Particle spectrograph

Wave operator and propagator

	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	0	0	0	0
$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\frac{-2ik^3(2r_1+r_5)+ikt_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}^{\alpha}$	$\frac{-2k^4(2r_1+r_5)+k^2 t_1}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\sigma_{1^-}^{\#2}{}^{\alpha}$	$\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	0	0	0	0
$\tau_{1^-}^{\#1}{}^{\alpha}$	$\frac{i(2k^3(2r_1+r_5)+kt_1)}{(1+k^2)^2 t_1^2}$	0	0	0	0
$\tau_{1^-}^{\#2}{}^{\alpha}$	0	0	0	0	0

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

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	$k^2 t_1$	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
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} + 2ik\,\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + ik\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\,\alpha\beta} - 2ik\,\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	17

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	0	0	0	$-\frac{1}{t_1}$
$\tau_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	$-\frac{1}{t_1}$	0	0	0

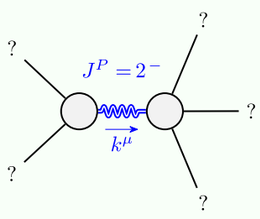
	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$-t_1$

	$\omega_{1^+\alpha\beta}^{\#1}$	$\omega_{1^+\alpha\beta}^{\#2}$	$f_{1^+\alpha\beta}^{\#1}$	$\omega_{1^-\alpha}^{\#1}$	$\omega_{1^-\alpha}^{\#2}$	$f_{1^-\alpha}^{\#1}$	$f_{1^-\alpha}^{\#2}$
$\omega_{1^+\alpha\beta}^{\#1}{}^{\dagger\alpha\beta}$	$k^2(2r_1+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1^+\alpha\beta}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1^+\alpha\beta}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-\alpha}^{\#1}{}^{\dagger\alpha}$	0	0	0	$k^2(r_1+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ikt_1}{3}$
$\omega_{1^-\alpha}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}\,kt_1$
$f_{1^-\alpha}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f_{1^-\alpha}^{\#2}{}^{\dagger\alpha}$	0	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt{2}\,kt_1$	0	$\frac{2k^2t_1}{3}$

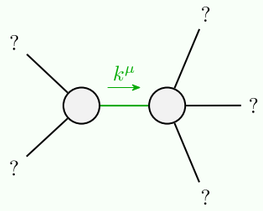
Quadratic (free) action

$$S_F == \iiint\!\!\iint(\tfrac{1}{6}(-2t_1\,\omega_l^{\alpha\prime}\,\omega_{\kappa\alpha}{}^{\kappa}-6t_1\,\omega_l^{\kappa\lambda\prime}\,\omega_{\kappa\lambda}{}^{\prime}+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-6r_5\,\partial_l\omega^{\kappa\lambda}{}_{\kappa}$$
$$\partial^{\prime}\omega_{\lambda}{}^{\alpha}{}_{\alpha}-4r_1\,\partial^{\beta}\omega^{\theta\alpha}{}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}-4r_1\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta}+4r_1\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta}-$$
$$6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}+6r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}-6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+$$
$$12r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}-3t_1\,\partial^{\alpha}f_{\theta\kappa}\,\partial^{\kappa}f_{\alpha}{}^{\theta}-3t_1\,\partial^{\alpha}f_{\kappa\theta}\,\partial^{\kappa}f_{\alpha}{}^{\theta}-3t_1\,\partial^{\alpha}f_{\lambda}{}^{\kappa}\,\partial^{\kappa}f_{\alpha\lambda}+$$
$$2t_1\,\omega_{\kappa\alpha}{}^{\alpha}\,\partial^{\kappa}f_{l}^{\prime}+2t_1\,\omega_{\kappa\lambda}{}^{\lambda}\,\partial^{\kappa}f_{l}^{\prime}+4t_1\,\partial^{\alpha}f_{l\kappa}\,\partial^{\kappa}f_{\lambda}{}^{\lambda}{}^{\prime}-2t_1\,\partial^{\alpha}f_{\kappa}{}^{\lambda}\,\partial_{\kappa}f_{\lambda}{}^{\lambda}{}^{\prime}-2t_1\,\partial^{\alpha}f_{\lambda}{}^{\lambda}\,\partial^{\kappa}f_{l\kappa}{}^{\prime}+$$
$$12t_1\,\omega_{l\kappa\theta}\,\partial^{\kappa}f^{\prime\theta}-2t_1\,\omega_{l\alpha}{}^{\alpha}\,\partial^{\kappa}f_{\kappa}^{\prime}-2t_1\,\omega_{l\lambda}{}^{\lambda}\,\partial^{\kappa}f_{\kappa}{}^{\theta}+3t_1\,\partial^{\alpha}f_{\kappa}{}^{\lambda}\,\partial^{\kappa}f_{\lambda}{}^{\theta}+3t_1\,\partial^{\alpha}f_{\lambda}{}^{\lambda}\,\partial^{\kappa}f_{\theta}{}^{\theta}-2t_1\,\partial_{\kappa}f_{\lambda}{}^{\lambda}\,\partial^{\kappa}f_{\theta}{}^{\theta}+$$
$$4r_1\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}+4r_1\,\partial^{\beta}\omega_{l}^{\alpha\lambda}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime}-16r_1\,\partial^{\beta}\omega_{l}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime}+$$
$$6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}-6r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}))[t,x,y,z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra



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



Quadratic pole	
Pole residue:	$-\frac{1}{(r_1+r_5)t_1^2} > 0$
Polarisations:	2

Unitarity conditions

$r_1 < 0$ && $r_5 < -r_1$ && $t_1 > 0$