Particle spectrograph

Wave operator and propagator

	$\sigma_1^{\#1}\dagger^{\alpha\beta}$	$\sigma_1^{\#2}\dagger^{\alpha\beta}$	$\tau_1^{\#1}\dagger^{\alpha\beta}$	$\sigma_1^{\#1}\dagger^{\alpha}$	$\sigma_1^{\#2}\dagger^{\alpha}$	$\tau_1^{\#1}\dagger^{\alpha}$	$\tau_1^{\#2}\dagger^{\alpha}$
$\tau_1^{\#2}{}_{\alpha}$	0	0	0	$\frac{2ikt_1-4ikt_3}{3t_1t_3+6k^2t_1t_3}$	$\frac{i\sqrt{2}(t_1+4t_3)}{3(1+2k^2)^2t_1t_3}$	0	$\frac{2k^2(t_1+4t_3)}{3(1+2k^2)^2t_1t_3}$
$\tau_1^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$\sigma_1^{\#2}{}_{\alpha}$	0	0	0	$-\frac{\sqrt{2}(t_1-2t_3)}{3(1+2k^2)t_1t_3}$	$\frac{t_1+4t_3}{3(1+2k^2)^2t_1t_3}$	0	$-\frac{i\sqrt{2}k(t_1+4t_3)}{3(1+2k^2)^2t_1t_3}$
$\sigma_1^{\#1}{}_{\alpha}$	0	0	0	$\frac{2(t_1+t_3)}{3t_1t_3}$	$-\frac{\sqrt{2}(t_1-2t_3)}{3(1+2k^2)t_1t_3}$	0	$\frac{2ik(t_1-2t_3)}{3t_1t_3+6k^2t_1t_3}$
$\tau_1^{\#1}{}_{\alpha\beta}$	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$-\frac{i(2k^3r_1-kt_1)}{(1+k^2)^2t_1^2}$	$-\frac{2k^4r_1+k^2t_1}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_1^{\#2}{}_{\alpha\beta}$	$\frac{\sqrt{2}}{t_1+k^2t_1}$	$-\frac{2k^2r_1+t_1}{(1+k^2)^2t_1^2}$	$\frac{i(2k^3r_1-kt_1)}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_1^{\#1}{}_{\alpha\beta}$	0	$\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	0	0	0	0

	$\omega_1^{\#1}\dagger^{\alpha\beta}$	$\omega_1^{\#2}\dagger^{\alpha\beta}$	$f_1^{\#1}\dagger^{\alpha\beta}$	$\omega_1^{\#1}\dagger^{\alpha}$	$\omega_1^{\#2}\dagger^{\alpha}$	$f_1^{\#1}\dagger^{\alpha}$	$f_1^{\#2}\dagger^{\alpha}$
$f_1^{\#2}{}_{-\alpha}$	0	0	0	0	$\frac{1}{3}ik(t_1-2t_3)$	$\frac{1}{3}i\sqrt{2}k(t_1+t_3)$	$\frac{2}{3}k^2(t_1+t_3)$
$f_1^{\#1}{}_{-\alpha}$	0	0	0	0	0	0	0
$\omega_1^{\#2}{}_{-\alpha}$	0	0	0	$\frac{t_1-2t_3}{3\sqrt{2}}$	$\frac{t_1+t_3}{3}$	0	$-\frac{1}{3}i\sqrt{2}k(t_1+t_3)$
$\omega_1^{\#1}{}_{-\alpha}$	0	0	0	$\frac{1}{6}(t_1+4t_3)$	$\frac{t_1-2t_3}{3\sqrt{2}}$	0	$-\frac{1}{3}ik(t_1-2t_3)$
$f_1^{\#1}{}_{+\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_1^{\#2}{}_{+\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0
$\omega_1^{\#1}{}_{+\alpha\beta}$	$k^2r_1-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0

