Particle spectrograph

Wave operator and propagator

	$\sigma^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#2}_{1^+\,\alpha\beta}$	$\tau^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#1}_{1^-\,\alpha}$	$\sigma^{\#2}_{1^-\,\alpha}$	$\tau^{\#1}_{1^-\,\alpha}$	$\tau^{\#2}_{1^-\,\alpha}$
$\sigma^{\#1}_{1^+}\dagger^{\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	0	0	0	0
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{-2k^2(2r_1+r_5)+t_1}{(1+k^2)^2 t_1{}^2}$	$\frac{-2ik^3(2r_1+r_5)+ikt_1}{(1+k^2)^2 t_1{}^2}$	0	0	0	0
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	$\frac{i(2k^3(2r_1+r_5)-kt_1)}{(1+k^2)^2 t_1{}^2}$	$\frac{-2k^4(2r_1+r_5)+k^2 t_1}{(1+k^2)^2 t_1{}^2}$	0	0	0	0
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2(t_1+t_3)}{3t_1t_3+2k^2(r_1+r_5)(t_1+t_3)}$	$-\frac{\sqrt{2}(t_1-2t_3)}{(1+2k^2)(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$	0	$-\frac{2ik(t_1-2t_3)}{(1+2k^2)(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{\sqrt{2}(t_1-2t_3)}{(1+2k^2)(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$	$\frac{6k^2(r_1+r_5)+t_1+4t_3}{(1+2k^2)^2(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$	0	$\frac{i\sqrt{2}\,k(6k^2(r_1+r_5)+t_1+4t_3)}{(1+2k^2)^2(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$
$\tau^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$\tau^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2ik(t_1-2t_3)}{(1+2k^2)(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$	$-\frac{i\sqrt{2}\,k(6k^2(r_1+r_5)+t_1+4t_3)}{(1+2k^2)^2(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$	0	$\frac{2k^2(6k^2(r_1+r_5)+t_1+4t_3)}{(1+2k^2)^2(3t_1t_3+2k^2(r_1+r_5)(t_1+t_3))}$

	$\omega^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}\dagger$	t_3	$-i\sqrt{2}\,kt_3$	0	0
$f^{\#1}_{0^+}\dagger$	$i\sqrt{2}\,kt_3$	$2k^2t_3$	0	0
$f^{\#2}_{0^+}\dagger$	0	0	0	0
$\omega^{\#1}_{0^-}\dagger$	0	0	0	$-t_1$

	$\omega^{\#1}_{2^+\,\alpha\beta}$	$f^{\#1}_{2^+\,\alpha\beta}$	$\omega^{\#1}_{2^-\,\alpha\beta\chi}$
$\omega^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	k^2t_1	0
$\omega^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$k^2r_1+\frac{t_1}{2}$

	$\omega^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#2}_{1^+\,\alpha\beta}$	$f^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#1}_{1^-\,\alpha}$	$\omega^{\#2}_{1^-\,\alpha}$	$f^{\#1}_{1^-\,\alpha}$	$f^{\#2}_{1^-\,\alpha}$
$\omega^{\#1}_{1^+}\dagger^{\alpha\beta}$	$k^2(2r_1+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$\omega^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	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	$\frac{1}{6}(6k^2(r_1+r_5)+t_1+4t_3)$	$\frac{t_1-2t_3}{3\sqrt{2}}$	0	$\frac{1}{3}ik(t_1-2t_3)$
$\omega^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{t_1-2t_3}{3\sqrt{2}}$	$\frac{t_1+t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}\,k(t_1+t_3)$
$f^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{1}{3}ik(t_1-2t_3)$	$-\frac{1}{3}i\sqrt{2}\,k(t_1+t_3)$	0	$\frac{2}{3}k^2(t_1+t_3)$

	$\sigma^{\#1}_{2^+\,\alpha\beta}$	$\tau^{\#1}_{2^+\,\alpha\beta}$	$\sigma^{\#1}_{2^-\,\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2t_1}$	$-\frac{2i\sqrt{2}\,k}{(1+2k^2)^2t_1}$	0
$\tau^{\#1}_{2^+}\dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}\,k}{(1+2k^2)^2t_1}$	$\frac{4k^2}{(1+2k^2)^2t_1}$	0
$\sigma^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$\frac{2}{2k^2r_1+t_1}$

