Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S_F == \iiint\int \left(\frac{1}{6}\left(4\,t_2\,{\omega_l}^{\kappa\lambda}\,{\omega_{\kappa\lambda}}'+2\,t_2\,{\omega_{\kappa\lambda}}'\,{\omega_l}^{\kappa\lambda}+6\,{f^{\alpha\beta}}_{\tau_{\alpha\beta}}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+12\,r_1\right.\right.$$
$$\partial_l{\omega^{\kappa\lambda}}_\kappa\partial'{\omega_\lambda}^\alpha{}_\alpha-4\,r_1\,\partial^\beta{\omega^{\theta\alpha}}_\kappa\partial_\theta{\omega_{\alpha\beta}}^\kappa+4\,r_2\,\partial^\beta{\omega^{\theta\alpha}}_\kappa\partial_\theta{\omega_{\alpha\beta}}'-4\,r_1\,\partial_\theta{\omega_\kappa}^{\alpha\beta\theta}\partial_\kappa{\omega^\kappa}_{\alpha\beta}-$$
$$2\,r_2\,\partial_\theta{\omega_{\alpha\beta}}^\kappa\partial_\kappa{\omega^{\alpha\beta\theta}}+4\,r_1\,\partial_\theta{\omega_{\alpha\beta}}^\kappa\partial_\kappa{\omega^{\theta\alpha\beta}}-4\,r_2\,\partial_\theta{\omega_{\alpha\beta}}^\kappa\partial_\kappa{\omega^{\theta\alpha\beta}}+$$
$$12\,r_1\,\partial_\alpha{\omega_\lambda}^\alpha{}_\theta\partial_\kappa{\omega^{\theta\kappa\lambda}}-12\,r_1\,\partial_\theta{\omega_\lambda}^\alpha{}_\alpha\partial_\kappa{\omega^{\theta\kappa\lambda}}+12\,r_1\,\partial_\alpha{\omega_\lambda}^\alpha{}_\theta\partial_\kappa{\omega^{\kappa\lambda\theta}}-$$
$$24\,r_1\,\partial_\theta{\omega_\lambda}^\alpha{}_\alpha\partial_\kappa{\omega^{\kappa\lambda\theta}}+t_2\,\partial^\alpha{f_{\theta\kappa}}\partial^\kappa{f_\alpha}^\theta-t_2\,\partial^\alpha{f_{\kappa\theta}}\partial^\kappa{f_\alpha}^\theta+t_2\,\partial^\alpha{f^\lambda}_\kappa\partial^\kappa{f_{\alpha\lambda}}+$$
$$2\,t_2\,\omega_{\iota\theta\kappa}\,\partial^\kappa{f'}^{\iota\theta}-2\,t_2\,\omega_{\theta\iota\kappa}\,\partial^\kappa{f'}^{\iota\theta}+4\,t_2\,\omega_{\theta\kappa\iota}\,\partial^\kappa{f'}^{\iota\theta}-$$
$$t_2\,\partial^\alpha{f^\lambda}_\kappa\partial^\kappa{f_{\lambda\alpha}}-t_2\,\partial_\kappa{f^\lambda}_\theta\partial^\kappa{f_\lambda}^\theta+4\,r_1\,\partial_\kappa{\omega^{\alpha\beta\theta}}\partial^\kappa{\omega_{\alpha\beta\theta}}+$$
$$2\,r_2\,\partial_\kappa{\omega^{\alpha\beta\theta}}\partial^\kappa{\omega_{\alpha\beta\theta}}-4\,r_1\,\partial_\kappa{\omega^{\theta\alpha\beta}}\partial^\kappa{\omega_{\alpha\beta\theta}}+4\,r_2\,\partial_\kappa{\omega^{\theta\alpha\beta}}\partial^\kappa{\omega_{\alpha\beta\theta}}+4\,r_1\,\partial^\beta{\omega_l}^{\alpha\lambda}$$
$$\partial_l{\omega_{\alpha\beta}}'-4\,r_2\,\partial^\beta{\omega_l}^{\alpha\lambda}\partial_\lambda{\omega_{\alpha\beta}}'-16\,r_1\,\partial^\beta{\omega_l}^{\lambda\alpha}\partial_\lambda{\omega_{\alpha\beta}}'+4\,r_2\,\partial^\beta{\omega_l}^{\lambda\alpha}\partial_\lambda{\omega_{\alpha\beta}}'-$$
$$\left.\left.12\,r_1\,\partial_\alpha{\omega_\lambda}^\alpha{}_\theta\partial^\lambda{\omega^{\theta\kappa}}_\kappa+12\,r_1\,\partial_\theta{\omega_\lambda}^\alpha{}_\alpha\partial^\lambda{\omega^{\theta\kappa}}_\kappa\right)\right)[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