	$\sigma_2^{\#1}\dagger^{\alpha\beta}$	$\tau_2^{\#1}\dagger^{\alpha\beta}$	$\sigma_2^{\#1}\dagger^{\alpha\beta\chi}$
$\sigma_2^{\#1}{}_{-\alpha\beta\chi}$	0	0	$\frac{2}{2k^2r_1+t_1}$
$\tau_2^{\#1}{}_{+\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	$\frac{4k^2}{(1+2k^2)^2t_1}$	0
$\sigma_2^{\#1}{}_{+\alpha\beta}$	$\frac{2}{(1+2k^2)^2t_1}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	0

	$\omega_2^{\#1}{}_{+\alpha\beta}$	$f_2^{\#1}{}_{+\alpha\beta}$	$\omega_2^{\#1}{}_{-\alpha\beta\chi}$
$\omega_2^{\#1}{}_{+}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f_2^{\#1}{}_{+}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	k^2t_1	0
$\omega_2^{\#1}{}_{-}\dagger^{\alpha\beta\chi}$	0	0	$k^2r_1+\frac{t_1}{2}$

	$\omega_0^{\#1}{}_{+}$	$f_0^{\#1}{}_{+}$	$f_0^{\#2}{}_{+}$	$\omega_0^{\#1}{}_{-}$
$\omega_0^{\#1}{}_{+}\dagger$	t_3	$-i\sqrt{2}kt_3$	0	0
$f_0^{\#1}{}_{+}\dagger$	$i\sqrt{2}kt_3$	$2k^2t_3$	0	0
$f_0^{\#2}{}_{+}\dagger$	0	0	0	0
$\omega_0^{\#1}{}_{-}\dagger$	0	0	0	$-t_1$

	$\sigma_0^{\#1}{}_{+}\dagger$	$\tau_0^{\#1}{}_{+}\dagger$	$\tau_0^{\#2}{}_{+}\dagger$	$\sigma_0^{\#1}{}_{-}\dagger$
$\sigma_0^{\#1}{}_{-}$	0	0	0	$-\frac{1}{t_1}$
$\tau_0^{\#1}{}_{+}$	$\frac{i\sqrt{2}k}{(1+2k^2)^2t_3}$	$\frac{2k^2}{(1+2k^2)^2t_3}$	0	0
$\sigma_0^{\#1}{}_{+}$	$\frac{1}{(1+2k^2)^2t_3}$	$\frac{i\sqrt{2}k}{(1+2k^2)^2t_3}$	0	0

