Particle spectrograph

Wave operator and propagator

Quadratic (free) Lagrangian density

$$\frac{2}{3} t_2\, \omega_{\iota}{}^{\kappa\lambda}\, \omega_{\kappa\lambda}{}' + \frac{1}{3} t_2\, \omega^{\kappa\lambda}{}_{\iota}{}' + f^{\alpha\beta}\, \tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\, \sigma_{\alpha\beta\chi} + \frac{3}{2} r_3\, \partial_{\iota}\omega^{\kappa\lambda}{}_{\kappa}\, \partial^{\iota}\omega_{\lambda}{}^{\alpha}{}_{\alpha} +$$
$$\frac{2}{3} r_2\, \partial^{\beta}\omega^{\theta\alpha}{}_{\kappa}\, \partial_{\theta}\omega_{\alpha\beta}{}^{\kappa} - \frac{1}{3} r_2\, \partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\, \partial_{\kappa}\omega^{\alpha\beta\theta} - \frac{2}{3} r_2\, \partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\, \partial_{\kappa}\omega^{\theta\alpha\beta} +$$
$$\frac{5}{2} r_3\, \partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial_{\kappa}\omega^{\theta\kappa\lambda} - \frac{5}{2} r_3\, \partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial_{\kappa}\omega^{\kappa\lambda\theta} + 3\, r_3\, \partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial_{\kappa}\omega^{\kappa\lambda\theta} +$$
$$\frac{1}{3} t_2\, \omega_{\iota}{}^{\theta\kappa}\, \partial^{\kappa} f^{\iota\theta} - \frac{2}{3} t_2\, \omega_{\iota\theta\kappa}\, \partial^{\kappa} f^{\iota\theta} + \frac{1}{6} t_2\, \partial^{\alpha} f_{\kappa\theta}\, \partial^{\kappa} f_{\alpha}{}^{\theta} + \frac{1}{6} t_2\, \partial^{\alpha} f^{\lambda}{}_{\kappa}\, \partial^{\kappa} f_{\alpha\lambda} +$$
$$\frac{1}{3} t_2\, \omega_{\iota\theta\kappa}\, \partial^{\kappa} f^{\iota\theta} - \frac{1}{3} t_2\, \omega_{\theta\iota\kappa}\, \partial^{\kappa} f^{\iota\theta} + \frac{2}{3} t_2\, \omega_{\theta\kappa\iota}\, \partial^{\kappa} f^{\iota\theta} -$$
$$\frac{1}{6} t_2\, \partial_{\kappa} f_{\theta}{}^{\lambda}\, \partial^{\kappa} f_{\lambda}{}^{\theta} + \frac{1}{6} t_2\, \partial_{\kappa} f^{\lambda}{}_{\theta}\, \partial^{\kappa} f_{\lambda}{}^{\theta} + \frac{1}{3} r_2\, \partial_{\kappa}\omega^{\alpha\beta\theta}\, \partial^{\kappa}\omega_{\alpha\beta\theta} +$$
$$\frac{2}{3} r_2\, \partial^{\beta}\omega_{\iota}{}^{\alpha\lambda}\, \partial_{\lambda}\omega_{\alpha\beta}{}' + \frac{2}{3} r_2\, \partial^{\beta}\omega_{\iota}{}^{\lambda\alpha}\, \partial_{\lambda}\omega_{\alpha\beta}{}' - \frac{2}{3} r_2\, \partial^{\beta}\omega^{\theta\alpha\beta}\, \partial^{\kappa}\omega_{\alpha\beta\theta} -$$
$$4\, r_3\, \partial^{\beta}\omega_{\iota}{}^{\lambda\alpha}\, \partial_{\lambda}\omega_{\alpha\beta}{}' - \frac{5}{2} r_3\, \partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa} + \frac{5}{2} r_3\, \partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}$$

	$\omega_{1^+}^{\#1}{}^{\alpha\beta}$	$\omega_{1^+}^{\#2}{}^{\alpha\beta}$	$f_{1^+}^{\#1}{}^{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\alpha\beta}\,\dagger$	$\frac{2 t_2}{3}$	$\frac{\sqrt{2}\, t_2}{3}$	$-\frac{1}{3} i \sqrt{2}\, k t_2$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\alpha\beta}\,\dagger$	$\frac{\sqrt{2}\, t_2}{3}$	$\frac{t_2}{3}$	$\frac{i k t_2}{3}$	0	0	0	0
$f_{1^+}^{\#1}{}^{\alpha\beta}\,\dagger$	$-\frac{1}{3} i \sqrt{2}\, k t_2$	$-\frac{1}{3} i k t_2$	$\frac{k^2 t_2}{3}$	0	0	0	0
$\omega_{1^-}^{\#1}{}_{\alpha}\,\dagger$	0	0	0	$-\frac{3 k^2 r_3}{2}$	0	0	0
$\omega_{1^-}^{\#2}{}_{\alpha}\,\dagger$	0	0	0	0	0	0	0
$f_{1^-}^{\#1}{}_{\alpha}\,\dagger$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}_{\alpha}\,\dagger$	0	0	0	0	0	0	0

	$\sigma_{1^+}^{\#2}{}^{\alpha\beta}$	$\tau_{1^+}^{\#1}{}^{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\alpha\beta}\,\dagger$	$\frac{6}{(3+k^2)^2 t_2}$	$\frac{3 i \sqrt{2}\, k}{(3+k^2)^2 t_2}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}^{\alpha\beta}\,\dagger$	$\frac{3\sqrt{2}}{(3+k^2)^2 t_2}$	$\frac{3 i k}{(3+k^2)^2 t_2}$	0	0	0	0
$\tau_{1^+}^{\#1}{}^{\alpha\beta}\,\dagger$	$-\frac{3 i \sqrt{2}\, k}{(3+k^2)^2 t_2}$	$\frac{3 k^2}{(3+k^2)^2 t_2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}_{\alpha}\,\dagger$	0	0	$-\frac{2}{3 k^2 r_3}$	0	0	0
$\sigma_{1^-}^{\#2}{}_{\alpha}\,\dagger$	0	0	0	0	0	0
$\tau_{1^-}^{\#1}{}_{\alpha}\,\dagger$	0	0	0	0	0	0
$\tau_{1^-}^{\#2}{}_{\alpha}\,\dagger$	0	0	0	0	0	0

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

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}\,\dagger$	0	0	0	0
$f_{0^+}^{\#1}\,\dagger$	0	0	0	0
$f_{0^+}^{\#2}\,\dagger$	0	0	0	0
$\omega_{0^-}^{\#1}\,\dagger$	0	0	0	$k^2 r_2 + t_2$

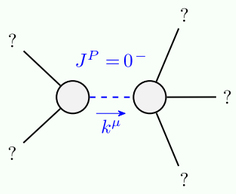
Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + i k\, \sigma_{1^+}^{\#1\,\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#1\,\alpha\beta} == \sigma_{1^+}^{\#2\,\alpha\beta}$	3
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	5
$\tau_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	28

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

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}\,\dagger$	0	0	0	0
$\tau_{0^+}^{\#1}\,\dagger$	0	0	0	0
$\tau_{0^+}^{\#2}\,\dagger$	0	0	0	0
$\sigma_{0^-}^{\#1}\,\dagger$	0	0	0	$\frac{1}{k^2 r_2 + t_2}$

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

(No massless particles)

Unitarity conditions

$r_2 < 0 \;\&\&\; t_2 > 0$