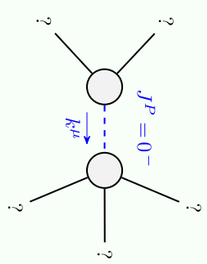
Particle spectrograph

Wave operator and propagator

	$\sigma^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#2}_{1^+\,\alpha\beta}$	$\tau^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#1}_{1^-\,\alpha}$	$\sigma^{\#2}_{1^-\,\alpha}$	$\tau^{\#1}_{1^-\,\alpha}$	$\tau^{\#2}_{1^-\,\alpha}$
$\sigma^{\#1}_{1^+}{}^{\dagger\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	0	0	0	0
$\sigma^{\#2}_{1^+}{}^{\dagger\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{-2k^2(2r_3+r_5)+t_1}{(1+k^2)^2 {t_1}^2}$	$\frac{-2ik^3(2r_3+r_5)+ikt_1}{(1+k^2)^2 {t_1}^2}$	0	0	0	0
$\tau^{\#1}_{1^+}{}^{\dagger\alpha\beta}$	$\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	$\frac{i(2k^3(2r_3+r_5)-kt_1)}{(1+k^2)^2 {t_1}^2}$	$\frac{-2k^4(2r_3+r_5)+k^2 t_1}{(1+k^2)^2 {t_1}^2}$	0	0	0	0
$\sigma^{\#1}_{1^-}{}^{\dagger\alpha}$	0	0	0	$\frac{1}{k^2(2r_3+r_5)}$	$-\frac{1}{\sqrt{2}\,(k^2+2k^4)(2r_3+r_5)}$	0	$-\frac{i}{k(1+2k^2)(2r_3+r_5)}$
$\sigma^{\#2}_{1^-}{}^{\dagger\alpha}$	0	0	0	$-\frac{1}{\sqrt{2}\,(k^2+2k^4)(2r_3+r_5)}$	$\frac{6k^2(2r_3+r_5)+t_1}{2(k+2k^3)^2(2r_3+r_5)t_1}$	0	$\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}\,k(1+2k^2)^2(2r_3+r_5)t_1}$
$\tau^{\#1}_{1^-}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$\tau^{\#2}_{1^-}{}^{\dagger\alpha}$	0	0	0	$\frac{i}{k(1+2k^2)(2r_3+r_5)}$	$-\frac{i(6k^2(2r_3+r_5)+t_1)}{\sqrt{2}\,k(1+2k^2)^2(2r_3+r_5)t_1}$	0	$\frac{6k^2(2r_3+r_5)+t_1}{(1+2k^2)^2(2r_3+r_5)t_1}$

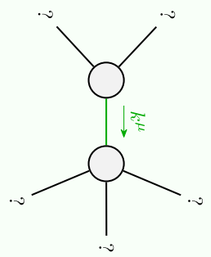
Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$\frac{t_1}{r_2} > 0$
Spin:	0
Parity:	Odd

