Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S_F == \iiint (\tfrac{1}{3}(-6\,\beta_1\,\omega_\alpha^{\ \chi\delta}\,\omega_{\chi\delta}^{\ \ \alpha} + 3\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 3\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 6\,\beta_1\,\omega_\alpha^{\ \ \chi}\,\partial_\beta f^{\alpha\beta} - 6\,\beta_1\,\omega_{\alpha\ \delta}^{\ \ \delta}\,\partial_\beta f^{\alpha\beta} - 12\,\beta_1\,f^{\alpha\beta}\,\partial_\beta\omega_\alpha^{\ \ \chi} + 12\,\beta_1\,\partial_\beta\omega^{\alpha\beta}{}_\alpha^{\ \ \chi} + 2\,\alpha_3\,\partial^\alpha\omega^{\beta\zeta}{}_{\chi\ \beta}^{\ \ \chi}\,\partial_\beta\omega_{\zeta\alpha}^{\ \ \ \chi} + 6\,\beta_1\,\omega_\beta^{\ \ \chi}\,\partial^\beta f^\alpha{}_{\chi\ \alpha}^{\ \ \ \beta} + 6\,\beta_1\,\omega_\beta^{\ \ \delta}\,\partial^\beta f^\alpha{}_{\delta\ \alpha}^{\ \ \ \chi} + 12\,\beta_1\,f^{\alpha\beta}\,\partial_\chi\omega_{\alpha\ \beta}^{\ \ \chi} - 12\,\beta_1\,f^\alpha{}_{\alpha\ \chi}^{\ \ \ \beta}\,\partial_\beta\omega_\zeta^{\ \ \chi} - 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} + 6\,\beta_1\,\omega_{\alpha\chi\beta}\,(\omega^{\alpha\beta\chi} - 2\,\partial^\chi f^{\alpha\beta}) + 3\,\beta_1\,\partial_\chi f^{\alpha\beta}\,\partial^\chi f_{\alpha\beta} + 3\,\beta_1\,\partial_\chi f^{\alpha\beta}\,\partial^\chi f_{\beta\alpha} + 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\beta\alpha} + 12\,\beta_1\,\partial^\beta f^\alpha{}_{\alpha\ \beta}^{\ \ \delta}\,\partial_\delta f^\chi{}_\zeta^{\ \ \zeta} + 6\,\beta_1\,\partial_\beta f^{\ \beta}{}_\chi^{\ \alpha}\,\partial^\chi f^\delta{}_{\alpha\ \beta}^{\ \ \delta} + 2\,\alpha_3\,\partial^\beta\omega_{\zeta\beta}^{\ \ \ \alpha}\,\partial_\delta\omega_\alpha^{\ \ \zeta\delta} - 3\,\beta_1\,\partial^\chi f_\zeta^{\ \beta}\,\partial^\zeta f_{\beta\chi} - 3\,\beta_1\,\partial^\chi f_{\zeta\delta}\,\partial^\zeta f_\chi^{\ \delta})) [t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}\dagger^{\alpha\beta}$	0	0	0
$f_{2^+}^{\#1}\dagger^{\alpha\beta}$	0	$2\,\beta_1\,k^2$	0
$\omega_{2^-}^{\#1}\dagger^{\alpha\beta\chi}$	0	0	0

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\sigma_{1^-}^{\#1\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#1\,\alpha\beta} == 0$	3
$\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	5
Total constraints:	33

	$\sigma_{0^+}^{\#1}\dagger$	$\tau_{0^+}^{\#1}\dagger$	$\tau_{0^+}^{\#2}\dagger$	$\sigma_{0^-}^{\#1}\dagger$
$\sigma_{0^+}^{\#1}$	0	0	0	0
$\tau_{0^+}^{\#1}$	0	$-\frac{1}{4\,\beta_1\,k^2}$	0	0
$\tau_{0^+}^{\#2}$	0	0	0	0
$\sigma_{0^-}^{\#1}$	0	0	0	$\frac{1}{\alpha_3\,k^2}$

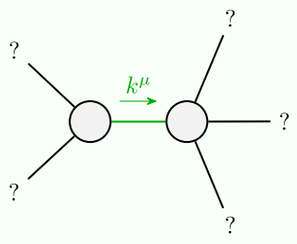
	$\omega_{0^+}^{\#1}\dagger$	$f_{0^+}^{\#1}\dagger$	$f_{0^+}^{\#2}\dagger$	$\omega_{0^-}^{\#1}\dagger$
$\omega_{0^+}^{\#1}$	0	0	0	0
$f_{0^+}^{\#1}$	0	$-4\,\beta_1\,k^2$	0	0
$f_{0^+}^{\#2}$	0	0	0	0
$\omega_{0^-}^{\#1}$	0	0	0	$\alpha_3\,k^2$

	$\sigma_{2^+}^{\#1}\dagger^{\alpha\beta}$	$\tau_{2^+}^{\#1}\dagger^{\alpha\beta}$	$\sigma_{2^-}^{\#1}\dagger^{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	0	$\frac{1}{2\,\beta_1\,k^2}$	0
$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$	0	0	0

	$\omega_{1^+}^{\#1}\dagger^{\alpha\beta}$	$\omega_{1^+}^{\#2}\dagger^{\alpha\beta}$	$f_{1^+}^{\#1}\dagger^{\alpha\beta}$	$\omega_{1^-}^{\#1}\dagger^{\alpha}$	$\omega_{1^-}^{\#2}\dagger^{\alpha}$	$f_{1^-}^{\#1}\dagger^{\alpha}$	$f_{1^-}^{\#2}\dagger^{\alpha}$
$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$f_{1^+}^{\#1}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$\omega_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$\omega_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0

	$\sigma_{1^+}^{\#1}\dagger^{\alpha\beta}$	$\sigma_{1^+}^{\#2}\dagger^{\alpha\beta}$	$\tau_{1^+}^{\#1}\dagger^{\alpha\beta}$	$\sigma_{1^-}^{\#1}\dagger^{\alpha}$	$\sigma_{1^-}^{\#2}\dagger^{\alpha}$	$\tau_{1^-}^{\#1}\dagger^{\alpha}$	$\tau_{1^-}^{\#2}\dagger^{\alpha}$
$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	0	0	0	0	0	0	0
$\sigma_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$\sigma_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0

Massive and massless spectra



Quadratic pole

Pole residue:	$\frac{1}{\beta_1} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$\beta_1 > 0$