Particle spectrograph

Wave operator and propagator

	$\omega^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#2}_{1^+\,\alpha\beta}$	$f^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#1}_{1^-\,\alpha}$	$\omega^{\#2}_{1^-\,\alpha}$	$f^{\#1}_{1^-\,\alpha}$	$f^{\#2}_{1^-\,\alpha}$
$\omega^{\#1}_{1^+}\dagger^{\alpha\beta}$	$k^2\,(2\,r_3+r_5)+\frac{2\,t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0	0
$\omega^{\#2}_{1^+}\dagger^{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0	0	0	0
$f^{\#1}_{1^+}\dagger^{\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{1}{3}\,i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0	0	0	0
$\omega^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$k^2\,(\frac{r_3}{2}+r_5)+\frac{2\,t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	0	$-\frac{2}{3}\,i\,k\,t_3$
$\omega^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_3$
$f^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2\,i\,k\,t_3}{3}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_3$	0	$\frac{2\,k^2\,t_3}{3}$

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	$\frac{1}{(1+2\,k^2)^2\,t_3}$	$-\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_3}$	0	0
$\tau^{\#1}_{0^+}\dagger$	$\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_3}$	$\frac{2\,k^2}{(1+2\,k^2)^2\,t_3}$	0	0
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}\dagger$	0	0	0	$\frac{1}{k^2\,r_2+t_2}$

	$\omega^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}\dagger$	t_3	$-i\,\sqrt{2}\,k\,t_3$	0	0
$f^{\#1}_{0^+}\dagger$	$i\,\sqrt{2}\,k\,t_3$	$2\,k^2\,t_3$	0	0
$f^{\#2}_{0^+}\dagger$	0	0	0	0
$\omega^{\#1}_{0^-}\dagger$	0	0	0	$k^2\,r_2+t_2$

	$\omega^{\#1}_{2^+\,\alpha\beta}$	$f^{\#1}_{2^+\,\alpha\beta}$	$\omega^{\#1}_{2^+\,\alpha\beta\chi}$
$\omega^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{3\,k^2\,r_3}{2}$	0	0
$f^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$\omega^{\#1}_{2^+}\dagger^{\alpha\beta\chi}$	0	0	0

	$\sigma^{\#1}_{2^+\,\alpha\beta}$	$\tau^{\#1}_{2^+\,\alpha\beta}$	$\sigma^{\#1}_{2^+\,\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{2}{3\,k^2\,r_3}$	0	0
$\tau^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta\chi}$	0	0	0

	$\tau^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#1}_{1^-\,\alpha}$	$\sigma^{\#2}_{1^-\,\alpha}$	$\tau^{\#1}_{1^-\,\alpha}$	$\tau^{\#2}_{1^-\,\alpha}$
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$-\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3+r_5)}$	0	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)\,(r_3+2\,r_5)}$	0	$\frac{4\,i}{k\,(1+2\,k^2)\,(r_3+2\,r_5)}$
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	$\frac{i\,(3\,k^2\,(2\,r_3+r_5)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	$\frac{3\,k^2\,(r_3+2\,r_5)+4\,t_3}{(k+2\,k^3)^2\,(r_3+2\,r_5)\,t_3}$	0	$\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{3\,k^2\,(2\,r_3+r_5)+2\,t_2}{(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	0	0	0
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	$\frac{2}{k^2\,(r_3+2\,r_5)}$	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)\,(r_3+2\,r_5)}$	0	$\frac{4\,i}{k\,(1+2\,k^2)\,(r_3+2\,r_5)}$
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)\,(r_3+2\,r_5)}$	$\frac{3\,k^2\,(r_3+2\,r_5)+4\,t_3}{(k+2\,k^3)^2\,(r_3+2\,r_5)\,t_3}$	$\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$	$\frac{6\,k^2\,(r_3+2\,r_5)+8\,t_3}{(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$
$\tau^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0
$\tau^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	0	0

	$\sigma^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#2}_{1^+\,\alpha\beta}$
$\sigma^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3+r_5)}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3+r_5)}$
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3+r_5)}$	$\frac{3\,k^2\,(2\,r_3+r_5)+4\,t_3}{(k+3\,k^3)^2\,(2\,r_3+r_5)\,t_3}$
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3+r_5)}$	$-\frac{i\,(3\,k^2\,(2\,r_3+r_5)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	0
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	0
$\tau^{\#1}_{1^-}\dagger^{\alpha}$	0	0
$\tau^{\#2}_{1^-}\dagger^{\alpha}$	0	0

