Particle spectrograph

Wave operator and propagator

	$\tau_{1^+}^{\#1\,\alpha\beta}$	$\sigma_{1^+}^{\#2\,\alpha\beta}$	$\sigma_{1^+}^{\#1\,\alpha\beta}$	$\sigma_{1^-}^{\#2\,\alpha}$	$\tau_{1^-}^{\#1\,\alpha}$	$\tau_{1^-}^{\#2\,\alpha}$
$\tau_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2\,t_1}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$\frac{\sqrt{2}}{t_1+k^2\,t_1}$	0	0	0
$\sigma_{1^+}^{\#2\,\dagger\,\alpha\beta}$	$-\frac{i\,(2\,k^3\,r_5-k\,t_1)}{(1+k^2)^2\,t_1^2}$	$-\frac{-2\,k^2\,r_5+t_1}{(1+k^2)^2\,t_1^2}$	$-\frac{i\,(2\,k^3\,r_5-k\,t_1)}{(1+k^2)^2\,t_1^2}$	0	0	0
$\tau_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$\frac{-2\,k^4\,r_5+k^2\,t_1}{(1+k^2)^2\,t_1^2}$	$\frac{i\,(2\,k^3\,r_5-k\,t_1)}{(1+k^2)^2\,t_1^2}$	$\frac{i\,\sqrt{2}\,k}{t_1+k^2\,t_1}$	0	0	0
$\sigma_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	$\frac{1}{k^2\,r_5}$	0	$-\frac{i}{k\,r_5+2\,k^3\,r_5}$
$\sigma_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{1}{\sqrt{2}\,(k^2\,r_5+2\,k^4\,r_5)}$	0	$\frac{i\,(6\,k^2\,r_5+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,r_5\,t_1}$
$\tau_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	$\frac{6\,k^2\,r_5+t_1}{2\,(k+2\,k^3)^2\,r_5\,t_1}$	0	0
$\tau_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{i\,(6\,k^2\,r_5+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,r_5\,t_1}$	0	$\frac{6\,k^2\,r_5+t_1}{(1+2\,k^2)^2\,r_5\,t_1}$

Quadratic (free) action

$$S_F == \int\int\int\int (\tfrac{1}{6}(-2\,t_1\,\omega_{\iota}^{\alpha\prime}\,\omega_{\kappa\alpha}^{\ \ \kappa} - 6\,t_1\,\omega_{\iota}^{\ \kappa\lambda\prime}\,\omega_{\kappa\lambda}^{\ \ \prime} + 6\,f^{\alpha\beta}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 6\,r_5\,\partial_\iota\omega^{\kappa\lambda}\,\partial_\kappa\omega_{\lambda\iota} + \partial^\iota\omega_{\lambda\ \alpha}^{\ \kappa}\,\partial_\kappa\omega^{\lambda\ \alpha}_{\ \iota} - 2\,r_2\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_\kappa\omega^{\theta\alpha\beta} - 4\,r_2\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa}\,\partial_\kappa\omega^{\theta\beta\alpha} + 4\,r_2\,\partial^\beta\omega^{\theta\alpha}_{\ \ \kappa}\,\partial_\theta\omega_{\alpha\beta}^{\ \ \kappa} - 6\,r_5\,\partial_\alpha\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_\kappa\omega^{\theta\kappa\lambda} - 6\,r_5\,\partial_\alpha\omega^{\alpha}_{\ \lambda\ \theta}\,\partial_\kappa\omega^{\kappa\lambda\theta} + 6\,r_5\,\partial_\theta\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_\kappa\omega^{\kappa\lambda\theta} - 3\,t_1\,\partial^\alpha f_{\alpha}^{\ \theta} - 3\,t_1\,\partial^\alpha f_{\kappa\theta}\,\partial^\kappa f_{\alpha}^{\ \theta} - 3\,t_1\,\partial^\alpha f_{\kappa}^{\ \theta}\,\partial^\kappa f_{\alpha\lambda} + 12\,r_5\,\partial_\theta\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_\kappa\omega^{\kappa\lambda\theta} - 3\,t_1\,\partial^\alpha f_{\theta\kappa}\,\partial^\kappa f_{\alpha}^{\ \lambda\theta} + 2\,t_1\,\omega_{\kappa\alpha}^{\ \ \alpha}\,\partial^\kappa f_{\iota}^{\ \iota\prime} + 2\,t_1\,\omega_{\kappa\lambda}^{\ \ \lambda}\,\partial^\kappa f_{\iota}^{\ \iota\prime} + 4\,t_1\,\partial^\alpha f_{\kappa\alpha}\,\partial^\kappa f_{\iota}^{\ \iota\prime} - 2\,t_1\,\partial_\kappa f^{\alpha}_{\ \iota}\,\partial^\kappa f_{\ \alpha}^{\iota\prime} + 12\,t_1\,\omega_{\iota\kappa\theta}\,\partial^\kappa f^{\iota\theta} - 2\,t_1\,\omega_{\iota\alpha}^{\ \ \alpha}\,\partial^\kappa f_{\ \kappa}^{\iota\prime} - 2\,t_1\,\omega_{\iota\lambda}^{\ \ \lambda}\,\partial^\kappa f_{\ \kappa}^{\iota\prime} + 3\,t_1\,\partial^\alpha f_{\ \kappa}^{\lambda}\,\partial^\kappa f_{\lambda\alpha} + 3\,t_1\,\partial_\kappa f^{\ \lambda}_{\theta}\,\partial^\kappa f_{\lambda}^{\ \theta} - 2\,t_1\,\partial^\alpha f_{\lambda}^{\ \theta}\,\partial^\kappa f_{\lambda\kappa} + 2\,r_2\,\partial_\kappa\omega^{\alpha\beta\theta}\,\partial^\kappa\omega_{\alpha\beta\theta} + 4\,r_2\,\partial_\kappa\omega^{\theta\alpha\beta}\,\partial^\kappa\omega_{\alpha\beta\theta} - 4\,r_2\,\partial^\beta\omega_{\iota}^{\ \lambda\alpha}\,\partial_\lambda\omega_{\alpha\beta}^{\ \ \prime} + 6\,r_5\,\partial_\alpha\omega_{\lambda\ \theta}^{\ \alpha}\,\partial^\lambda\omega^{\theta\kappa}_{\ \ \kappa} - 6\,r_5\,\partial_\theta\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial^\lambda\omega^{\theta\kappa}_{\ \ \kappa})[t,x,y,z]\,dz\,dy\,dx\,dt$$

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

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

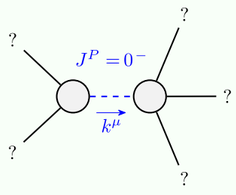
	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1\,\dagger}$	0	0	0	$\frac{1}{k^2\,r_2-t_1}$
$\tau_{0^+}^{\#1\,\dagger}$	0	0	0	0
$\tau_{0^+}^{\#2\,\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1\,\dagger}$	0	0	0	0

Source constraints/gauge generators

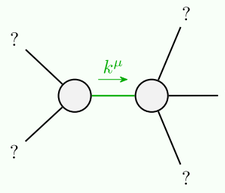
SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} + 2\,i\,k\,\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\,\alpha\beta} - 2\,i\,k\,\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	17

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

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



Quadratic pole	
Pole residue:	$-\frac{1}{r_5\,{t_1}^2} > 0$
Polarisations:	2

Unitarity conditions

$r_2 < 0$ && $r_5 < 0$ && $t_1 < 0$