Unitarity conditions

$r_2 < 0 \;\&\&\; r_5 < -2\,r_3 \;\&\&\; t_1 < 0$



Quadratic pole	
Pole residue:	$-\frac{1}{(2r_3+r_5)t_1^2} > 0$
Polarisations:	2

Quadratic (free) Lagrangian density

$$-\tfrac{1}{3}t_1\,\omega_I{}^{\alpha I}\,\omega_{\kappa\alpha}{}^{\kappa} - t_1\,\omega_I{}^{\kappa\lambda}\,\omega_{\kappa\lambda}{}^{I} + f^{\alpha\beta}\,\tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 2\,r_3\,\partial_I\omega^{\kappa\lambda}{}_{\kappa}\partial^I\omega_{\lambda}{}^{\alpha}{}_{\alpha} -$$
$$r_5\,\partial_I\omega^{\kappa\lambda}{}_{\kappa}\partial^I\omega_{\lambda}{}^{\alpha}{}_{\alpha} + \tfrac{2}{3}r_2\,\partial^\beta\omega^{\theta\alpha}{}_{\kappa}\partial_\theta\omega_{\alpha\beta}{}^{\kappa} - \tfrac{1}{3}r_2\,\partial_\theta\omega_{\alpha\beta}{}^{\kappa}\partial_\kappa\omega^{\alpha\beta\theta} -$$
$$\tfrac{2}{3}r_2\,\partial_\theta\omega_{\alpha\beta}{}^{\kappa}\partial_\kappa\omega^{\theta\alpha\beta} + 2\,r_3\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial_\kappa\omega^{\theta\kappa\lambda} - r_5\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial_\kappa\omega^{\theta\kappa\lambda} -$$
$$2\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial_\kappa\omega^{\theta\kappa\lambda} + r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial_\kappa\omega^{\theta\kappa\lambda} - 2\,r_3\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial_\kappa\omega^{\kappa\lambda\theta} -$$
$$r_5\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial_\kappa\omega^{\kappa\lambda\theta} + 4\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial_\kappa\omega^{\kappa\lambda\theta} + 2\,r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial_\kappa\omega^{\kappa\lambda\theta} -$$
$$\tfrac{1}{2}t_1\,\partial^\alpha f_{\theta\kappa}\partial^\kappa f_{\alpha}{}^{\theta} - \tfrac{1}{2}t_1\,\partial^\alpha f_{\kappa\theta}\partial^\kappa f_{\alpha}{}^{\theta} - \tfrac{1}{2}t_1\,\partial^\alpha f^{\lambda}{}_{\kappa}\partial^\kappa f_{\alpha\lambda} + \tfrac{1}{3}t_1\,\omega_{\kappa\alpha}{}^{\alpha}\,\partial^\kappa f'_I +$$
$$\tfrac{1}{3}t_1\,\omega_{\kappa\lambda}{}^{\lambda}\,\partial^\kappa f'_I + \tfrac{2}{3}t_1\,\partial^\alpha f_{\kappa\alpha}\partial^\kappa f'_I - \tfrac{1}{3}t_1\,\partial_\kappa f^{\lambda}{}_{\lambda}\partial^\kappa f'_I + 2\,t_1\,\omega_{I\kappa\theta}\,\partial^\kappa f'^{I\theta} -$$
$$\tfrac{1}{3}t_1\,\omega_{I\alpha}{}^{\alpha}\,\partial^\kappa f'_\kappa - \tfrac{1}{3}t_1\,\omega_{I\lambda}{}^{\lambda}\,\partial^\kappa f'_\kappa + \tfrac{1}{2}t_1\,\partial^\alpha f^{\lambda}{}_{\kappa}\partial^\kappa f_{\lambda\alpha} + \tfrac{1}{2}t_1\,\partial_\kappa f_{\theta}{}^{\lambda}\partial^\kappa f_{\lambda}{}^{\theta} +$$
$$\tfrac{1}{2}t_1\,\partial_\kappa f^{\lambda}{}_{\theta}\partial^\kappa f_{\lambda}{}^{\theta} - \tfrac{1}{3}t_1\,\partial^\alpha f^{\lambda}{}_{\alpha}\partial^\kappa f_{\lambda\kappa} + \tfrac{1}{3}r_2\,\partial_\kappa\omega^{\alpha\beta\theta}\partial^\kappa\omega_{\alpha\beta\theta} + \tfrac{2}{3}r_2\,\partial_\kappa\omega^{\theta\alpha\beta}\partial^\kappa\omega_{\alpha\beta\theta} -$$
$$\tfrac{2}{3}r_2\,\partial^\beta\omega_I{}^{\alpha\lambda}\partial_\lambda\omega_{\alpha\beta}{}' + \tfrac{2}{3}r_2\,\partial^\beta\omega_I{}^{\lambda\alpha}\partial_\lambda\omega_{\alpha\beta}{}' - 4\,r_3\,\partial^\beta\omega_I{}^{\lambda\alpha}\partial_\lambda\omega_{\alpha\beta}{}' -$$
$$2\,r_3\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial^\lambda\omega^{\theta\kappa}{}_{\kappa} + r_5\,\partial_\alpha\omega_{\lambda}{}^{\alpha}{}_{\theta}\partial^\lambda\omega^{\theta\kappa}{}_{\kappa} + 2\,r_3\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial^\lambda\omega^{\theta\kappa}{}_{\kappa} - r_5\,\partial_\theta\omega_{\lambda}{}^{\alpha}{}_{\alpha}\partial^\lambda\omega^{\theta\kappa}{}_{\kappa}$$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau^{\#2}_{0^+} == 0$	1
$\tau^{\#1}_{0^+} == 0$	1
$\tau^{\#2\,\alpha}_{1^-} + 2\,i\,k\,\sigma^{\#2\,\alpha}_{1^-} == 0$	3
$\tau^{\#1\,\alpha}_{1^-} == 0$	3
$\tau^{\#1\,\alpha\beta}_{1^+} + i\,k\,\sigma^{\#2\,\alpha\beta}_{1^+} == 0$	3
$\tau^{\#1\,\alpha\beta}_{2^+} - 2\,i\,k\,\sigma^{\#1\,\alpha\beta}_{2^+} == 0$	5
Total constraints:	16

