

Particle spectrograph

Wave operator and propagator

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

Quadratic (free) action

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

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

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

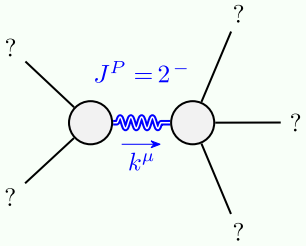
	$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{2-}^{\#1} \dagger^{\alpha\beta\chi}$
$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2}t_1$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2}t_1$	0
$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2}t_1$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

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

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

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\sigma_0^{\#1} == 0$	1
$\tau_0^{\#2} == 0$	1
$\tau_0^{\#1} - 2ik \sigma_0^{\#1} == 0$	1
$\tau_1^{\#2\alpha} + 2ik \sigma_1^{\#2\alpha} == 0$	3
$\tau_1^{\#1\alpha} == 0$	3
$\tau_1^{\#1\alpha\beta} - 2ik \sigma_1^{\#1\alpha\beta} == 0$	3
$2 \sigma_1^{\#1\alpha\beta} + \sigma_1^{\#2\alpha\beta} == 0$	3
$\tau_2^{\#1\alpha\beta} - 2ik \sigma_2^{\#1\alpha\beta} == 0$	5
Total constraints:	20

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

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