Particle spectrograph

Wave operator and propagator

	$\omega^{\#1}_{2^+\alpha\beta}$	$f^{\#1}_{2^+\alpha\beta}$	$\omega^{\#1}_{2^-\alpha\beta\chi}$
$\omega^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{\alpha_0}{4}+\beta_1$	$\frac{i(\alpha_0-4\beta_1)k}{2\sqrt{2}}$	0
$f^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{i(\alpha_0-4\beta_1)k}{2\sqrt{2}}$	$2\beta_1 k^2$	0
$\omega^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$-\frac{\alpha_0}{4}+\beta_1$

	$\sigma^{\#1}_{2^+\alpha\beta}$	$\tau^{\#1}_{2^+\alpha\beta}$	$\sigma^{\#1}_{2^-\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{16\beta_1}{\alpha_0^2-4\alpha_0\beta_1}$	$\frac{2i\sqrt{2}}{\alpha_0 k}$	0
$\tau^{\#1}_{2^+}\dagger^{\alpha\beta}$	$-\frac{2i\sqrt{2}}{\alpha_0 k}$	$\frac{2}{\alpha_0 k^2}$	0
$\sigma^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	$\frac{1}{-\frac{\alpha_0}{4}+\beta_1}$

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	$\frac{8\beta_1}{\alpha_0^2-4\alpha_0\beta_1}$	$-\frac{i\sqrt{2}}{\alpha_0 k}$	0	0
$\tau^{\#1}_{0^+}\dagger$	$\frac{i\sqrt{2}}{\alpha_0 k}$	$-\frac{1}{\alpha_0 k^2}$	0	0
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}\dagger$	0	0	0	$\frac{2}{\alpha_0-4\beta_1+2\alpha_3 k^2}$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau^{\#2}_{0^+} == 0$	1
$\tau^{\#2\alpha}_{1^-} + 2\,i\,k\,\sigma^{\#2\alpha}_{1^-} == 0$	3
$\tau^{\#1\alpha}_{1^-} == 0$	3
$\tau^{\#1\alpha\beta}_{1^+} + i\,k\,\sigma^{\#2\alpha\beta}_{1^+} == 0$	3
Total constraints:	10

Quadratic (free) action

$$S_{\mathrm{F}} == \iiiint \left(-\tfrac{1}{2}(\alpha_0-4\beta_1)\,\omega^{\alpha\beta}{}_\alpha\,\omega_\beta{}^\chi{}_\chi + \omega_{\alpha\chi\beta}\left(-\tfrac{1}{2}\alpha_0\,\omega^{\alpha\beta\chi}+4\beta_1\,\partial^\chi f^{\alpha\beta}\right)+\right.$$
$$\tfrac{1}{3}\left(-6\beta_1\,\omega_\alpha{}^{\chi\delta}\,\omega_{\chi\delta}{}^\alpha + 3\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-6\beta_1\,\omega_\alpha{}^\chi{}_\chi\,\partial_\beta f^{\alpha\beta}-6\beta_1\,\omega_\alpha{}^\delta{}_\delta\,\partial_\beta f^{\alpha\beta}+\right.$$
$$3\alpha_0\,\partial_\beta\omega^{\alpha\beta}{}_\alpha + 2\alpha_3\,\partial^\alpha\omega^{\beta\zeta}{}_\chi\,\partial_\beta\omega_{\zeta\alpha}{}^\chi + 6\beta_1\,\omega_\beta{}^\chi{}_\chi\,\partial^\beta f^\alpha{}_\alpha + 6\beta_1\,\omega_\beta{}^\delta{}_\delta\,\partial^\beta f^\alpha{}_\alpha -$$
$$6\beta_1\,\partial_\beta f^\chi{}_\chi\,\partial^\beta f^\alpha{}_\alpha + 3\,f^{\alpha\beta}\left(\tau_{\alpha\beta}-\alpha_0\,\partial_\beta\omega_\alpha{}^\chi{}_\chi+\alpha_0\,\partial_\chi\omega_\alpha{}^\chi{}_\beta\right)-3\alpha_0\,f^\alpha{}_\alpha\,\partial_\chi\omega^{\beta\chi}{}_\beta -$$
$$2\alpha_3\,\partial_\beta\omega_{\zeta\alpha}{}^\chi\,\partial_\chi\omega^{\beta\zeta\alpha}-\alpha_3\,\partial_\beta\omega_{\zeta\alpha}{}^\chi\,\partial_\chi\omega^{\zeta\alpha\beta}+3\beta_1\,\partial_\chi f_\beta{}^\delta\,\partial^\chi f_\delta{}^\beta + 3\beta_1\,\partial_\chi f^{\delta\beta}\,\partial^\chi f_\delta{}^\beta +$$
$$2\alpha_3\,\partial_\chi\omega^{\beta\zeta\alpha}\,\partial^\chi\omega_{\zeta\alpha\beta}+\alpha_3\,\partial_\chi\omega^{\zeta\alpha\beta}\,\partial^\chi\omega_{\zeta\alpha\beta}+12\beta_1\,\partial^\beta f^\alpha{}_\alpha\,\partial_\delta f_\beta{}^\delta -$$
$$6\beta_1\,\partial_\beta f_\chi{}^\beta\,\partial_\delta f^{\chi\delta}+2\alpha_3\,\partial^\beta\omega_\alpha{}^{\delta\zeta}\,\partial_\delta\omega_{\zeta\beta}{}^\alpha-2\alpha_3\,\partial^\beta\omega_\alpha{}^{\zeta\delta}\,\partial_\delta\omega_{\zeta\beta}{}^\alpha-3\beta_1\,\partial^\chi f_\zeta{}^\beta\,\partial^\zeta f_{\beta\chi}-$$
$$\left.\left.3\beta_1\,\partial^\chi f_\zeta{}^\beta\,\partial^\zeta f_{\chi\beta}+3\beta_1\,\partial^\chi f_{\delta\zeta}\,\partial^\zeta f^\delta{}_\chi-3\beta_1\,\partial^\chi f_{\zeta\delta}\,\partial^\zeta f^\delta{}_\chi\right)\right)[t,x,y,z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra

Massive particle

$J^P = 0^-$
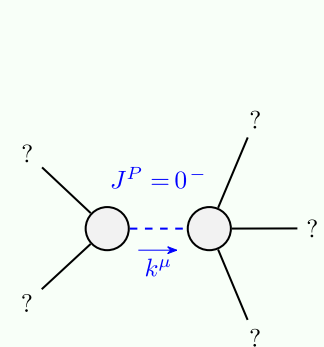
Pole residue:	$-\frac{1}{\alpha_3} > 0$
Polarisations:	1
Square mass:	$-\frac{\alpha_0-4\beta_1}{2\alpha_3} > 0$
Spin:	0
Parity:	Odd
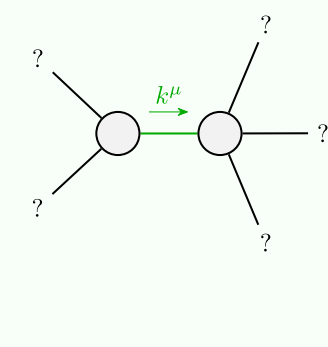
Quadratic pole

Pole residue:	$\frac{1}{\alpha_0} > 0$
Polarisations:	2

Unitarity conditions

$\alpha_0 > 0$ && $\alpha_3 < 0$ && $\beta_1 < \frac{\alpha_0}{4}$