	$\omega_{1^+}^{\#1}{}^{\alpha\beta}\dagger$	$\omega_{1^+}^{\#2}{}^{\alpha\beta}\dagger$	$f_{1^+}^{\#1}{}^{\alpha\beta}\dagger$	$\omega_{1^-}^{\#1}{}^{\alpha}\dagger$	$\omega_{1^-}^{\#2}{}^{\alpha}\dagger$	$f_{1^-}^{\#1}{}^{\alpha}\dagger$	$f_{1^-}^{\#2}{}^{\alpha}\dagger$
$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\frac{2t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$-\frac{1}{3}i\sqrt{2}\,k\,t_2$	0	0	0	0
$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$-\frac{1}{3}i\,k\,t_2$	0	0	0	0
$f_{1^+}^{\#1}{}_{\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}\,k\,t_2$	$-\frac{1}{3}i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0	0	0	0
$\omega_{1^-}^{\#1}{}_{\alpha}$	0	0	0	$-k^2\,r_1$	0	0	0
$\omega_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0

	$\sigma_{1^+}^{\#1}{}^{\alpha\beta}\dagger$	$\sigma_{1^+}^{\#2}{}^{\alpha\beta}\dagger$	$\tau_{1^+}^{\#1}{}^{\alpha\beta}\dagger$	$\sigma_{1^-}^{\#1}{}^{\alpha}\dagger$	$\sigma_{1^-}^{\#2}{}^{\alpha}\dagger$	$\tau_{1^-}^{\#1}{}^{\alpha}\dagger$	$\tau_{1^-}^{\#2}{}^{\alpha}\dagger$
$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\frac{6}{(3+k^2)^2\,t_2}$	$\frac{3\sqrt{2}}{(3+k^2)^2\,t_2}$	$-\frac{3i\sqrt{2}\,k}{(3+k^2)^2\,t_2}$	0	0	0	0
$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\frac{3\sqrt{2}}{(3+k^2)^2\,t_2}$	$\frac{3}{(3+k^2)^2\,t_2}$	$-\frac{3ik}{(3+k^2)^2\,t_2}$	0	0	0	0
$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$-\frac{3i\sqrt{2}\,k}{(3+k^2)^2\,t_2}$	$-\frac{3ik}{(3+k^2)^2\,t_2}$	$\frac{3k^2}{(3+k^2)^2\,t_2}$	0	0	0	0
$\sigma_{1^-}^{\#1}{}_{\alpha}$	0	0	0	$-\frac{1}{k^2\,r_1}$	0	0	0
$\sigma_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#2}{}_{\alpha}$	0	0	0	0	0	0	0

	$\omega_{0^+}^{\#1}\dagger$	$f_{0^+}^{\#1}\dagger$	$f_{0^+}^{\#2}\dagger$	$\omega_{0^-}^{\#1}\dagger$
$\omega_{0^+}^{\#1}$	0	0	0	0
$f_{0^+}^{\#1}$	0	0	0	0
$f_{0^+}^{\#2}$	0	0	0	0
$\omega_{0^-}^{\#1}$	0	0	0	$k^2\,r_2+t_2$

	$\omega_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	$f_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	$\omega_{2^-}^{\#1}{}^{\alpha\beta\chi}\dagger$
$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$f_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$	0	0	$k^2\,r_1$

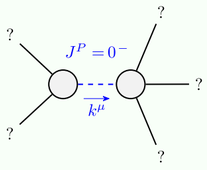
Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + i\,k\,\sigma_{1^+}^{\#1\,\alpha\beta} == 0$	3
$\sigma_{1^+}^{\#1\,\alpha\beta} == \sigma_{1^+}^{\#2\,\alpha\beta}$	3
$\tau_{2^+}^{\#1\,\alpha\beta} == 0$	5
$\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	28

	$\sigma_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	$\tau_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	$\sigma_{2^-}^{\#1}{}^{\alpha\beta\chi}\dagger$
$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	$\frac{1}{k^2\,r_1}$
$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$	0	0	0

	$\sigma_{0^+}^{\#1}\dagger$	$\tau_{0^+}^{\#1}\dagger$	$\tau_{0^+}^{\#2}\dagger$	$\sigma_{0^-}^{\#1}\dagger$
$\sigma_{0^+}^{\#1}$	0	0	0	0
$\tau_{0^+}^{\#1}$	0	0	0	0
$\tau_{0^+}^{\#2}$	0	0	0	0
$\sigma_{0^-}^{\#1}$	0	0	0	$\frac{1}{k^2\,r_2+t_2}$

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_2 < 0 \;\&\&\; t_2 > 0$