2 > 0$