

Particle spectrograph

Wave operator and propagator

	$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \alpha\beta$	$\tau_{1+}^{\#1} \alpha\beta$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	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
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{-2k^2(2r_1+r_5)+t_1}{(1+k^2)^2 t_1^2}$	$\frac{-2ik^3(2r_1+r_5)+ik t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{i\sqrt{2}k}{t_1+k^2 t_1}$	$\frac{i(2k^3(2r_1+r_5)-k t_1)}{(1+k^2)^2 t_1^2}$	$\frac{-2k^4(2r_1+r_5)+k^2 t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	0	$\frac{2ik}{t_1+2k^2 t_1}$
$\sigma_{1-}^{\#2} \dagger^{\alpha}$	0	0	0	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	$\frac{-2k^2(r_1+r_5)+t_1}{(t_1+2k^2 t_1)^2}$	0	$-\frac{i\sqrt{2}k(2k^2(r_1+r_5)-t_1)}{(t_1+2k^2 t_1)^2}$
$\tau_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0	0
$\tau_{1-}^{\#2} \dagger^{\alpha}$	0	0	0	$-\frac{2ik}{t_1+2k^2 t_1}$	$\frac{i\sqrt{2}k(2k^2(r_1+r_5)-t_1)}{(t_1+2k^2 t_1)^2}$	0	$\frac{-4k^4(r_1+r_5)+2k^2 t_1}{(t_1+2k^2 t_1)^2}$

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

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

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

Quadratic (free) action

$$S = \iiint ((f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + \frac{1}{2} t_1 (2 \omega^{\alpha\chi} \omega_{\alpha\chi} - 4 \omega_{\alpha\chi}^{\theta} \partial_{\theta} f^{\alpha\chi} + 4 \omega_{\alpha\chi}^{\theta} \partial_{\theta} f^{\alpha\chi} - 2 \partial_{\theta} f^{\alpha\chi} \partial_{\theta} f^{\alpha\chi} - 2 \partial_{\theta} f^{\alpha\chi} \partial_{\theta} f^{\alpha\chi} + \partial_{\theta} f_{\alpha\theta} \partial^{\theta} f^{\alpha\chi} + \partial_{\theta} f_{\alpha\theta} \partial^{\theta} f^{\alpha\chi} + 2 \omega_{\alpha\theta} (\omega^{\alpha\theta} + 2 \partial^{\theta} f^{\alpha\chi})) - \frac{2}{3} r_1 (2 \partial_{\beta} \omega_{\alpha\theta} \partial^{\theta} \omega_{\alpha\theta} + 4 \partial_{\beta} \omega_{\theta\alpha} + \partial_{\theta} \omega_{\alpha\beta} \partial^{\theta} \omega_{\alpha\beta} - \partial_{\theta} \omega_{\alpha\beta} \partial^{\theta} \omega_{\alpha\beta} + r_5 (\partial_{\theta} \omega_{\theta\kappa} \partial^{\theta} \omega_{\alpha\chi} - \partial_{\theta} \omega_{\alpha\chi} \partial^{\theta} \omega_{\theta\kappa} - (\partial_{\alpha} \omega^{\alpha\theta} - 2 \partial^{\theta} \omega_{\alpha}^{\chi}) (\partial_{\kappa} \omega_{\theta}^{\kappa} - \partial_{\kappa} \omega_{\theta}^{\kappa}))) [t, x, y, z] dz dy dx dt$$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	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
$\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\tau_{2+}^{\#1\alpha\beta} - 2ik\sigma_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	16

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

	$\omega_{1+}^{\#1} \alpha\beta$	$\omega_{1+}^{\#2} \alpha\beta$	$f_{1+}^{\#1} \alpha\beta$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2} \alpha$
$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$k^2(2r_1+r_5) - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ik t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{ik t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	$k^2(r_1+r_5) - \frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$ik t_1$
$\omega_{1-}^{\#2} \dagger^{\alpha}$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0	0
$f_{1-}^{\#2} \dagger^{\alpha}$	0	0	0	$-ik t_1$	0	0	0

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

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