Particle spectrograph

Wave operator and propagator

	$\sigma^{#1}_{1^+}\dagger^{\alpha\beta}$	$\sigma^{#2}_{1^+}\dagger^{\alpha\beta}$	$\tau^{#1}_{1^+}\dagger^{\alpha\beta}$	$\sigma^{#1}_{1^-}\dagger^{\alpha}$	$\sigma^{#2}_{1^-}\dagger^{\alpha}$	$\tau^{#1}_{1^-}\dagger^{\alpha}$	$\tau^{#2}_{1^-}\dagger^{\alpha}$
$\tau^{#2}_{1^-\alpha}$	0	0	0	$-\frac{i}{k(1+2k^2)(2r_3+r_5)t_1}$	$-\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt2\,k(1+2k^2)^2(2r_3+r_5)t_1}$		$\frac{6k^2(2r_3+r_5)+t_1}{(1+2k^2)^2(2r_3+r_5)t_1}$
$\tau^{#1}_{1^-\alpha}$	0	0	0	0	0	0	0
$\sigma^{#2}_{1^-\alpha}$	0	0	0	$-\frac{1}{\sqrt2(k^2+2k^4)(2r_3+r_5)}$	$\frac{6k^2(2r_3+r_5)+t_1}{2(k+2k^3)^2(2r_3+r_5)t_1}$		$\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt2\,k(1+2k^2)^2(2r_3+r_5)t_1}$
$\sigma^{#1}_{1^-\alpha}$	0	0	0	$\frac{1}{k^2(2r_3+r_5)}$	$\frac{1}{\sqrt2(k^2+2k^4)(2r_3+r_5)}$		$\frac{i}{k(1+2k^2)(2r_3+r_5)}$
$\tau^{#1}_{1^+\alpha\beta}$	$-\frac{i\sqrt2\,k}{t_1+k^2 t_1}$	$-\frac{2ik^3(2r_3+r_5)+ikt_1}{(1+k^2)^2 t_1^2}$	$-\frac{2k^4(2r_3+r_5)+k^2 t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\sigma^{#2}_{1^+\alpha\beta}$	$-\frac{\sqrt2}{t_1+k^2 t_1}$	$-\frac{2k^2(2r_3+r_5)+t_1}{(1+k^2)^2 t_1^2}$	$\frac{i(2k^3(2r_3+r_5)+kt_1)}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\sigma^{#1}_{1^+\alpha\beta}$	0	$-\frac{\sqrt2}{t_1+k^2 t_1}$	$\frac{i\sqrt2\,k}{t_1+k^2 t_1}$	0	0	0	0

	$\sigma^{#1}_{2^+\alpha\beta}$	$\tau^{#1}_{2^+\alpha\beta}$	$\sigma^{#1}_{2^-\alpha\beta\chi}$
$\sigma^{#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt2\,k}{(1+2k^2)^2 t_1}$	0
$\tau^{#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2i\sqrt2\,k}{(1+2k^2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2 t_1}$	0
$\sigma^{#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$\frac{2}{t_1}$

	$\sigma^{#1}_{2^+\alpha\beta}$	$f^{#1}_{2^+\alpha\beta}$	$\omega^{#1}_{2^-\alpha\beta\chi}$
$\omega^{#1}_{2^+}\dagger^{\alpha\beta}$	0	0	$\frac{t_1}{2}$
$f^{#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{ikt_1}{\sqrt2}$	$k^2 t_1$	0
$\omega^{#1}_{2^-}\dagger^{\alpha\beta\chi}$	$\frac{t_1}{2}$	$\frac{ikt_1}{\sqrt2}$	0

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau^{#2}_{0^+} == 0$	1
$\tau^{#1}_{0^+} == 0$	1
$\tau^{#2\alpha}_1 + 2ik\,\sigma^{#2\alpha}_1 == 0$	3
$\tau^{#1\alpha}_1 == 0$	3
$\tau^{#1\alpha\beta}_1 + ik\,\sigma^{#2\alpha\beta}_1 == 0$	3
$\tau^{#1\alpha\beta}_2 - 2ik\,\sigma^{#1\alpha\beta}_2 == 0$	5
Total constraints:	16

