Particle spectrograph

Wave operator and propagator

	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^+}^{\#1}$	$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$-\frac{i\sqrt{2}\,k}{t_1+\mu^2 t_1}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	0	0	0	0
$\sigma_{1^+}^{\#2\,\dagger}{}^{\alpha\beta}$	$-\frac{i(2k^3 r_5-k t_1)}{(1+k^2)^2 t_1^2}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$-\frac{-2k^2 r_5+t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\tau_{1^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$-\frac{-2k^4 r_5+k^2 t_1}{(1+k^2)^2 t_1^2}$	$\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	$\frac{i(2k^3 r_5-k t_1)}{(1+k^2)^2 t_1^2}$	0	0	0	$\frac{2ik}{t_1+2k^2 t_1}$
$\sigma_{1^-}^{\#1\,\dagger}{}^{\alpha}$	0	0	0	0	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	$\frac{-2k^2 r_5+t_1}{(t_1+2k^2 t_1)^2}$
$\sigma_{1^-}^{\#2\,\dagger}{}^{\alpha}$	0	0	0	0	0	0	$-\frac{i\sqrt{2}\,k(2k^2 r_5-t_1)}{(t_1+2k^2 t_1)^2}$
$\tau_{1^-}^{\#1\,\dagger}{}^{\alpha}$	0	0	0	$-\frac{2ik}{t_1+2k^2 t_1}$	$\frac{i\sqrt{2}\,k(2k^2 r_5-t_1)}{(t_1+2k^2 t_1)^2}$	0	$\frac{-4k^4 r_5+2k^2 t_1}{(t_1+2k^2 t_1)^2}$
$\tau_{1^-}^{\#2\,\dagger}{}^{\alpha}$	0	0	0	0	0	0	0

Quadratic (free) Lagrangian density

$$
\begin{aligned}
&-t_1\,\omega_{\prime}^{\alpha\prime}\,\omega_{\kappa\alpha}^{\ \ \kappa}-t_1\,\omega_{\prime}^{\ \kappa\lambda}\,\omega_{\kappa\lambda}{}'+f^{\alpha\beta}\,\tau_{\alpha\beta}+\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-r_5\,\partial_{\prime}\omega^{\kappa\lambda}{}_{\kappa}\,\partial'\omega_{\lambda\ \alpha}^{\ \alpha}+\\
&\frac{2}{3}\,r_2\,\partial^{\beta}\omega^{\theta\alpha}{}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}^{\ \ \kappa}-\frac{1}{3}\,r_2\,\partial_{\theta}\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta}-\\
&r_5\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}+r_5\,\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}{2}\,t_1\,\partial^{\alpha}f_{\theta\kappa}\,\partial^{\kappa}f_{\alpha}^{\ \theta}-\frac{1}{2}\,t_1\,\partial^{\alpha}f_{\kappa\theta}\,\partial^{\kappa}f_{\alpha}^{\ \theta}+t_1\,\omega_{\kappa\alpha}^{\ \ \alpha}\,\partial^{\kappa}f_{\prime}^{\ \prime}+\\
&t_1\,\omega_{\kappa\lambda}^{\ \ \lambda}\,\partial^{\kappa}f_{\prime}^{\ \prime}+2\,t_1\,\partial^{\alpha}f_{\kappa\alpha}\,\partial^{\kappa}f_{\prime}^{\ \prime}-t_1\,\partial_{\kappa}f^{\lambda}{}_{\lambda}\,\partial^{\kappa}f_{\prime}^{\ \prime}+2\,t_1\,\omega_{\prime\kappa\theta}\,\partial^{\kappa}f^{\prime\theta}-\\
&t_1\,\omega_{\prime\alpha}^{\ \ \alpha}\,\partial^{\kappa}f_{\kappa}^{\ \prime}-t_1\,\omega_{\prime\lambda}^{\ \ \lambda}\,\partial^{\kappa}f_{\kappa}^{\ \prime}+\frac{1}{2}\,t_1\,\partial_{\kappa}f^{\lambda}{}_{\theta}\,\partial^{\kappa}f_{\lambda}^{\ \theta}+\\
&\frac{1}{2}\,t_1\,\partial_{\kappa}f^{\lambda}{}_{\theta}\,\partial^{\kappa}f_{\lambda}^{\ \theta}-t_1\,\partial^{\alpha}f_{\lambda}^{\ \kappa}\,\partial^{\kappa}f_{\alpha}^{\ \lambda}+\frac{1}{2}\,t_1\,\partial_{\kappa}f^{\lambda}{}_{\alpha}\,\partial^{\kappa}f_{\lambda}^{\ \theta}+\\
&\frac{1}{3}\,r_2\,\partial_{\kappa}\omega^{\alpha\beta\theta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}+\frac{2}{3}\,r_2\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}-\\
&\frac{2}{3}\,r_2\,\partial^{\beta}\omega_{\prime}^{\ \alpha\lambda}\,\partial_{\lambda}\omega_{\alpha\beta}{}'+\frac{2}{3}\,r_2\,\partial^{\beta}\omega_{\prime}^{\ \lambda\alpha}\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \ \alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}-r_5\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \ \alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}
\end{aligned}
$$

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$k^2 r_5-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i k t_1}{\sqrt{2}}$	$k^2 r_5-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$i k t_1$
$\omega_{1^+}^{\#2\,\dagger}{}^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-}^{\#1\,\dagger}{}^{\alpha}$	0	0	0	0	0	0	$-i k t_1$
$\omega_{1^-}^{\#2\,\dagger}{}^{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#1\,\dagger}{}^{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2\,\dagger}{}^{\alpha}$	0	0	0	$i k t_1$	0	0	0

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1\,\dagger}$	$-\frac{1}{(1+2k^2)^2 t_1}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	0	0
$\tau_{0^+}^{\#1\,\dagger}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	$-\frac{2k^2}{(1+2k^2)^2 t_1}$	0	0
$\tau_{0^+}^{\#2\,\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1\,\dagger}$	0	0	0	$\frac{1}{k^2 r_2 t_1}$

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

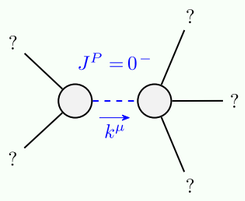
	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1\,\dagger}{}^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_{2^-}^{\#1\,\dagger}{}^{\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1\,\dagger}$	$-t_1$	$i\sqrt{2}\,k t_1$	0	0
$f_{0^+}^{\#1\,\dagger}$	$-i\sqrt{2}\,k t_1$	$-2k^2 t_1$	0	0
$f_{0^+}^{\#2\,\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1\,\dagger}$	0	0	0	$k^2 r_2 - t_1$

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
$\tau_{1^+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\,\alpha\beta} - 2\,i\,k\,\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	16

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

(No massless particles)

Unitarity conditions

$r_2 < 0 \;\&\&\; t_1 < 0$