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
$\sigma_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\frac{1}{k^2 (r_1+r_5)}$	$\frac{\sqrt{2}}{k^2 (1+2k^2)(r_1+r_5)}$	$-\frac{2i}{k(1+2k^2)(r_1+r_5)}$	0
$\sigma_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{\sqrt{2}}{k^2 (1+2k^2)(r_1+r_5)}$	$\frac{3k^2 (r_1+r_5)+2t_3}{(k+2k^3)^2 (r_1+r_5)t_3}$	$-\frac{i\sqrt{2}\,(3k^2 (r_1+r_5)+2t_3)}{k(1+2k^2)^2 (r_1+r_5)t_3}$	0
$\tau_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0
$\tau_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{2i}{k(1+2k^2)(r_1+r_5)}$	$\frac{i\sqrt{2}\,(3k^2 (r_1+r_5)+2t_3)}{k(1+2k^2)^2 (r_1+r_5)t_3}$	0	$\frac{6k^2 (r_1+r_5)+4t_3}{(1+2k^2)^2 (r_1+r_5)t_3}$

Quadratic (free) action

$$S_F == \iiint\Big(\frac{1}{3}(2t_3\,\omega_{\iota}^{\alpha\iota}\,\omega_{\kappa\alpha}^{\ \ \kappa} + 3\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 3\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 3r_5\,\partial_\iota\omega^{\kappa\lambda}\,\partial'\omega_{\lambda\ \alpha}^{\ \alpha} - 2r_1\,\partial^\beta\omega^{\theta\alpha}\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa} - 2r_1\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_\kappa\omega^{\alpha\beta\theta} - 3r_5\,\partial_\alpha\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_\kappa\omega^{\kappa\lambda\theta} + 6r_5\,\partial_\theta\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_\kappa\omega^{\kappa\lambda\theta} - 2t_3\,\omega_{\kappa\alpha}^{\ \ \alpha}\,\partial^\kappa f'_{\iota} - 4t_3\,\partial^\alpha f_{\kappa\alpha}\,\partial^\kappa f'_{\iota} + 2t_3\,\partial_\kappa f^{\kappa\lambda}\,\partial^\kappa f'_{\lambda} + 2t_3\,\omega_{\iota\alpha}^{\ \ \alpha}\,\partial^\kappa f'_{\kappa} + 2t_3\,\partial^\alpha f^{\kappa\lambda}\,\partial^\kappa f'_{\lambda\kappa} + 2r_1\,\partial_\kappa\omega^{\alpha\beta\theta}\,\partial^\kappa\omega_{\alpha\beta\theta} - 2r_1\,\partial^\kappa\omega_{\alpha\beta\theta}\,\partial^\beta\omega_{\iota}^{\alpha\lambda}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \prime} - 8r_1\,\partial^\beta\omega_{\iota}^{\lambda\alpha}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \prime} + 3r_5\,\partial_\alpha\omega_{\lambda\ \theta}^{\ \alpha}\,\partial^\lambda\omega^{\theta\kappa} - 3r_5\,\partial_\theta\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial^\lambda\omega^{\theta\kappa}\Big)[t,x,y,z]\,dz\,dy\,dx\,dt$$

	$\omega_{1^+}^{\#1}{}_{\alpha}$	$\omega_{1^+}^{\#2}{}_{\alpha}$	$f_{1^+}^{\#1}{}_{\alpha}$	$f_{1^+}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$k^2 (r_1+r_5)+\frac{2t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	0	$-\frac{2}{3}ikt_3$
$\omega_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}\,kt_3$
$f_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{2ikt_3}{3}$	$-\frac{1}{3}i\sqrt{2}\,kt_3$	0	$\frac{2k^2 t_3}{3}$

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$
$\omega_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$k^2 (2r_1+r_5)$	0	0
$\omega_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$f_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0
$\omega_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0
$f_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0
$f_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0

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

	$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\tau_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\sigma_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0	0	$\frac{1}{k^2 r_1}$

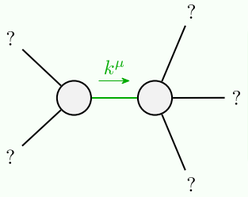
	$\omega_{0^+}^{\#1}{}_{}$	$f_{0^+}^{\#1}{}_{}$	$f_{0^+}^{\#2}{}_{}$	$\omega_{0^-}^{\#1}{}_{}$
$\omega_{0^+}^{\#1}{}^{\dagger}{}^{}$	t_3	$-i\sqrt{2}\,kt_3$	0	0
$f_{0^+}^{\#1}{}^{\dagger}{}^{}$	$i\sqrt{2}\,kt_3$	$2k^2 t_3$	0	0
$f_{0^+}^{\#2}{}^{\dagger}{}^{}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}{}^{}$	0	0	0	0

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$f_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\omega_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0	0	$k^2 r_1$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma_{0^-}^{\#1} == 0$	1
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} - 2i\,k\,\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\alpha} + 2i\,k\,\sigma_{1^-}^{\#2\alpha} == 0$	3
$\tau_{1^-}^{\#1\alpha} == 0$	3
$\tau_{1^+}^{\#1\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#2\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\alpha\beta} == 0$	5
$\sigma_{2^+}^{\#1\alpha\beta} == 0$	5
Total constraints:	25

Massive and massless spectra



Quadratic pole

Pole residue:	$-\frac{1}{r_1 (r_1+r_5)(2r_1+r_5)p^2} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$r_1 < 0 \,\&\&\, (r_5 < -r_1 \,||\, r_5 > -2r_1) \,||\, r_1 > 0 \,\&\&\, -2r_1 < r_5 < -r_1$