Particle spectrograph

Wave operator and propagator

Quadratic (free) Lagrangian density

$$\mathcal{L} = \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - \tfrac{1}{2}\,r_3\,\partial_l\omega^{\kappa\lambda}{}_\kappa\,\partial^l\omega_{\lambda}{}^{\alpha}{}_\alpha - r_5\,\partial_l\omega^{\kappa\lambda}{}_\kappa\,\partial_\theta\omega^{\theta\alpha}{}_{\alpha} + \tfrac{2}{3}\,r_2\,\partial^\beta\omega^{\theta\alpha}{}_\kappa\,\partial_\theta\omega_{\alpha\beta}{}^{\kappa} -$$
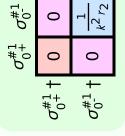$$\tfrac{1}{3}\,r_2\,\partial_\theta\omega_{\alpha\beta}{}^\kappa\,\partial_\kappa\omega^{\alpha\beta\theta} - \tfrac{2}{3}\,r_2\,\partial_\theta\omega_{\alpha\beta}{}^\kappa\,\partial_\kappa\omega^{\theta\alpha\beta} + \tfrac{1}{2}\,r_3\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} -$$
$$r_5\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_\theta\,\partial_\kappa\omega^{\theta\kappa\lambda} - \tfrac{1}{2}\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial_\kappa\omega^{\theta\kappa\lambda} -$$
$$\tfrac{1}{2}\,r_3\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_\theta\,\partial_\kappa\omega^{\kappa\lambda\theta} + r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} +$$
$$2\,r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial_\kappa\omega^{\kappa\lambda\theta} + \tfrac{1}{3}\,r_2\,\partial_\kappa\omega^{\alpha\beta\theta}\,\partial^\kappa\omega_{\alpha\beta\theta} + \tfrac{2}{3}\,r_2\,\partial_\kappa\omega^{\theta\alpha\beta}\,\partial^\kappa\omega_{\alpha\beta\theta} -$$
$$\tfrac{2}{3}\,r_2\,\partial^\beta\omega_{l}{}^{\alpha\lambda}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{l} + \tfrac{2}{3}\,r_2\,\partial^\beta\omega_{l}{}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{l} - 4\,r_3\,\partial^\beta\omega_{l}{}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{l} -$$
$$\tfrac{1}{2}\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\theta\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa + r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa + \tfrac{1}{2}\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa - r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_\alpha\,\partial^\lambda\omega^{\theta\kappa}{}_\kappa$$

	$\sigma^{\#1}_{1^+\alpha\beta}$	$\sigma^{\#2}_{1^+\alpha\beta}$	$\sigma^{\#1}_{1^-\alpha}$	$\sigma^{\#2}_{1^-\alpha}$
$\sigma^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\dfrac{1}{k^2(2r_3+r_5)}$	0	0	0
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	0	0	0	0
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	0	$\dfrac{2}{k^2(r_3+2r_5)}$	0
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	0

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

	$\omega^{\#2}_{1^-\alpha}$	$\omega^{\#1}_{1^-\alpha}$	$\omega^{\#2}_{1^+\alpha\beta}$	$\omega^{\#1}_{1^+\alpha\beta}$
$\omega^{\#1}_{1^+}\dagger^{\alpha\beta}$	0	0	0	$k^2(2r_3+r_5)$
$\omega^{\#2}_{1^+}\dagger^{\alpha\beta}$	0	0	0	0
$\omega^{\#1}_{1^-}\dagger^{\alpha}$	0	$\tfrac{1}{2}k^2(r_3+2r_5)$	0	0
$\omega^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	0

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma^{\#1}_{0^+} == 0$	1
$\sigma^{\#2\,\alpha}_{1^-} == 0$	3
$\sigma^{\#2\,\alpha\beta}_{1^+} == 0$	3
$\sigma^{\#1\,\alpha\beta\chi}_{2^-} == 0$	5
Total constraints: 12	

	$\omega^{\#1}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}\dagger$	0	0
$\omega^{\#1}_{0^-}\dagger$	0	$k^2 r_2$

	$\sigma^{\#1}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	0	$\dfrac{1}{k^2 r_2}$
$\sigma^{\#1}_{0^-}\dagger$	0	0

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

Massive and massless spectra

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

(No massive particles)

Unitarity conditions

$$r_3 < 0 \,\&\&\, \left(r_5 < -\tfrac{r_3}{2} \,\|\, r_5 > -2r_3\right) \,\|\, r_3 > 0 \,\&\&\, -2r_3 < r_5 < -\tfrac{r_3}{2}$$