

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S = \int \int \int \int (\frac{1}{6} f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 18 r_3 \partial_\beta \omega_{,\theta}^\theta \partial'_l \omega_{,\alpha}^{\alpha\beta} - 6 r_3 \partial_l \omega_{,\beta}^\theta \partial'_l \omega_{,\alpha}^{\alpha\beta} - 6 r_3 \partial_\alpha \omega_{,\beta}^{\alpha\beta l} \partial_\theta \omega_{,\beta}^\theta + 12 r_3 \partial'_l \omega_{,\alpha}^{\alpha\beta} \partial_\theta \omega_{,\beta}^\theta - 18 r_3 \partial_\alpha \omega_{,\beta}^{\alpha\beta l} \partial_\theta \omega_{,\beta}^\theta + 36 r_3 \partial'_l \omega_{,\alpha}^{\alpha\beta} \partial_\alpha \omega_{,\beta}^\theta + 4 t_2 \omega_{,\theta\alpha} \partial^\theta f^{\alpha l} + 2 t_2 \partial_\alpha f_{,\theta} \partial^\theta f^{\alpha l} - t_2 \partial_\alpha f_{,\theta l} \partial^\theta f^{\alpha l} - t_2 \partial_l f_{\alpha\theta} \partial^\theta f^{\alpha l} + t_2 \partial_\theta f_{\alpha l} \partial^\theta f^{\alpha l} - t_2 \partial_\theta f_{,\alpha} \partial^\theta f^{\alpha l} - 4 t_2 \omega_{\alpha\theta l} (\omega^{\alpha l\theta} + \partial^\theta f^{\alpha l}) + 2 t_2 \omega_{\alpha l\theta} (\omega^{\alpha l\theta} + 2 \partial^\theta f^{\alpha l}) + 8 r_2 \partial_\beta \omega_{\alpha l\theta} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} - 4 r_2 \partial_l \omega_{\alpha\beta\theta} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} + 4 r_2 \partial_\beta \omega_{,\theta\alpha} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} - 24 r_3 \partial_\beta \omega_{,\theta\alpha} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} - 2 r_2 \partial_l \omega_{\alpha\beta\theta} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} + 2 r_2 \partial_\theta \omega_{\alpha\beta l} \partial^\theta \omega_{,\alpha}^{\alpha\beta l} - 4 r_2 \partial_\theta \omega_{\alpha l\beta} \partial^\theta \omega_{,\alpha}^{\alpha\beta l})) [t, x, y, z] d^3z dy dx dt$$

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1-}^{\#1} \dagger^{\alpha}$	$\sigma_{1-}^{\#2} \dagger^{\alpha}$	$\tau_{1-}^{\#1} \dagger^{\alpha}$	$\tau_{1-}^{\#2} \dagger^{\alpha}$
$\frac{1}{k^2 r_3}$	$-\frac{\sqrt{2}}{k^2 r_3 + k^4 r_3}$	$-\frac{i \sqrt{2}}{k r_3 + k^3 r_3}$	0	0	0	0
$-\frac{\sqrt{2}}{k^2 r_3 + k^4 r_3}$	$\frac{3 k^2 r_3 + 2 t_2}{(k + k^3)^2 r_3 t_2}$	$\frac{i (3 k^2 r_3 + 2 t_2)}{k (1 + k^2)^2 r_3 t_2}$	0	0	0	0
$-\frac{i \sqrt{2}}{k r_3 + k^3 r_3}$	$-\frac{i (3 k^2 r_3 + 2 t_2)}{k (1 + k^2)^2 r_3 t_2}$	$\frac{3 k^2 r_3 + 2 t_2}{(1 + k^2)^2 r_3 t_2}$	0	0	0	0
0	0	0	$\frac{1}{k^2 r_3}$	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \dagger^{\alpha}$	$\omega_{1-}^{\#2} \dagger^{\alpha}$	$f_{1-}^{\#1} \dagger^{\alpha}$	$f_{1-}^{\#2} \dagger^{\alpha}$
$k^2 r_3 + \frac{2 t_2}{3}$	$\frac{\sqrt{2} t_2}{3}$	$\frac{1}{3} i \sqrt{2} k t_2$	0	0	0	0
$\frac{\sqrt{2} t_2}{3}$	$\frac{t_2}{3}$	$\frac{i k t_2}{3}$	0	0	0	0
$-\frac{1}{3} i \sqrt{2} k t_2$	$-\frac{1}{3} i k t_2$	$\frac{k^2 t_2}{3}$	0	0	0	0
0	0	0	$k^2 r_3$	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

	$\sigma_{0+}^{\#1}$	$\tau_{0+}^{\#1}$	$\tau_{0+}^{\#2}$	$\sigma_{0-}^{\#1}$
$\sigma_{0+}^{\#1} \dagger$	$\frac{1}{6 k^2 r_3}$	0	0	0
$\tau_{0+}^{\#1} \dagger$	0	0	0	0
$\tau_{0+}^{\#2} \dagger$	0	0	0	0
$\sigma_{0-}^{\#1} \dagger$	0	0	0	$\frac{1}{k^2 r_2 + t_2}$

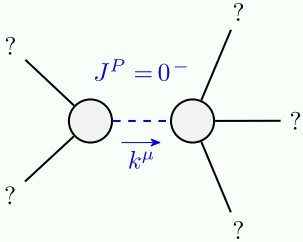
	$\omega_{0+}^{\#1}$	$f_{0+}^{\#1}$	$f_{0+}^{\#2}$	$\omega_{0-}^{\#1}$
$\omega_{0+}^{\#1} \dagger$	$6 k^2 r_3$	0	0	0
$f_{0+}^{\#1} \dagger$	0	0	0	0
$f_{0+}^{\#2} \dagger$	0	0	0	0
$\omega_{0-}^{\#1} \dagger$	0	0	0	$k^2 r_2 + t_2$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\sigma_{1-}^{\#2\alpha} == 0$	3
$\tau_{1+}^{\#1\alpha\beta} + i k \sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\sigma_{2-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2+}^{\#1\alpha\beta} == 0$	5
$\sigma_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	29

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

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

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

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