	$\sigma^{\#1}_{2^+\,\alpha\beta}$	$\tau^{\#1}_{2^+\,\alpha\beta}$	$\sigma^{\#1}_{2^-\,\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}{}^{\dagger\alpha\beta}$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	0
$\tau^{\#1}_{2^+}{}^{\dagger\alpha\beta}$	$\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2 t_1}$	0
$\sigma^{\#1}_{2^-}{}^{\dagger\alpha\beta\chi}$	0	0	$\frac{2}{t_1}$

	$\omega^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#2}_{1^+\,\alpha\beta}$	$f^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#1}_{1^-\,\alpha}$	$\omega^{\#2}_{1^-\,\alpha}$	$f^{\#1}_{1^-\,\alpha}$	$f^{\#2}_{1^-\,\alpha}$
$\omega^{\#1}_{1^+}{}^{\dagger\alpha\beta}$	$k^2(2r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$\omega^{\#2}_{1^+}{}^{\dagger\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f^{\#1}_{1^+}{}^{\dagger\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega^{\#1}_{1^-}{}^{\dagger\alpha}$	0	0	0	$k^2(2r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ikt_1}{3}$
$\omega^{\#2}_{1^-}{}^{\dagger\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}\,kt_1$
$f^{\#1}_{1^-}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}{}^{\dagger\alpha}$	0	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt{2}\,kt_1$	0	$\frac{2k^2t_1}{3}$

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}{}^{\dagger}$	$\frac{1}{6k^2 r_3}$	0	0	0
$\tau^{\#1}_{0^+}{}^{\dagger}$	0	0	0	0
$\tau^{\#2}_{0^+}{}^{\dagger}$	0	0	0	0
$\sigma^{\#1}_{0^-}{}^{\dagger}$	0	0	0	$\frac{1}{k^2 r_2 - t_1}$

	$\omega^{\#1}_{2^+\,\alpha\beta}$	$f^{\#1}_{2^+\,\alpha\beta}$	$\omega^{\#1}_{2^-\,\alpha\beta\chi}$
$\omega^{\#1}_{2^+}{}^{\dagger\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f^{\#1}_{2^+}{}^{\dagger\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega^{\#1}_{2^-}{}^{\dagger\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

	$\omega^{\#1}_{0^+}{}^{\dagger}$	$f^{\#1}_{0^+}{}^{\dagger}$	$f^{\#2}_{0^+}{}^{\dagger}$	$\omega^{\#1}_{0^-}{}^{\dagger}$
$\omega^{\#1}_{0^+}$	$6k^2 r_3$	0	0	0
$f^{\#1}_{0^+}$	0	0	0	0
$f^{\#2}_{0^+}$	0	0	0	0
$\omega^{\#1}_{0^-}$	0	0	0	$k^2 r_2 - t_1$