

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	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	0	0	0	0
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{-2ik^3(2r_3+r_5)+t_1}{(1+k^2)^2t_1^2}$	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$\frac{i(2k^3(2r_3+r_5)-kt_1)}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^{\alpha}$	0	0	$\frac{1}{k^2(2r_3+r_5)}$	$-\frac{1}{\sqrt{2}(\mu^2+2k^4)(2r_3+r_5)}$	0	$-\frac{i}{k(1+2k^2)(2r_3+r_5)}$
$\sigma_{1-}^{\#2} \dagger^{\alpha}$	0	0	0	$-\frac{1}{\sqrt{2}(\mu^2+2k^4)(2r_3+r_5)}$	0	$\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}k(1+2k^2)^2(2r_3+r_5)t_1}$
$\tau_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0
$\tau_{1-}^{\#2} \dagger^{\alpha}$	0	0	$\frac{i}{k(1+2k^2)(2r_3+r_5)}$	$-\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}k(1+2k^2)^2(2r_3+r_5)t_1}$	0	$\frac{6k^2(2r_3+r_5)+t_1}{(1+2k^2)^2(2r_3+r_5)t_1}$

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

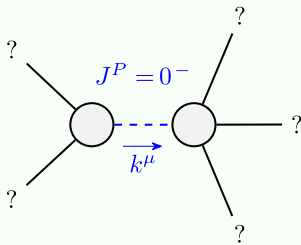
$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \alpha\beta$	$f_{1+}^{\#1} \alpha\beta$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2} \alpha$
$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$k^2(2r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0
$\omega_{1-}^{\#1} \dagger^{\alpha}$	0	0	$k^2(2r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ikt_1}{3}$
$\omega_{1-}^{\#2} \dagger^{\alpha}$	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_1$
$f_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0
$f_{1-}^{\#2} \dagger^{\alpha}$	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt{2}kt_1$	0	$\frac{2k^2t_1}{3}$

Quadratic (free) action

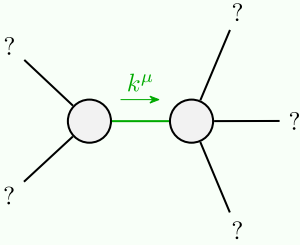
$S = \iiint \left(f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + \frac{1}{6} t_1 (2 \omega_{\alpha}^{\alpha i} \omega_{\theta}^{\theta} - 4 \omega_{\alpha}^{\theta} \omega_{\theta}^{\alpha} \partial_{\theta} f^{\alpha i} + 4 \omega_{\theta}^{\theta} \omega_{\theta}^{\alpha} \partial_{\theta} f^{\alpha i} - \right.$
 $2 \partial_{\theta} f^{\theta} \partial_{\theta} f^{\alpha} - 2 \partial_{\theta} f^{\alpha i} \partial_{\theta} f_{\alpha}^{\theta} + 4 \partial_{\theta} f^{\alpha} \partial_{\theta} f_{\alpha}^{\theta} - 6 \partial_{\alpha} f_{\theta}^{\theta} \partial_{\theta} f^{\alpha i} - 3 \partial_{\alpha} f_{\theta i} \partial_{\theta} f^{\alpha i} +$
 $3 \partial_{\theta} f_{\alpha\theta} \partial_{\theta} f^{\alpha i} + 3 \partial_{\theta} f_{\alpha i} \partial_{\theta} f^{\alpha \theta} + 3 \partial_{\theta} f_{\alpha}^{\theta} \partial_{\theta} f^{\alpha i} + 6 \omega_{\alpha\theta i} (\omega^{\alpha i\theta} + 2 \partial_{\theta} f^{\alpha i})) +$
 $\frac{1}{3} r_2 (4 \partial_{\beta} \omega_{\alpha i \theta} \partial_{\theta} \omega_{\alpha\theta i} - 2 \partial_{\beta} \omega_{\alpha\theta i} + 2 \partial_{\beta} \omega_{\theta\alpha} \partial_{\theta} \omega_{\alpha\beta\theta} + \partial_{\theta} \omega_{\alpha\beta\theta} - 2 \partial_{\theta} \omega_{\alpha i \beta}) \partial_{\theta} \omega^{\alpha\beta i} -$
 $2 r_3 (\partial_{\beta} \omega_{\theta}^{\theta} \partial_{\theta} \omega_{\alpha}^{\alpha\beta} + \partial_{\theta} \omega_{\beta}^{\theta} \partial_{\theta} \omega_{\alpha}^{\alpha\beta} + \partial_{\alpha} \omega^{\alpha\beta i} \partial_{\theta} \omega_{\beta}^{\theta} - 2 \partial_{\theta} \omega_{\alpha}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} +$
 $\partial_{\alpha} \omega^{\alpha\beta i} \partial_{\theta} \omega_{\beta}^{\theta} - 2 \partial_{\theta} \omega_{\alpha}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} + 2 \partial_{\beta} \omega_{\theta\alpha} \partial_{\theta} \omega^{\alpha\beta i}) + r_5 (\partial_{\theta} \omega_{\alpha}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} -$
 $\partial_{\theta} \omega_{\alpha}^{\alpha\beta} \partial_{\theta} \omega_{\beta}^{\theta} - (\partial_{\alpha} \omega^{\alpha i \theta} - 2 \partial_{\theta} \omega_{\alpha}^{\alpha i}) (\partial_{\alpha} \omega_{\theta}^{\alpha\beta} - \partial_{\theta} \omega_{\alpha}^{\alpha\beta})) [t, x, y, z] dz dy dx dt$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} + 2ik\sigma_{1-}^{\#2\alpha} == 0$	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

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$\frac{t_1}{r_2} > 0$
Spin:	0
Parity:	Odd



Quadratic pole	
Pole residue:	$-\frac{1}{(2r_3+r_5)t_1^2} > 0$
Polarisations:	2

Unitarity conditions

$r_2 < 0 \&\& r_5 < -2r_3 \&\& t_1 < 0$