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

Quadratic (free) action

$$S_F == \int\int\int\int (\tfrac{1}{6}(-2t_1\,\omega_{\iota}^{\alpha\prime}\,\omega_{\kappa\alpha}^{\ \kappa}-6t_1\,\omega_{\iota}^{\kappa\lambda}\,\omega_{\kappa\lambda}^{\ \prime}+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-6r_5\,\partial_\iota\omega^{\kappa\lambda}{}_\kappa$$
$$\partial^\prime\omega_\lambda^{\ \alpha}{}_\alpha-6r_5\,\partial_\alpha\omega_\lambda^{\ \alpha}{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda}+6r_5\,\partial_\alpha\omega_\lambda^{\ \alpha}{}_\theta\,\partial_\kappa\omega^{\kappa\lambda\theta}+$$
$$12r_5\,\partial_\theta\omega_\lambda^{\ \alpha}{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta}-3t_1\,\partial^\alpha f_{\theta\kappa}\,\partial^\kappa f_\alpha^{\ \theta}-3t_1\,\partial^\alpha f_{\kappa\theta}\,\partial^\kappa f_\alpha^{\ \theta}-$$
$$3t_1\,\partial^\alpha f^\lambda{}_\kappa\,\partial^\kappa f_{\alpha\lambda}+2t_1\,\omega_{\kappa\alpha}^{\ \ \alpha}\,\partial^\kappa f_\iota^{\ \prime}+4t_1\,\partial^\alpha f_{\kappa\alpha}\,\partial^\kappa f_\iota^{\ \prime}-$$
$$2t_1\,\partial_\kappa f^\lambda{}_\lambda\,\partial^\kappa f_\iota^{\ \prime}+12t_1\,\omega_{\iota\kappa\theta}\,\partial^\kappa f^{\iota\theta}-2t_1\,\omega_{\iota\lambda}^{\ \ \lambda}\,\partial^\kappa f^{\iota\prime}{}_\kappa+$$
$$3t_1\,\partial^\alpha f^\lambda{}_\kappa\,\partial^\kappa f_{\lambda\alpha}+3t_1\,\partial_\kappa f^\lambda{}_\theta\,\partial^\kappa f_\lambda^{\ \theta}+3t_1\,\partial^\alpha f^\lambda{}_\alpha\,\partial^\kappa f_{\lambda\kappa}+$$
$$6r_5\,\partial_\alpha\omega_\lambda^{\ \alpha}{}_\theta\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa-6r_5\,\partial_\theta\omega_\lambda^{\ \alpha}{}_\alpha\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa))[t,x,y,z]\,dz\,dy\,dx\,dt$$

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

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

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

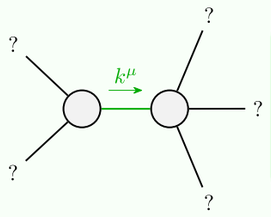
	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	0	0	0	$-t_1$
$f_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0

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

Source constraints/gauge generators

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

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

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