Particle spectrograph

Wave operator and propagator

	$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{2}{3k^2r_3}$	$-\frac{2\sqrt{2}}{3k^2r_3+3k^4r_3}$	$-\frac{2i\sqrt{2}}{3kr_3+3k^3r_3}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{2\sqrt{2}}{3k^2r_3+3k^4r_3}$	$\frac{9k^2r_3+4t_2}{3(k+k^3)^2r_3t_2}$	$\frac{i(9k^2r_3+4t_2)}{3k(1+k^2)^2r_3t_2}$	0	0	0	0
$\tau_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{2i\sqrt{2}}{3kr_3+3k^3r_3}$	$-\frac{i(9k^2r_3+4t_2)}{3k(1+k^2)^2r_3t_2}$	$\frac{9k^2r_3+4t_2}{3(1+k^2)^2r_3t_2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$\frac{6}{(3+2k^2)^2t_3}$	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	0	$-\frac{6ik}{(3+2k^2)^2t_3}$
$\sigma_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	$\frac{3}{(3+2k^2)^2t_3}$	0	$\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$
$\tau_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{6ik}{(3+2k^2)^2t_3}$	$-\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$	0	$\frac{6k^2}{(3+2k^2)^2t_3}$

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{1}{6}(9k^2r_3+4t_2)$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{1}{3}ikt_2$	$\frac{k^2t_2}{3}$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$\frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	0	$-\frac{2}{3}ikt_3$
$\omega_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$-\frac{\sqrt{2}t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_3$
$f_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{2ikt_3}{3}$	$-\frac{1}{3}i\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$

Quadratic (free) action

$$
\begin{aligned}
&\mathcal{S} == \\
&\iiiint\Big(\tfrac{1}{6}\big(-4t_3\,\omega^{\alpha\iota}{}_{\alpha}\,\omega_{\iota}{}^{\kappa}{}_{\kappa}+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+8t_3\,\omega_{\alpha}{}^{\kappa}{}_{\kappa}\,\partial_\iota f^{\alpha\iota}-8t_3\,\omega_{\iota}{}^{\kappa}{}_{\kappa}\\
&\partial^\iota f^{\alpha}{}_{\alpha}+4t_3\,\partial_\iota f^{\kappa}{}_{\kappa}\partial^\iota f^{\alpha}{}_{\alpha}-6r_3\,\partial_\beta\omega_{\iota}{}^{\theta}{}_{\theta}\partial^\iota\omega^{\alpha\beta}{}_{\alpha}-6r_3\,\partial_\alpha\omega^{\alpha\beta\iota}\partial_\theta\omega_{\iota}{}^{\theta}{}_{\beta}+\\
&12r_3\,\partial^\iota\omega^{\alpha\beta}{}_{\alpha}\partial_\theta\omega_{\iota}{}^{\theta}{}_{\beta}+4t_2\,\omega_{\iota\theta\alpha}\,\partial^\theta f^{\alpha\iota}+2t_2\,\partial_\alpha f_{\iota\theta}\partial^\theta f^{\alpha\iota}-t_2\,\partial_\alpha f_{\theta\iota}\partial^\theta f^{\alpha\iota}-\\
&t_2\,\partial_\iota f_{\alpha\theta}\partial^\theta f^{\alpha\iota}+t_2\,\partial_\theta f_{\alpha\iota}\partial^\theta f^{\alpha\iota}-t_2\,\partial_\theta f_{\iota\alpha}\partial^\theta f^{\alpha\iota}-4t_2\,\omega_{\alpha\theta\iota}\,(\omega^{\alpha\iota\theta}+\partial^\theta f^{\alpha\iota})+\\
&2t_2\,\omega_{\alpha\iota\theta}\,(\omega^{\alpha\iota\theta}+2\,\partial^\theta f^{\alpha\iota})+8r_2\,\partial_\beta\omega_{\alpha\iota\theta}\partial^\theta\omega^{\alpha\beta\iota}-4r_2\,\partial_\beta\omega_{\alpha\theta\iota}\partial^\theta\omega^{\alpha\beta\iota}+4r_2\\
&\partial_\beta\omega_{\iota\theta\alpha}\partial^\theta\omega^{\alpha\beta\iota}-24r_3\,\partial_\beta\omega_{\iota\theta\alpha}\partial^\theta\omega^{\alpha\beta\iota}-2r_2\,\partial_\iota\omega_{\alpha\beta\theta}\partial^\theta\omega^{\alpha\beta\iota}+2r_2\,\partial_\theta\omega_{\alpha\beta\iota}\partial^\theta\omega^{\alpha\beta\iota}-\\
&4r_2\,\partial_\theta\omega_{\alpha\iota\beta}\partial^\theta\omega^{\alpha\beta\iota}+4t_3\,\partial_\iota f^{\alpha\iota}\,\partial_\kappa f_{\alpha}{}^{\kappa}-8t_3\,\partial^\iota f^{\alpha}{}_{\alpha}\partial_\kappa f_{\iota}{}^{\kappa}\big)\big)[t,x,y,z]\,dz\,dy\,dx\,dt
\end{aligned}
$$

Source constraints/gauge generators

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

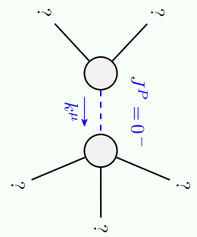
	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$-\frac{3k^2r_3}{2}$	0	0
$f_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	0	0	0
$\omega_{2^-}^{\#1}{}^{\dagger\alpha\beta\chi}$	0	0	0

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

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	$\frac{1}{(1+2k^2)^2t_3}$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2t_3}$	0	0
$\tau_{0^+}^{\#1}{}^{\dagger}$	$\frac{i\sqrt{2}k}{(1+2k^2)^2t_3}$	$\frac{2k^2}{(1+2k^2)^2t_3}$	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$\frac{1}{k^2r_2+t_2}$

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	t_3	$-i\sqrt{2}\,kt_3$	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	$i\sqrt{2}\,kt_3$	$2k^2t_3$	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$k^2r_2+t_2$

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

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