Particle spectrograph

Wave operator and propagator

	$\sigma_{1^+}^{\#1}{}^{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	0	$-\frac{\sqrt{2}}{t_1+2k^2 t_1}$	0	$\frac{2ik}{t_1+2k^2 t_1}$
$\sigma_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{-2k^2 r_1+t_1}{(1+k^2)^2 t_1^2}$	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	$\frac{1}{(1+2k^2)^2 t_1}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	
$\tau_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{\sqrt{2}\,i\,k}{t_1+k^2 t_1}$	$\frac{i(2k^3 r_1-k t_1)}{(1+k^2)^2 t_1^2}$				
$\sigma_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	$-\frac{2ik}{t_1+2k^2 t_1}$
$\sigma_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	$-\frac{\sqrt{2}}{t_1+2k^2 t_1}$	$-\frac{1}{(1+2k^2)^2 t_1}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	
$\tau_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	$-\frac{2k^2}{(1+2k^2)^2 t_1}$
$\tau_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	$\frac{2ik}{t_1+2k^2 t_1}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	$\frac{2k^2}{(1+2k^2)^2 t_1}$	

Quadratic (free) Lagrangian density

$$
\begin{aligned}
&-t_1\,\omega_{\iota}^{\alpha\iota}\,\omega_{\kappa\alpha}^{\ \ \kappa}-t_1\,\omega_{\iota}^{\ \ \kappa\lambda}\,\omega_{\kappa\lambda}{}'+f^{\alpha\beta}\,\tau_{\alpha\beta}+\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+r_1\,\partial_\iota\omega^{\kappa\lambda}{}_{\kappa}\,\partial'\omega_{\lambda}^{\ \ \alpha}{}_{\alpha}-\\
&\tfrac{2}{3}\,r_1\,\partial^\beta\omega^{\theta\alpha}{}_{\kappa}\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}-\tfrac{2}{3}\,r_1\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_\kappa\omega^{\theta\alpha\beta}+\tfrac{2}{3}\,r_1\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_\kappa\omega^{\theta\alpha\beta}+\\
&r_1\,\partial_\alpha\omega_{\lambda}^{\ \ \alpha}{}_{\theta}\,\partial_\kappa\omega^{\theta\kappa\lambda}-r_1\,\partial_\theta\omega_{\lambda}^{\ \ \alpha}{}_{\alpha}\,\partial_\kappa\omega^{\theta\kappa\lambda}+r_1\,\partial_\alpha\omega_{\lambda}^{\ \ \alpha}{}_{\theta}\,\partial_\kappa\omega^{\kappa\lambda\theta}-2\,r_1\,\partial_\theta\omega_{\lambda}^{\ \ \alpha}{}_{\alpha}\,\partial_\kappa\omega^{\kappa\lambda\theta}-\\
&\tfrac{1}{2}\,t_1\,\partial^\alpha f_{\kappa\theta}\,\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}+t_1\,\omega_{\kappa\alpha}^{\ \ \alpha}\,\partial^\kappa f'_{\iota}+\\
&t_1\,\omega_{\kappa\lambda}^{\ \ \lambda}\,\partial^\kappa f'_{\iota}+2\,t_1\,\partial^\alpha f_{\kappa\alpha}\,\partial^\kappa f'_{\iota}-t_1\,\partial_\kappa f^{\lambda}{}_{\lambda}\,\partial^\kappa f'_{\iota}+2\,t_1\,\omega_{\iota\kappa\theta}\,\partial^\kappa f'^{\theta}-\\
&t_1\,\omega_{\iota\alpha}^{\ \ \alpha}\,\partial^\kappa f'_{\kappa}-t_1\,\omega_{\iota\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^{\lambda}{}_{\theta}\,\partial^\kappa f_{\lambda}^{\ \ \theta}+\\
&\tfrac{2}{3}\,r_1\,\partial^\beta\omega_{\iota}^{\ \ \alpha\alpha}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \lambda}{}'-t_1\,\partial^\alpha f^{\lambda}{}_{\alpha}\,\partial^\kappa f_{\lambda\kappa}+\tfrac{2}{3}\,r_1\,\partial_\kappa\omega^{\alpha\beta\theta}\,\partial^\kappa\omega_{\alpha\beta\theta}-\tfrac{2}{3}\,r_1\,\partial_\kappa\omega^{\theta\alpha\beta}\,\partial^\kappa\omega_{\alpha\beta\theta}+\\
&\tfrac{2}{3}\,r_1\,\partial^\beta\omega_{\iota}^{\ \ \alpha\lambda}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \ \ \kappa}{}'-\tfrac{8}{3}\,r_1\,\partial^\beta\omega_{\iota}^{\ \ \alpha\lambda}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \ \ \kappa}{}'-r_1\,\partial_\alpha\omega_{\lambda}^{\ \ \alpha}{}_{\theta}\,\partial^\lambda\omega^{\theta\kappa}{}_{\kappa}+r_1\,\partial_\theta\omega_{\lambda}^{\ \ \alpha}{}_{\alpha}\,\partial^\lambda\omega^{\theta\kappa}{}_{\kappa}
\end{aligned}
$$

	$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	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	$\frac{2}{2k^2 r_1+t_1}$

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

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

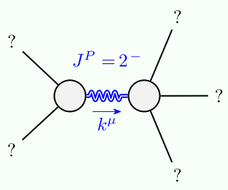
	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$k^2 r_1-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	$-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$i k t_1$
$\omega_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	$-i k t_1$	0	0	0

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	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	$k^2 r_1+\frac{t_1}{2}$

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:	$-\frac{1}{r_1} > 0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2 r_1} > 0$
Spin:	2
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_1 < 0 \;\&\&\; t_1 > 0$