

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

$$S = \iiint \{ (\frac{1}{6} (2t_1\omega_{\alpha}^{\alpha i}\omega_{\theta}^{\theta} + 6f^{\alpha\beta}\tau_{\alpha\beta} + 6\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi} - 4t_1\omega_{\alpha}^{\theta}\partial_{\theta}f^{\alpha i} + 4t_1\omega_{\theta}^{\alpha}\partial_{\alpha}f^{\theta i} - \partial_{\alpha}f^{\alpha} - 2t_1\partial_{\theta}f_{\theta}^{\theta}\partial_{\alpha}f^{\alpha} - 2t_1\partial_{\alpha}f^{\alpha i}\partial_{\theta}f_{\theta}^{\theta} + 4t_1\partial_{\alpha}f^{\alpha}\partial_{\theta}f_{\theta}^{\theta} - 6t_1\partial_{\alpha}f_{\theta}^{\theta}\partial^{\theta}f^{\alpha i} - 3t_1\partial_{\alpha}f_{\theta i}^{\theta}\partial^{\theta}f^{\alpha i} + 3t_1\partial_{\alpha}f_{\theta}^{\theta}\partial^{\theta}f^{\alpha i} + 3t_1\partial_{\theta}f_{\alpha i}^{\theta}\partial^{\theta}f^{\alpha i} + 3t_1\partial_{\theta}f_{\alpha}^{\theta}\partial^{\theta}f^{\alpha i} - 3t_1\partial_{\theta}f_{\alpha}^{\theta}\partial^{\theta}f^{\alpha i}) + 6t_1\omega_{\alpha\theta i}(\omega^{\alpha i\theta} + 2\partial^{\theta}f^{\alpha i}) + 8r_2\partial_{\beta}\omega_{\alpha i\theta}\partial^{\theta}\omega^{\alpha\beta i} - 4r_2\partial_{\beta}\omega_{\alpha\theta i}\partial^{\theta}\omega^{\alpha\beta i} + 2r_2\partial_{\theta}\omega_{\alpha\beta i}\partial^{\theta}\omega^{\alpha\beta i} - 4r_2\partial_{\theta}\omega_{\alpha i\beta}\partial^{\theta}\omega^{\alpha\beta i})) [t, x, y, z] dz dy dx dt$$

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

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	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:	20

$\omega_{0^+}^{\#1} \dagger$	$\omega_{0^+}^{\#1} f_{0^+}^{\#2}$	$\omega_{0^+}^{\#1}$
0	0	0
$f_{0^+}^{\#1} \dagger$	0	0
$f_{0^+}^{\#2} \dagger$	0	0
$\omega_{0^+}^{\#1} \dagger$	0	0
0	0	$k^2r_2-t_1$

$\sigma_{0^+}^{\#1} \dagger$	$\tau_{0^+}^{\#1} \dagger$	$\tau_{0^+}^{\#2}$	$\sigma_{0^+}^{\#1}$
0	0	0	0
0	0	0	0
0	0	0	0
$\frac{1}{k^2r_2-t_1}$	0	0	0

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

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

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

No massless particles

(no massless particles)

Unitarity conditions

$r_2 < 0 \&\& t_1 < 0$