

Particle spectrograph

Wave operator and propagator

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \alpha\beta$	$\tau_{1+}^{\#1} \alpha\beta$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
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	$\frac{12}{(3+4k^2)^2}t_1$	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	$\frac{24k^2}{(3+4k^2)^2}t_1$

Quadratic (free) action

$$S = \iiint \Big(\frac{1}{6} (2t_1 \omega_{\alpha}^{\alpha i} \omega_{\theta}^{\theta} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 4t_1 \omega_{\alpha}^{\theta} \partial_{\theta} f^{\alpha i} + 4t_1 \omega_{\theta}^{\alpha} \partial' f_{\alpha}^{\alpha} - 2t_1 \partial_{\theta} f_{\alpha}^{\theta} \partial' f_{\alpha}^{\alpha} - 6r_1 \partial_{\beta} \omega_{\theta}^{\theta} \partial' \omega_{\beta}^{\alpha\beta} + 6r_1 \partial_{\theta} \omega_{\beta}^{\theta} \partial' \omega_{\beta}^{\alpha\beta} - 2t_1 \partial_{\theta} f_{\alpha}^{\alpha i} \partial_{\theta} f_{\alpha}^{\theta} + 4t_1 \partial_{\theta} f_{\alpha}^{\alpha} \partial_{\theta} f_{\theta}^{\theta} + 6r_1 \partial_{\alpha} \omega_{\beta}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} - 12r_1 \partial_{\theta} \omega_{\beta}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} - 6r_1 \partial_{\alpha} \omega_{\beta}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} - 6t_1 \partial_{\alpha} f_{\theta}^{\theta} \partial_{\theta} f_{\alpha}^{\alpha i} - 3t_1 \partial_{\alpha} f_{\theta}^{\theta} \partial_{\theta} f_{\alpha}^{\alpha i} + 3t_1 \partial_{\alpha} f_{\theta}^{\theta} \partial_{\theta} f_{\alpha}^{\alpha i} + 6t_1 \omega_{\alpha\theta}^{\alpha\beta i} (\omega^{\alpha i\theta} + 2 \partial_{\theta} f^{\alpha i}) - 8r_1 \partial_{\beta} \omega_{\alpha\theta}^{\alpha\beta i} \partial^{\theta} \omega_{\alpha\beta i} + 4r_1 \partial_{\beta} \omega_{\alpha\theta i} \partial^{\theta} \omega_{\alpha\beta i} - 16r_1 \partial_{\beta} \omega_{\theta\alpha}^{\alpha\beta i} \partial^{\theta} \omega_{\alpha\beta i} - 4r_1 \partial_{\theta} \omega_{\alpha\beta}^{\alpha\beta i} \partial^{\theta} \omega_{\alpha\beta i} + 4r_1 \partial_{\theta} \omega_{\alpha\beta i} \partial^{\theta} \omega_{\alpha\beta i}) [t, x, y, z] dz dy dx dt$$

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

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

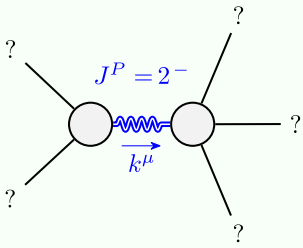
SO(3) irreps	Multiplicities
$\sigma_{0+}^{\#1} == 0$	1
$\tau_{0+}^{\#1} == 0$	1
$\tau_{0+}^{\#2} == 0$	1
$\tau_{1-}^{\#2\alpha} + 2ik \sigma_{1-}^{\#1\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\sigma_{1-}^{\#1\alpha} == \sigma_{1-}^{\#2\alpha}$	3
$\tau_{1+}^{\#1\alpha\beta} + ik \sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\tau_{2+}^{\#1\alpha\beta} - 2ik \sigma_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	20

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

	$\omega_{0+}^{\#1}$	$f_{0+}^{\#1}$	$\omega_{0+}^{\#2}$	$\omega_{0-}^{\#1}$
$\omega_{0+}^{\#1} \dagger$	0	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	$-t_1$

	$\sigma_{0+}^{\#1}$	$\tau_{0+}^{\#1}$	$\tau_{0+}^{\#2}$	$\sigma_{0-}^{\#1}$
$\sigma_{0+}^{\#1} \dagger$	0	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	$-\frac{1}{t_1}$

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
(see particles on)

Unitarity conditions

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