Quadratic (free) Lagrangian density

$$-\frac{1}{3}t_1\,\omega_i{}^{\alpha l}\,\omega_{\kappa\alpha}{}^{\kappa}+\frac{2}{3}t_3\,\omega_i{}^{\alpha l}\,\omega_{\kappa\alpha}{}^{\kappa}-t_1\,\omega_i{}^{\kappa\lambda}\,\omega_{\kappa\lambda}{}^{i}+f^{\alpha\beta}\,\tau_{\alpha\beta}+$$
$$\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+r_1\,\partial_i\omega^{\kappa\lambda}\,\partial^i\omega_{\lambda\kappa}-\frac{2}{3}r_1\,\partial^{\beta}\omega^{\theta\alpha}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}-\frac{2}{3}r_1\,\partial_{\theta}\omega_{\kappa}{}^{\alpha\beta}\,\partial_{\kappa}\omega^{\alpha\beta\theta}+$$
$$\frac{2}{3}r_1\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta}+r_1\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}_{\theta}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}-r_1\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}-\frac{1}{2}t_1\,\partial^{\alpha}f^{\lambda}_{\kappa}\,\partial^{\kappa}f_{\alpha\lambda}+$$
$$2\,r_1\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}-\frac{1}{2}t_1\,\partial^{\alpha}f_{\theta\kappa}\,\partial^{\kappa}f_{\alpha}{}^{\theta}-\frac{1}{2}t_1\,\partial^{\alpha}f^{\lambda}_{\kappa}\,\partial^{\kappa}f_{\alpha\lambda}+$$
$$\frac{1}{3}t_1\,\omega_{\kappa\alpha}{}^{\alpha}\,\partial^{\kappa}f_i{}^{i}-\frac{2}{3}t_3\,\omega_{\kappa\alpha}{}^{\alpha}\,\partial^{\kappa}f_i{}^{i}+\frac{1}{3}t_1\,\omega_{\kappa\lambda}{}^{\lambda}\,\partial^{\kappa}f_i{}^{i}+$$
$$\frac{2}{3}t_1\,\partial^{\alpha}f_{\kappa\alpha}\,\partial^{\kappa}f_i{}^{i}-\frac{1}{3}t_1\,\partial^{\alpha}f_{\kappa\alpha}\,\partial^{\kappa}f_i{}^{i}+\frac{2}{3}t_1\,\partial_{\kappa}f^{\lambda}_{\lambda}\,\partial^{\kappa}f_i{}^{i}+$$
$$2\,t_1\,\omega_{i\kappa\theta}\,\partial^{\kappa}f^{i\theta}-\frac{1}{3}t_1\,\omega_{i\alpha}{}^{\alpha}\,\partial^{\kappa}f^i{}_{\kappa}+\frac{1}{2}t_1\,\omega_{i\lambda}{}^{\lambda}\,\partial^{\kappa}f^i{}_{\kappa}+$$
$$\frac{2}{3}t_3\,\omega_{i\lambda}{}^{\lambda}\,\partial^{\kappa}f^i{}_{\kappa}+\frac{1}{2}t_1\,\partial^{\alpha}f^{\lambda}_{\theta}\,\partial^{\kappa}f_{\lambda\alpha}+\frac{1}{2}t_1\,\partial_{\kappa}f^{\lambda}_{\theta}\,\partial^{\theta}f_{\lambda}{}^{\kappa}-$$
$$\frac{1}{3}t_1\,\partial^{\alpha}f^{\lambda}_{\lambda}\,\partial^{\kappa}f_{\lambda\kappa}+\frac{2}{3}t_3\,\partial^{\alpha}f^{\lambda}_{\lambda}\,\partial^{\kappa}f_{\lambda\kappa}+\frac{2}{3}r_1\,\partial_{\kappa}\omega^{\alpha\beta\theta}\,\omega_{\alpha\beta\theta}-\frac{2}{3}r_1\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\omega_{\alpha\beta\theta}+$$
$$\frac{2}{3}r_1\,\partial^{\beta}\omega_{i}{}^{\alpha\lambda}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{i}-\frac{8}{3}r_1\,\partial^{\beta}\omega_{\lambda}{}^{\lambda\alpha}\,\partial_{\alpha}\omega_{\alpha\beta}{}^{i}-r_1\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}$$

Source constraints/gauge generators

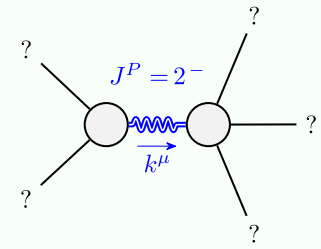| SO(3) irreps	Multiplicities
$\tau_0^{\#2}{}_{+}==0$	1
$\tau_0^{\#1}{}_{+}-2ik\,\sigma_0^{\#1}{}_{+}==0$	1
$\tau_1^{\#2\alpha}+2ik\,\sigma_1^{\#2\alpha}==0$	3
$\tau_1^{\#1\alpha}==0$	3
$\tau_1^{\#1\alpha\beta}+ik\,\sigma_1^{\#2\alpha\beta}==0$	3
$\tau_2^{\#1\alpha\beta}-2ik\,\sigma_2^{\#1\alpha\beta}==0$	5
Total constraints:	16

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

$J^P=2^-$

(No massless particles)

Unitarity conditions

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