Particle spectrograph

Wave operator and propagator

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

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	0	0	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	0	0	0	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$-\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$k^2 r_5+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{i k t_1}{3}$
$\omega_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3} i\sqrt{2}\,k t_1$
$f_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{i k t_1}{3}$	$\frac{1}{3} i\sqrt{2}\,k t_1$	0	$\frac{2k^2 t_1}{3}$

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

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

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{1^-}^{\#2\alpha} + 2\,i\,k\,\sigma_{1^-}^{\#2\alpha} == 0$	3
$\tau_{1^-}^{\#1\alpha} == 0$	3
$\tau_{1^+}^{\#1\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\alpha\beta} - 2\,i\,k\,\sigma_{2^+}^{\#1\alpha\beta} == 0$	5
Total constraints:	17

Quadratic (free) action

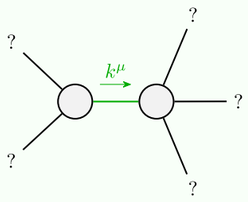
$S ==$

$$\int\int\int\int (f^{\alpha\beta}\,\tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + \tfrac{1}{6} t_1 (2\,\omega^{\alpha\prime}{}_{\alpha}\,\omega_{\prime}{}^{\theta}{}_{\theta} - 4\,\omega_{\alpha}{}^{\theta}{}_{\theta}\,\partial_{\prime} f^{\alpha\prime} + 4\,\omega_{\prime}{}^{\theta}{}_{\theta}\,\partial^{\prime} f^{\alpha}{}_{\alpha} - 2\,\partial_{\prime} f^{\theta}{}_{\theta}\,\partial^{\prime} f^{\alpha}{}_{\alpha} - 2\,\partial_{\prime} f^{\alpha\prime}\,\partial_{\theta} f_{\alpha}{}^{\theta} + 4\,\partial^{\prime} f^{\alpha}{}_{\alpha}\,\partial_{\theta} f_{\prime}{}^{\theta} - 6\,\partial_{\alpha} f_{\prime\theta}\,\partial^{\theta} f^{\alpha\prime} - 3\,\partial_{\alpha} f_{\theta\prime}\,\partial^{\theta} f^{\alpha\prime} + 3\,\partial_{\prime} f_{\alpha\theta}\,\partial^{\theta} f^{\alpha\prime} + 3\,\partial_{\theta} f_{\alpha\prime}\,\partial^{\theta} f^{\alpha\prime} + 3\,\partial_{\theta} f_{\prime\alpha}\,\partial^{\theta} f^{\alpha\prime} + 6\,\omega_{\alpha\theta\prime}\,(\omega^{\alpha\prime\theta} + 2\,\partial^{\theta} f^{\alpha\prime})) + r_5\,(\partial_{\prime}\omega_{\theta}{}^{\kappa}{}_{\kappa}\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha} - \partial_{\theta}\omega_{\prime}{}^{\kappa}{}_{\kappa}\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha} - (\partial_{\alpha}\omega^{\alpha\prime\theta} - 2\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha})\,(\partial_{\kappa}\omega_{\prime}{}^{\kappa}{}_{\theta} - \partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\prime})))[t, x, y, z]\,dz\,dy\,dx\,dt$$

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



Quadratic pole

Pole residue:	$-\frac{1}{r_5 t_1^2} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$r_5 < 0 \;\&\&\; t_1 < 0 \,||\, t_1 > 0$