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	$\frac{1}{(1+2k^2)^2t_3}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2t_3}$	0	0
$\tau^{\#1}_{0^+}\dagger$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2t_3}$	$\frac{2k^2}{(1+2k^2)^2t_3}$	0	0
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}\dagger$	0	0	0	$-\frac{1}{t_1}$

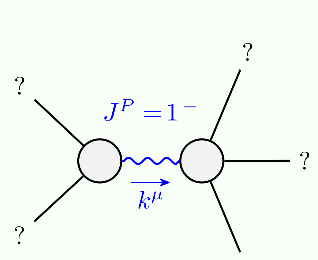
Source constraints

SO(3) irreps	Fundamental fields	Multiplicities
$\tau^{\#2}_{0^+}==0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}==0$	1
$\tau^{\#1}_{0^+}-2ik\,\sigma^{\#1}_{0^+}==0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}==\partial_\beta\partial^\beta\tau^\alpha{}_\alpha+2\,\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}{}_\alpha$	1
$\tau^{\#2\,\alpha}_{1^-}+2ik\,\sigma^{\#2\,\alpha}_{1^-}==0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi}==\partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta}+2\,\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	3
$\tau^{\#1\,\alpha}_{1^-}==0$	$\partial_\chi\partial_\beta\partial^\alpha\tau^{\beta\chi}==\partial_\chi\partial^\chi\partial_\beta\tau^{\beta\alpha}$	3
$\tau^{\#1\,\alpha\beta}_{1^+}+ik\,\sigma^{\#2\,\alpha\beta}_{1^+}==0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi}+\partial_\chi\partial^\beta\tau^{\chi\alpha}+\partial_\chi\partial^\chi\tau^{\alpha\beta}+$ $2\,\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta}+2\,\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi}==$ $\partial_\chi\partial^\alpha\tau^{\chi\beta}+\partial_\chi\partial^\beta\tau^{\alpha\chi}+$ $\partial_\chi\partial^\chi\tau^{\beta\alpha}+2\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
$\tau^{\#1\,\alpha\beta}_{2^+}-2ik\,\sigma^{\#1\,\alpha\beta}_{2^+}==0$	$-i(4\,\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta}+2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^\chi{}_\chi-$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi}-3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\chi\beta}-$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi}-3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\chi\alpha}+$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}+3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\beta\alpha}+$ $4i\,k^\chi\,\partial_\epsilon\partial_\chi\partial^\beta\partial^\alpha\sigma^{\delta\epsilon}{}_\delta-$ $6i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\delta\epsilon}-$ $6i\,k^\chi\,\partial_\epsilon\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\delta\epsilon}+$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\tau^{\chi\delta}+$ $6i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\alpha\delta\beta}+$ $6i\,k^\chi\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial_\chi\sigma^{\beta\delta\alpha}-$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\epsilon\partial_\delta\partial^\delta\tau^\chi{}_\chi-$ $4i\,\eta^{\alpha\beta}\,k^\chi\,\partial_\phi\partial^\phi\partial_\epsilon\partial_\chi\sigma^{\delta\epsilon}{}_\delta)==0$	5
Total constraints/gauge generators:		16

