Particle spectrograph

Wave operator and propagator

	$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\alpha\beta}$	$\frac{1}{k^2\,(2\,r_3+r_5)}$	$-\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3+r_5)}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}^{\alpha\beta}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3+r_5)}$	$\frac{i\,(3\,k^2\,(2\,r_3+r_5)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	0	0	0
$\tau_{1^+}^{\#1}{}^{\alpha\beta}$	$\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3+r_5)}$	$\frac{3\,k^2\,(2\,r_3+r_5)+2\,t_2}{(1+k^2)^2\,(2\,r_3+r_5)\,t_2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\alpha}$	0	0	$\frac{2}{k^2\,(r_3+2\,r_5)}$	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)\,(r_3+2\,r_5)}$	$-\frac{4\,i}{k\,(1+2\,k^2)\,(r_3+2\,r_5)}$	$\frac{4\,i}{k\,(1+2\,k^2)\,(r_3+2\,r_5)}$
$\sigma_{1^-}^{\#2}{}^{\alpha}$	0	0	$\frac{2\,\sqrt{2}}{k^2\,(1+2\,k^2)\,(r_3+2\,r_5)}$	$\frac{3\,k^2\,(r_3+2\,r_5)+4\,t_3}{(k+2\,k^3)^2\,(r_3+2\,r_5)\,t_3}$	$-\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$	$\frac{i\,\sqrt{2}\,(3\,k^2\,(r_3+2\,r_5)+4\,t_3)}{k\,(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$
$\tau_{1^-}^{\#1}{}^{\alpha}$	0	0	0	0	0	0
$\tau_{1^-}^{\#2}{}^{\alpha}$	0	0	0	0	0	$\frac{6\,k^2\,(r_3+2\,r_5)+8\,t_3}{(1+2\,k^2)^2\,(r_3+2\,r_5)\,t_3}$

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\alpha\beta}$	$k^2\,(2\,r_3+r_5)+\frac{2\,t_3}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i\,k\,t_2}{3}$	0	0	0	0
$f_{1^+}^{\#1}{}^{\alpha\beta}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{1}{3}\,i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\alpha}$	0	0	0	$k^2\,(\frac{r_3}{2}+r_5)+\frac{2\,t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_3$	$\frac{2\,i\,k\,t_3}{3}$
$\omega_{1^-}^{\#2}{}^{\alpha}$	0	0	0	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	0
$f_{1^-}^{\#1}{}^{\alpha}$	0	0	0	0	0	0	$-\frac{2\,k^2\,t_3}{3}$
$f_{1^-}^{\#2}{}^{\alpha}$	0	0	0	$-\frac{2}{3}\,i\,k\,t_3$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_3$	$\frac{2\,k^2\,t_3}{3}$	$-\frac{2\,k^2\,t_3}{3}$

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

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

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

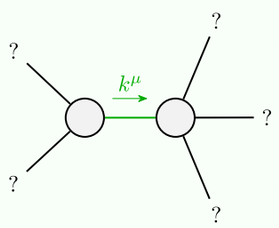
	$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}\dagger^{\alpha\beta}$	$-\frac{2}{3\,k^2\,r_3}$	0	0
$\tau_{2^+}^{\#1}{}\dagger^{\alpha\beta}$	0	0	0
$\sigma_{2^-}^{\#1}{}\dagger^{\alpha\beta\chi}$	0	0	0

Source constraints/gauge generators	Multiplicities
SO(3) irreps	
$\tau_{0^+}^{\#2} == 0$	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
$\tau_{1^+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\sigma_{2^-}^{\#1\,\alpha\beta\chi} == 0$	5
$\tau_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	21

