Particle spectrograph

Wave operator and propagator

Quadratic (free) Lagrangian density

$$
\begin{aligned}
&-2\,\beta_1\,\omega_{\alpha\chi\beta}\,\omega^{\alpha\beta\chi} - 2\,\beta_1\,\omega_{\alpha}{}^{\chi\delta}\,\omega_{\chi\delta}{}^{\alpha} + f^{\alpha\beta}\,\tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 2\,\beta_1\,\omega_{\alpha}{}^{\chi}\,\partial_{\beta}f^{\alpha\beta} - \\
&2\,\beta_1\,\omega_{\alpha}{}^{\delta}{}_{\delta}\,\partial_{\beta}f^{\alpha\beta} - 4\,\beta_1\,f^{\alpha\beta}\,\partial_{\beta}\omega_{\alpha}{}^{\chi}{}_{\chi} + 4\,\beta_1\,\partial_{\beta}\omega^{\alpha\beta}{}_{\alpha} + \tfrac{2}{3}\,\alpha_3\,\partial^{\alpha}\omega^{\beta\zeta}{}_{\chi}\,\partial_{\beta}\omega_{\zeta\alpha}{}^{\chi} + \\
&2\,\beta_1\,\omega_{\beta}{}^{\chi}{}_{\chi}\,\partial^{\beta}f^{\alpha}{}_{\alpha} + 2\,\beta_1\,\omega_{\beta}{}^{\delta}{}_{\delta}\,\partial^{\beta}f^{\alpha}{}_{\alpha} - 2\,\beta_1\,\partial_{\beta}f^{\chi}{}_{\chi}\,\partial^{\beta}f^{\alpha}{}_{\alpha} + 4\,\beta_1\,f^{\alpha\beta}\,\partial_{\chi}\omega_{\alpha}{}^{\chi}{}_{\beta} - \\
&4\,\beta_1\,f^{\alpha}{}_{\alpha}\,\partial_{\chi}\omega^{\beta\chi}{}_{\beta} - \tfrac{2}{3}\,\alpha_3\,\partial_{\beta}\omega_{\zeta\alpha}{}^{\chi}\,\partial_{\chi}\omega^{\beta\zeta\alpha} - \tfrac{1}{3}\,\alpha_3\,\partial_{\beta}\omega_{\zeta\alpha}{}^{\chi}\,\partial_{\chi}\omega^{\zeta\alpha\beta} + 4\,\beta_1\,\omega_{\alpha\chi\beta}\,\partial^{\chi}f^{\alpha\beta} + \\
&\beta_1\,\partial_{\chi}f^{\delta}{}_{\beta}\,\partial^{\chi}f_{\delta}{}^{\beta} + \tfrac{2}{3}\,\alpha_3\,\partial_{\chi}\omega^{\beta\zeta\alpha}\,\partial^{\chi}\omega_{\zeta\alpha\beta} + \tfrac{1}{3}\,\alpha_3\,\partial_{\chi}\omega^{\zeta\alpha\beta}\,\partial^{\chi}\omega_{\zeta\alpha\beta} + \\
&4\,\beta_1\,\partial_{\beta}f_{\chi}{}^{\beta}\,\partial_{\delta}f^{\chi\delta} + \tfrac{2}{3}\,\alpha_3\,\partial^{\beta}\omega_{\alpha}{}^{\delta\zeta}\,\partial_{\delta}\omega_{\zeta\beta}{}^{\alpha} - \tfrac{2}{3}\,\alpha_3\,\partial^{\beta}\omega_{\alpha}{}^{\zeta\delta}\,\partial_{\delta}\omega_{\zeta\beta}{}^{\alpha} - \\
&\beta_1\,\partial^{\chi}f_{\zeta}{}^{\beta}\,\partial^{\zeta}f_{\chi\beta} - \beta_1\,\partial^{\chi}f_{\beta\chi} - \beta_1\,\partial^{\zeta}f_{\zeta\delta}\,\partial^{\zeta}f^{\delta}{}_{\chi} + \beta_1\,\partial^{\chi}f_{\zeta\delta}\,\partial^{\zeta}f^{\delta}{}_{\chi}
\end{aligned}
$$

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

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

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

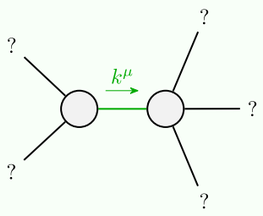
	$\omega_{2^+}^{\#1\,\alpha\beta}$	$f_{2^+}^{\#1\,\alpha\beta}$	$\omega_{2^-}^{\#1\,\alpha\beta\chi}$
$\omega_{2^+}^{\#1\,\alpha\beta}\,\dagger$	0	0	0
$f_{2^+}^{\#1\,\alpha\beta}\,\dagger$	0	$2\,\beta_1\,k^2$	0
$\omega_{2^-}^{\#1\,\alpha\beta\chi}\,\dagger$	0	0	0

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

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

	$\sigma_{2^+}^{\#1\,\alpha\beta}\,\dagger$	$\tau_{2^+}^{\#1\,\alpha\beta}\,\dagger$	$\sigma_{2^-}^{\#1\,\alpha\beta\chi}\,\dagger$
$\sigma_{2^+}^{\#1\,\alpha\beta}$	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

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

$\beta_1 > 0$