Particle spectrograph

Wave operator and propagator

	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\tau_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\frac{2}{k^2 (r_3+2 r_5)}$	$\frac{2\sqrt{2}}{k^2 (1+2k^2)(r_3+2r_5)}$	0	$\frac{4i}{k(1+2k^2)(r_3+2r_5)}$
$\sigma_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{2\sqrt{2}}{k^2 (1+2k^2)(r_3+2r_5)}$	$\frac{3k^2(r_3+2r_5)+4t_3}{(k+2k^3)^2 (r_3+2r_5)t_3}$	0	$\frac{i\sqrt{2}\,(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$
$\tau_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0
$\tau_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$-\frac{i\sqrt{2}\,(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$	0	0	$\frac{6k^2(r_3+2r_5)+8t_3}{(1+2k^2)^2(r_3+2r_5)t_3}$

Quadratic (free) action

$$S_F == \iiint (\tfrac{1}{6}(4 t_3\, \omega_{,}^{\alpha\prime}{}_{\kappa\alpha}\, \omega_{,}^{\kappa}{}_{\alpha\beta} + 6\, f^{\alpha\beta}{}_{\tau\alpha\beta} + 6\, \omega^{\alpha\beta\chi}{}_{\sigma\alpha\beta\chi} - 3 r_3\, \partial_\iota \omega^{\kappa\lambda}{}_{\kappa}\, \partial^{\prime} \omega_{\lambda}{}^{\alpha}{}_{\alpha} - 6 r_5\, \partial_\theta \omega^{\kappa}{}_{\alpha\beta}\, \partial_\kappa \omega^{\theta\alpha\beta} + 2 r_2\, \partial_\theta \omega^{\kappa}{}_{\alpha\beta}\, \partial_\kappa \omega^{\alpha\beta\theta} - 4 r_2\, \partial_\theta \omega^{\kappa}{}_{\alpha\beta}\, \partial^{\beta} \omega^{\theta\alpha}{}_{\kappa} - 2 r_2\, \partial_\theta \omega^{\kappa}{}_{\alpha\beta}\, \partial_\kappa \omega^{\theta\alpha\beta} + 3 r_3\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial_\kappa \omega^{\theta\kappa\lambda} + 6 r_5\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial_\kappa \omega^{\theta\kappa\lambda} - 3 r_3\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial_\kappa \omega^{\kappa\lambda\theta} - 6 r_5\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial_\kappa \omega^{\kappa\lambda\theta} + 3 r_3\, \partial_\theta \omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial_\kappa \omega^{\kappa\lambda\theta} + 6 r_5\, \partial_\theta \omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial_\kappa \omega^{\kappa\lambda\theta} - 12 r_5\, \partial_\theta \omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial_\kappa \omega^{\kappa\lambda\theta} - 4 t_3\, \omega_{\kappa\alpha}{}^{\alpha}\, \partial^{\kappa} f^{\prime}{}_{\iota}{}^{\iota} - 4 t_3\, \omega_{\iota\alpha}{}^{\alpha}\, \partial^{\kappa} f^{\prime}{}_{\kappa}{}^{\iota} + 4 t_3\, \omega_{\iota\lambda}{}^{\lambda}\, \partial^{\kappa} f^{\prime}{}_{\kappa}{}^{\iota} + 4 t_3\, \partial^{\alpha} f^{\kappa\lambda}{}_{\alpha}\, \partial^{\kappa} f_{\lambda\kappa} + 2 r_2\, \partial_\kappa \omega^{\alpha\beta\theta}\, \partial^{\kappa} \omega_{\alpha\beta\theta} + 4 r_2\, \partial_\kappa \omega^{\theta\alpha\beta}\, \partial^{\kappa} \omega_{\alpha\beta\theta} - 4 r_2\, \partial^{\beta} \omega_{\iota}^{\alpha\lambda}\, \partial_\lambda \omega_{\alpha\beta}{}^{\prime} + 4 r_2\, \partial^{\beta} \omega^{\lambda\alpha}\, \partial_\lambda \omega_{\alpha\beta}{}^{\prime} - 24 r_3\, \partial^{\beta} \omega_{\iota}^{\lambda\alpha}\, \partial_\lambda \omega_{\alpha\beta}{}^{\prime} - 3 r_3\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial^{\lambda} \omega^{\theta\kappa}{}_{\kappa} + 6 r_5\, \partial_\alpha \omega_{\lambda}{}^{\alpha}{}_{\theta}\, \partial^{\lambda} \omega^{\theta\kappa}{}_{\kappa} + 3 r_3\, \partial_\theta \omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial^{\lambda} \omega^{\theta\kappa}{}_{\kappa} - 6 r_5\, \partial_\theta \omega_{\lambda}{}^{\alpha}{}_{\alpha}\, \partial^{\lambda} \omega^{\theta\kappa}{}_{\kappa}))[t, x, y, z]\, dz\, dy\, dx\, dt$$

	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$k^2 (\frac{r_3}{2} + r_5) + \frac{2t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	$-\frac{2}{3} i k t_3$	0
$\omega_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	$\frac{1}{3} i \sqrt{2}\, k t_3$	0
$f_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	$-\frac{1}{3} i \sqrt{2}\, k t_3$	$\frac{2k^2 t_3}{3}$

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

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

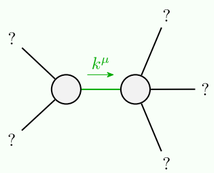
	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	t_3	$-i\sqrt{2}\, k t_3$	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	$i\sqrt{2}\, k t_3$	$2k^2 t_3$	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$k^2 r_2$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} - 2 i k \sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\alpha} + 2 i k\, \sigma_{1^-}^{\#2\alpha} == 0$	3
$\tau_{1^-}^{\#1\alpha} == 0$	3
$\tau_{1^+}^{\#1\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#2\alpha\beta} == 0$	3
$\sigma_{2^-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2^+}^{\#1\alpha\beta} == 0$	5
Total constraints:	24

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	$\frac{1}{(1+2k^2)^2 t_3}$	$-\frac{i\sqrt{2}\, k}{(1+2k^2)^2 t_3}$	0	0
$\tau_{0^+}^{\#1}{}^{\dagger}$	$\frac{i\sqrt{2}\, k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$\frac{1}{k^2 r_2}$

Massive and massless spectra



Quadratic pole

Pole residue:	$-\frac{1}{r_3 (2 r_3 + r_5)(r_3 + 2 r_5) p^2} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

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