Quadratic (free) Lagrangian density

$$\frac{2}{3}\,t_3\;\omega_{\prime}{}^{\alpha\prime}\;\omega_{\kappa\alpha}{}^{\kappa}+\frac{2}{3}\,t_2\;\omega_{\prime}{}^{\kappa\lambda}\;\omega_{\kappa\lambda}{}^{\prime}+\frac{1}{3}\,t_2\;\omega_{\kappa\lambda}{}^{\prime}\;\omega^{\kappa\lambda}{}_{\prime}+f^{\alpha\beta}\;\tau_{\alpha\beta}+$$
$$\omega^{\alpha\beta\chi}\;\sigma_{\alpha\beta\chi}-\frac{1}{2}\,r_3\,\partial_{\prime}\omega^{\kappa\lambda}{}_{\kappa}\,\partial^{\prime}\omega_{\lambda}{}^{\alpha}{}_{\alpha}-r_5\,\partial_{\prime}\omega^{\kappa\lambda}{}_{\kappa}\,\partial^{\prime}\omega_{\lambda}{}^{\alpha}{}_{\alpha}+\frac{1}{2}\,r_3\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}-$$
$$r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}-\frac{1}{2}\,r_3\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}+r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}-\frac{1}{2}\,r_3\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}-$$
$$r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+r_3\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+2\,r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+$$
$$\frac{1}{6}\,t_2\,\partial^{\alpha}f_{\theta\kappa}\,\partial^{\kappa}f_{\alpha}{}^{\theta}-\frac{1}{6}\,t_2\,\partial^{\alpha}f_{\kappa\theta}\,\partial^{\kappa}f_{\alpha}{}^{\theta}+\frac{1}{6}\,t_2\,\partial^{\alpha}f^{\lambda}{}_{\kappa}\,\partial^{\kappa}f_{\alpha\lambda}-\frac{2}{3}\,t_3\;\omega_{\kappa\alpha}{}^{\alpha}\,\partial^{\kappa}f^{\prime}{}_{\prime}-$$
$$\frac{2}{3}\,t_3\;\omega_{\kappa\lambda}{}^{\lambda}\,\partial^{\kappa}f^{\prime}{}_{\prime}-\frac{4}{3}\,t_3\,\partial^{\alpha}f_{\kappa\alpha}\,\partial^{\kappa}f^{\prime}{}_{\prime}+\frac{2}{3}\,t_3\,\partial_{\kappa}f^{\lambda}{}_{\lambda}\,\partial^{\kappa}f^{\prime}{}_{\prime}+\frac{1}{3}\,t_2\;\omega_{\prime\theta\kappa}\,\partial^{\kappa}f^{\prime\theta}-$$
$$\frac{2}{3}\,t_2\;\omega_{\prime\kappa\theta}\,\partial^{\kappa}f^{\prime\theta}-\frac{1}{3}\,t_2\;\omega_{\theta\prime\kappa}\,\partial^{\kappa}f^{\prime\theta}+\frac{2}{3}\,t_2\;\omega_{\theta\kappa\prime}\,\partial^{\kappa}f^{\prime\theta}+\frac{2}{3}\,t_3\;\omega_{\prime\alpha}{}^{\alpha}\,\partial^{\kappa}f^{\prime}{}_{\kappa}+$$
$$\frac{2}{3}\,t_3\;\omega_{\prime\lambda}{}^{\lambda}\,\partial^{\kappa}f^{\prime}{}_{\kappa}-\frac{1}{6}\,t_2\,\partial^{\alpha}f^{\lambda}{}_{\kappa}\,\partial^{\kappa}f_{\lambda\alpha}-\frac{1}{6}\,t_2\,\partial_{\kappa}f_{\theta}{}^{\lambda}\,\partial^{\kappa}f_{\lambda}{}^{\theta}+\frac{1}{6}\,t_2\,\partial_{\kappa}f^{\lambda}{}_{\theta}\,\partial^{\kappa}f_{\lambda}{}^{\theta}+$$
$$\frac{2}{3}\,t_3\,\partial^{\alpha}f^{\lambda}{}_{\alpha}\,\partial^{\kappa}f_{\lambda\kappa}-4\,r_3\,\partial^{\beta}\omega_{\prime}{}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime}-\frac{1}{2}\,r_3\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}+$$
$$r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}+\frac{1}{2}\,r_3\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}-r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}$$

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

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