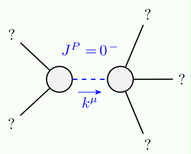
Source constraints

SO(3) irreps	Fundamental fields	Multiplicities
$\tau^{\#2}_{0^+}==0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}==0$	1
$\tau^{\#1}_{0^+}-2\,i\,k\,\sigma^{\#1}_{0^+}==0$	$\partial_\beta\partial_\alpha\tau^{\alpha\beta}==\partial_\beta\partial^\alpha\tau_\alpha+2\,\partial_\chi\partial^\chi\partial_\beta\sigma^{\alpha\beta}$	1
$\tau^{\#2\,\alpha}_{1^-}+2\,i\,k\,\sigma^{\#2\,\alpha}_{1^-}==0$	$\partial_\chi\partial_\beta\partial_\alpha\tau^{\alpha\beta}==\partial_\chi\partial^\chi\partial_\beta\tau^{\alpha\beta}+2\,\partial_\delta\partial^\delta\partial_\chi\partial_\beta\sigma^{\alpha\beta\chi}$	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
$\tau^{\#1\,\alpha\beta}_{1^+}+i\,k\,\sigma^{\#2\,\alpha\beta}_{1^+}==0$	$\partial_\chi\partial^\alpha\tau^{\beta\chi}+\partial_\chi\partial^\beta\tau^{\alpha\chi}+\partial_\chi\partial^\chi\tau^{\alpha\beta}+$ $2\,\partial_\delta\partial_\chi\partial^\alpha\sigma^{\beta\chi\delta}+2\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}+4\,\partial_\delta\partial^\delta\partial_\chi\sigma^{\alpha\beta\chi}==$ $\partial_\chi\partial^\alpha\tau^{\chi\beta}+\partial_\chi\partial^\beta\tau^{\alpha\chi}+$ $\partial_\chi\partial^\chi\tau^{\beta\alpha}+2\,\partial_\delta\partial_\chi\partial^\beta\sigma^{\alpha\chi\delta}$	3
$\sigma^{\#1}_{2^-}==0$	$3\,\partial_\epsilon\partial_\delta\partial^\chi\partial^\alpha\sigma^{\beta\delta\epsilon}+3\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\beta}{}_\xi+$ $2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\beta\sigma^{\alpha\chi\delta}+4\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi}+$ $2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha}+4\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\chi\sigma^{\alpha\beta\delta}+$ $2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi}+2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha}+$ $3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\alpha\sigma^{\delta\epsilon}{}_\delta+$ $3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\beta\sigma^{\delta\epsilon}{}_\delta+$ $3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\xi\sigma^{\alpha\delta}{}_\xi+$ $3\,\partial_\epsilon\partial_\delta\partial^\chi\partial^\xi\sigma^{\alpha\delta\epsilon}+3\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi}+$ $2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\alpha\sigma^{\beta\chi\delta}+4\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\chi\sigma^{\alpha\beta\delta}+$ $2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\alpha\sigma^{\chi\delta\beta}+2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\chi\beta}+$ $4\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\alpha\beta\chi}+2\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\sigma^{\beta\chi\alpha}+$ $3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\beta\sigma^{\delta\epsilon}{}_\delta+$ $3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\alpha\sigma^{\delta\epsilon}{}_\delta+$ $3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\delta\sigma^{\beta\delta\epsilon}{}_\delta+$ $3\,\eta^{\beta\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\delta\sigma^{\alpha\delta\epsilon}{}_\delta+$ $3\,\eta^{\alpha\chi}\,\partial_\phi\partial^\phi\partial_\epsilon\partial^\delta\sigma^{\beta\delta\epsilon}{}_\delta==$	5
$\tau^{\#1\,\alpha\beta}_{2^+}==0$	$4\,\partial_\delta\partial_\chi\partial^\beta\partial^\alpha\tau^{\chi\delta}+2\,\partial_\delta\partial^\delta\partial^\beta\partial^\alpha\tau^{\chi}{}_\chi+$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}+3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi}+$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\xi\partial_\delta\partial_\chi\tau^{\chi\delta}==$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\alpha\tau^{\beta\chi}+3\,\partial_\delta\partial^\delta\partial_\chi\partial^\beta\tau^{\alpha\chi}+$ $3\,\partial_\delta\partial^\delta\partial_\chi\partial^\chi\tau^{\alpha\beta}+$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon\partial^\xi\partial_\delta\partial^\delta\tau^{\chi}{}_\chi$	5
Total constraints/gauge generators:		21