Quadratic (free) action

$$S_F == \iiint\Big(\tfrac{1}{6}\big(-2t_1\,\omega_i{}^{\alpha l}\,\omega_{\kappa\alpha}{}^{\kappa} - 6t_1\,\omega_i{}^{\kappa\lambda}\,\omega_{\kappa\lambda}{}^{i} + 6f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} -$$
$$12r_3\,\partial_i\omega^{\kappa\lambda}{}_\kappa\,\partial^i\omega_\lambda{}^\alpha{}_\alpha - 6r_5\,\partial_i\omega^{\kappa\lambda}{}_\alpha\,\partial^i\omega_\lambda{}^\alpha{}_\kappa + 12r_3\,\partial_\alpha\omega_\lambda{}^\alpha{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} -$$
$$6r_5\,\partial_\alpha\omega_\lambda{}^\alpha{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} - 12r_3\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} -$$
$$12r_5\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} - 6r_5\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} +$$
$$24r_3\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} - 3t_1\,\partial^\alpha f_{\theta\kappa}\,\partial^\kappa f_\alpha{}^\theta -$$
$$3t_1\,\partial^\alpha f_\kappa{}^\lambda\,\partial^\kappa f_{\lambda\alpha} + 3t_1\,\partial_\kappa f_\theta{}^\lambda\,\partial^\kappa f_\lambda{}^\theta - 2t_1\,\partial_\kappa f^\lambda{}_\theta\,\partial^\kappa f_{\lambda\kappa} -$$
$$2t_1\,\partial_\kappa f^\lambda{}_\kappa\,\partial^\kappa f^I{}_I + 12t_1\,\omega_{I\kappa\theta}\,\partial^\kappa f^{I\theta} - 2t_1\,\omega_{I\lambda}{}^\alpha\,\partial^\kappa f^I{}_\kappa +$$
$$3t_1\,\partial^\alpha f^\lambda{}_\kappa\,\partial^\kappa f_{\lambda\alpha} + 2t_1\,\omega_{I\kappa\theta}\,\partial^\kappa f^{I\theta} + 4t_1\,\partial^\alpha f_{\kappa\alpha}\,\partial^\kappa f^I{}_I +$$
$$12r_5\,\partial_\alpha\omega_\lambda{}^\alpha{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} - 6r_5\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} +$$
$$6r_5\,\partial_\alpha\omega_\lambda{}^\alpha{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} - 12r_3\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} +$$
$$12r_3\,\partial_\theta\omega_\lambda{}^\alpha{}_\alpha\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa\big)\big)[t,x,y,z]\,dz\,dy\,dx\,dt$$

	$\sigma^{#1}_{0^+}\dagger$	$\tau^{#1}_{0^+}\dagger$	$\tau^{#2}_{0^+}\dagger$	$\sigma^{#1}_{0^-}\dagger$
$\sigma^{#1}_{0^+}$	0	0	0	$-\frac{1}{t_1}$
$\tau^{#1}_{0^+}$	0	0	0	0
$\tau^{#2}_{0^+}$	0	0	0	0
$\sigma^{#1}_{0^-}$	$\frac{1}{6k^2 r_3}$	0	0	0

	$\omega^{#1}_{0^+}$	$f^{#1}_{0^+}$	$f^{#2}_{0^+}$	$\omega^{#1}_{0^-}$
$\omega^{#1}_{0^+}\dagger$	$6k^2 r_3$	0	0	0
$f^{#1}_{0^+}\dagger$	0	0	0	0
$f^{#2}_{0^+}\dagger$	0	0	0	0
$\omega^{#1}_{0^-}\dagger$	0	0	0	$-t_1$

	$\omega^{#1}_{1^+\alpha\beta}$	$\omega^{#2}_{1^+\alpha\beta}$	$f^{#1}_{1^+\alpha\beta}$	$\omega^{#1}_{1^-\alpha}$	$\omega^{#2}_{1^-\alpha}$	$f^{#1}_{1^-\alpha}$	$f^{#2}_{1^-\alpha}$
$\omega^{#1}_{1^+}\dagger^{\alpha\beta}$	$k^2(2r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt2}$	$-\frac{ikt_1}{\sqrt2}$	0	0	0	0
$\omega^{#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt2}$	0	0	0	0	0	0
$f^{#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt2}$	0	0	0	0	0	0
$\omega^{#1}_{1^-}\dagger^{\alpha}$	0	0	0	$k^2(2r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt2}$	0	$\frac{ikt_1}{3}$
$\omega^{#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{t_1}{3\sqrt2}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt2\,k t_1$
$f^{#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$f^{#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt2\,k t_1$	0	$\frac{2k^2 t_1}{3}$

Massive and massless spectra

k^μ
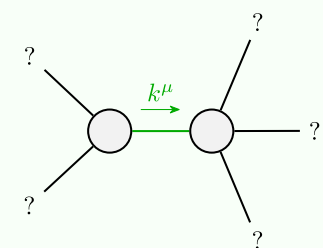
Quadratic pole

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

(No massive particles)

Unitarity conditions

$r_5 < -2r_3\ \&\&\ t_1 < 0\ ||\ t_1 > 0$