Quadratic (free) action

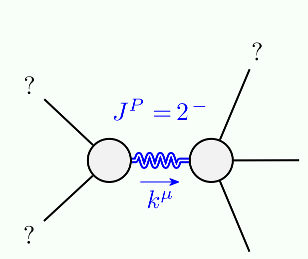
$$\mathcal{S}==\iiiint(\tfrac{1}{6}(2\,\omega^{\alpha\iota}{}_\alpha(t_1\,\omega_\iota{}^\theta{}_\theta-2t_3\,\omega_\iota{}^\kappa{}_\kappa)+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-$$
$$4t_1\,\omega_\alpha{}^\theta{}_\theta\,\partial_\iota f^{\alpha\iota}+8t_3\,\omega_\alpha{}^\kappa{}_\kappa\,\partial_\iota f^{\alpha\iota}+4t_1\,\omega_\iota{}^\theta{}_\theta\,\partial^\iota f^\alpha{}_\alpha-$$
$$8t_3\,\omega_\iota{}^\kappa{}_\kappa\,\partial^\iota f^\alpha{}_\alpha-2t_1\,\partial_\iota f^\theta{}_\theta\partial^\iota f^\alpha{}_\alpha+4t_3\,\partial_\iota f^\kappa{}_\kappa\partial^\iota f^\alpha{}_\alpha-$$
$$2t_1\,\partial_\iota f^{\alpha\iota}\partial_\theta f_\alpha{}^\theta+4t_1\,\partial^\iota f^\alpha{}_\alpha\partial_\theta f_\iota{}^\theta-6t_1\,\partial_\alpha f_{\iota\theta}\partial^\theta f^{\alpha\iota}-$$
$$3t_1\,\partial_\alpha f_{\theta\iota}\partial^\theta f^{\alpha\iota}+3t_1\,\partial_\iota f_{\alpha\theta}\partial^\theta f^{\alpha\iota}+3t_1\,\partial_\theta f_{\alpha\iota}\partial^\theta f^{\alpha\iota}+$$
$$3t_1\,\partial_\theta f_{\iota\alpha}\partial^\theta f^{\alpha\iota}+6t_1\,\omega_{\alpha\theta\iota}\,(\omega^{\alpha\iota\theta}+2\,\partial^\theta f^{\alpha\iota})-$$
$$8r_1\,\partial_\beta\omega_{\alpha\iota\theta}\partial^\theta\omega^{\alpha\beta\iota}+4r_1\,\partial_\beta\omega_{\alpha\theta\iota}\partial^\theta\omega^{\alpha\beta\iota}-$$
$$16r_1\,\partial_\beta\omega_{\iota\theta\alpha}\partial^\theta\omega^{\alpha\beta\iota}-4r_1\,\partial_\iota\omega_{\alpha\beta\theta}\partial^\theta\omega^{\alpha\beta\iota}+$$
$$4r_1\,\partial_\theta\omega_{\alpha\beta\iota}\partial^\theta\omega^{\alpha\beta\iota}+4r_1\,\partial_\theta\omega_{\alpha\iota\beta}\partial^\theta\omega^{\alpha\beta\iota}+$$
$$6r_5\,\partial_\iota\omega_\theta{}^\kappa{}_\kappa\partial^\theta\omega^{\alpha\iota}{}_\alpha-6r_5\,\partial_\theta\omega_\iota{}^\kappa{}_\kappa\partial^\theta\omega^{\alpha\iota}{}_\alpha+$$
$$4t_3\,\partial_\iota f^{\alpha\iota}\partial_\kappa f_\alpha{}^\kappa-8t_3\,\partial^\iota f^\alpha{}_\alpha\partial_\kappa f_\iota{}^\kappa-6r_5\,\partial_\alpha\omega^{\alpha\iota\theta}\partial_\kappa\omega_\iota{}^\kappa{}_\theta+$$
$$12r_5\,\partial^\theta\omega^{\alpha\iota}{}_\alpha\partial_\kappa\omega_\iota{}^\kappa{}_\theta+6r_5\,\partial_\alpha\omega^{\alpha\iota\theta}\partial_\kappa\omega_\theta{}^\kappa{}_\iota-$$
$$12r_5\,\partial^\theta\omega^{\alpha\iota}{}_\alpha\partial_\kappa\omega_\theta{}^\kappa{}_\iota))[t,x,y,z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra



Massive particle

Pole residue:	$-\frac{3(-2t_1t_3(t_1+t_3)+r_1(t_1{}^2+2t_3{}^2)+r_5(t_1{}^2+2t_3{}^2))}{2(r_1+r_5)(t_1+t_3)(-3t_1t_3+r_1(t_1+t_3)+r_5(t_1+t_3))}>0$
Polarisations:	3
Square mass:	$-\frac{3t_1t_3}{2(r_1+r_5)(t_1+t_3)}>0$
Spin:	1
Parity:	Odd



Massive particle

Pole residue:	$-\frac{1}{r_1}>0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2r_1}>0$
Spin:	2
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_1<0$ && $r_5<-r_1$ && $t_1>0$ && $t_3<-t_1$ || $t_3>0$