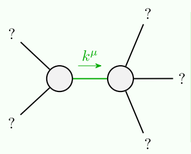
Quadratic (free) action

$$S==\int\int\int\int\left(\frac{1}{6}\right.(-4\,t_3\,\omega^{\alpha\prime}{}_\alpha\,\omega_\prime{}^\kappa{}_\kappa+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+8\,t_3\,\omega_\alpha{}^\kappa{}_\kappa\,\partial_\prime f^{\alpha\prime}{}_\kappa+$$
$$8\,t_3\,\omega_\prime{}^\kappa{}_\kappa\,\partial^\prime f^\alpha{}_\alpha+4\,t_3\,\partial_\prime f^\kappa{}_\kappa\,\partial^\prime f^\alpha{}_\alpha-3\,r_3\,\partial_\beta\omega^\theta{}_\alpha\,\partial_\theta\omega^{\alpha\beta}{}_\prime-$$
$$3\,r_3\,\partial_\prime\omega_\beta{}^\theta\,\partial^\prime\omega^{\alpha\beta}{}_\alpha-3\,r_3\,\partial_\alpha\omega^{\alpha\beta\prime}\,\partial_\theta\omega_\beta{}^\theta{}_\prime+$$
$$6\,r_3\,\partial^\prime\omega^{\alpha\beta}{}_\alpha\,\partial_\theta\omega_\prime{}^\theta{}_\beta-3\,r_3\,\partial_\alpha\omega^{\alpha\beta\prime}\,\partial_\theta\omega_\prime{}^\theta{}_\beta+$$
$$6\,r_3\,\partial^\prime\omega^{\alpha\beta}{}_\alpha\,\partial_\theta\omega_\prime{}^\theta{}_\beta+4\,t_2\,\omega_{\prime\theta\alpha}\,\partial^\theta f^{\alpha\prime}+2\,t_2\,\partial_\theta f_\prime{}^\theta\,\partial^\theta f^{\alpha\prime}-$$
$$t_2\,\partial_\theta f_{\prime\alpha}\,\partial^\theta f^{\alpha\prime}-t_2\,\partial_\theta f_{\alpha\prime}\,\partial^\theta f^{\alpha\prime}-$$
$$t_2\,\partial_\theta f_{\prime\alpha}\,\partial^\theta f^{\alpha\prime}-4\,t_2\,\omega_{\alpha\theta\prime}\,(\omega^{\alpha\prime\theta}+\partial^\theta f^{\alpha\prime})+$$
$$2\,t_2\,\omega_{\alpha\prime\theta}\,(\omega^{\alpha\prime\theta}+2\,\partial^\theta f^{\alpha\prime})+8\,r_2\,\partial_\beta\omega_{\alpha\prime\theta}\,\partial^\theta\omega^{\alpha\beta\prime}-$$
$$4\,r_2\,\partial_\beta\omega_{\alpha\theta\prime}\,\partial^\theta\omega^{\alpha\beta\prime}+4\,r_2\,\partial_\beta\omega_{\prime\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\prime}-$$
$$24\,r_3\,\partial_\beta\omega_{\prime\theta\alpha}\,\partial^\theta\omega^{\alpha\beta\prime}-2\,r_2\,\partial_\prime\omega_{\alpha\beta\theta}\,\partial^\theta\omega^{\alpha\beta\prime}+$$
$$2\,r_2\,\partial_\theta\omega_{\alpha\beta\prime}\,\partial^\theta\omega^{\alpha\beta\prime}-4\,r_2\,\partial_\theta\omega_{\alpha\prime\beta}\,\partial^\theta\omega^{\alpha\beta\prime}+$$
$$6\,r_5\,\partial_\prime\omega_\theta{}^\kappa\,\partial^\theta\omega^{\alpha\prime}{}_\alpha-6\,r_5\,\partial_\theta\omega_\prime{}^\kappa\,\partial^\theta\omega^{\alpha\prime}{}_\alpha+$$
$$4\,t_3\,\partial_\prime f^\alpha{}_\kappa\,\partial^\prime f_\alpha{}^\kappa-8\,t_3\,\partial^\prime f^\alpha{}_\alpha\,\partial_\kappa f_\prime{}^\kappa-6\,r_5\,\partial_\alpha\omega^{\alpha\prime\theta}\,\partial_\kappa\omega_\prime{}^\kappa{}_\theta+$$
$$12\,r_5\,\partial^\theta\omega^{\alpha\prime}{}_\alpha\,\partial_\kappa\omega_\prime{}^\kappa{}_\theta+6\,r_5\,\partial_\alpha\omega^{\alpha\prime\theta}\,\partial_\kappa\omega_\theta{}^\kappa{}_\prime-$$
$$\left.12\,r_5\,\partial^\theta\omega^{\alpha\prime}{}_\alpha\,\partial_\kappa\omega_\theta{}^\kappa{}_\prime\right))[t,x,y,z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2}>0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2}>0$
Spin:	0
Parity:	Odd



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

Unitarity conditions

$$r_2<0\,\&\&\,r_3<0\,\&\&\,r_5<-\frac{r_3}{2}\,\&\&\,t_2>0\,\|\,r_2<0\,\&\&\,r_3<0\,\&\&\,r_5>-2\,r_3\,\&\&\,t_2>0\,\|\,r_2<0\,\&\&\,r_3>0\,\&\&\,-2\,r_3<r_5<-\frac{r_3}{2}\,\&\&\,t_2>0$$