

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S = \iiint [(f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + \frac{1}{6} t_1 (2 \omega^\alpha_\alpha \omega^\theta_\theta \omega^\alpha_\theta \partial_\theta f^\alpha_\alpha + 4 \omega^\theta_\theta \partial_\theta f^\alpha_\alpha - 2 \partial_\theta f^\theta_\theta \partial_\theta f^\alpha_\alpha - 2 \partial_\theta f^\alpha_\alpha \partial_\theta f^\theta_\theta + 4 \partial_\theta f^\alpha_\alpha \partial_\theta f^\theta_\theta - 6 \partial_\alpha f_\theta \partial^\theta f^\alpha_\theta - 3 \partial_\alpha f_\theta \partial^\theta f^\alpha_\theta + 3 \partial_\theta f_{\alpha\theta} \partial^\theta f^\alpha_\theta + 3 \partial_\theta f_{\alpha\theta} \partial^\theta f^\alpha_\theta + 3 \partial_\theta f_{\alpha\theta} \partial^\theta f^\alpha_\theta + 6 \omega_{\alpha\theta\theta} (\omega^{\alpha\theta\theta} + 2 \partial^\theta f^{\alpha\theta\theta})) - 4 r_3 (\partial_\beta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + \partial_\alpha \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + 3 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - 2 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + \partial_\beta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + \partial_\beta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - \frac{1}{3} r_1 (9 \partial_\beta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + 3 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + 3 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - 18 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - 6 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} + 9 \partial_\alpha \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - 18 \partial_\theta \omega_{\theta\theta} \partial_\theta \omega_{\theta\theta} - 4 \partial_\beta \omega_{\alpha\theta\theta} \partial^\theta \omega_{\alpha\theta\theta} + 4 \partial_\beta \omega_{\theta\alpha\theta} \partial^\theta \omega_{\alpha\theta\theta} - 2 \partial_\theta \omega_{\alpha\theta\theta} \partial^\theta \omega_{\alpha\theta\theta} + 2 \partial_\theta \omega_{\alpha\theta\theta} \partial^\theta \omega_{\alpha\theta\theta}))][t, x, y, z] dz dy dx dt$$

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1-}^{\#1} \dagger^{\alpha}$	$\sigma_{1-}^{\#2} \dagger^{\alpha}$	$\tau_{1-}^{\#1} \dagger^{\alpha}$	$\tau_{1-}^{\#2} \dagger^{\alpha}$
0	$-\frac{\sqrt{2}}{t_1+k^2}t_1$	$-\frac{i\sqrt{2}k}{t_1+k^2}t_1$	0	0	0	0
$-\frac{\sqrt{2}}{t_1+k^2}t_1$	$-\frac{2k^2r_1+t_1}{(1+k^2)^2}t_1^2$	$-\frac{i(2k^3r_1-kt_1)}{(1+k^2)^2}t_1^2$	0	0	0	0
$\frac{i\sqrt{2}k}{t_1+k^2}t_1$	$\frac{i(2k^3r_1-kt_1)}{(1+k^2)^2}t_1^2$	$\frac{-2k^4r_1+k^2t_1}{(1+k^2)^2}t_1^2$	0	0	0	0
0	0	0	$\frac{6}{(3+4k^2)^2}t_1$	$\frac{6\sqrt{2}}{(3+4k^2)^2}t_1$	0	$\frac{12ik}{(3+4k^2)^2}t_1$
0	0	0	0	$\frac{6\sqrt{2}}{(3+4k^2)^2}t_1$	0	$\frac{12i\sqrt{2}k}{(3+4k^2)^2}t_1$
0	0	0	0	0	0	0
0	0	0	$-\frac{12ik}{(3+4k^2)^2}t_1$	$-\frac{12i\sqrt{2}k}{(3+4k^2)^2}t_1$	0	$\frac{24k^2}{(3+4k^2)^2}t_1$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \dagger^{\alpha}$	$\omega_{1-}^{\#2} \dagger^{\alpha}$	$f_{1-}^{\#1} \dagger^{\alpha}$	$f_{1-}^{\#2} \dagger^{\alpha}$
$k^2r_1-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
0	0	0	$\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ikt_1}{3}$
0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_1$
0	0	0	0	0	0	0
0	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt{2}kt_1$	0	$\frac{2k^2t_1}{3}$

	$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{2-}^{\#1} \dagger^{\alpha\beta\chi}$
$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2}t_1$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2}t_1$	0
$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2}t_1$	$\frac{4k^2}{(1+2k^2)^2}t_1$	0
$\sigma_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	0	0	$\frac{2}{2k^2r_1+t_1}$

Source constraints/gauge generators

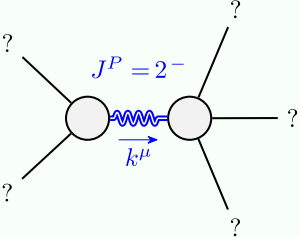
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} + 2ik\sigma_{1-}^{\#1\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\sigma_{1-}^{\#1\alpha} == \sigma_{1-}^{\#2\alpha}$	3
$\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\tau_{2+}^{\#1\alpha\beta} - 2ik\sigma_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	19

$\sigma_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#2} \dagger$	$\sigma_{0-}^{\#1} \dagger$
$\frac{1}{6k^2(-r_1+r_3)}$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$-\frac{1}{t_1}$

$\omega_{0+}^{\#1} \dagger$	$f_{0+}^{\#1} \dagger$	$f_{0+}^{\#2} \dagger$	$\omega_{0-}^{\#1} \dagger$
$6k^2(-r_1+r_3)$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$-t_1$

$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2-}^{\#1} \dagger^{\alpha\beta\chi}$
$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$\frac{ikt_1}{\sqrt{2}}$	k^2t_1	0
0	0	$k^2r_1+\frac{t_1}{2}$

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_1} > 0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2r_1} > 0$
Spin:	2
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_1 < 0 \ \&\& \ t_1 > 0$