Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S == \int\int\int\int (\tfrac{1}{6}(6\, f^{\alpha\beta}\ \tau_{\alpha\beta} + 6\ \omega^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi} - 12\, r_1\, \partial_\beta \omega_{\iota\ \theta}^{\ \theta}\, \partial^\iota \omega^{\alpha\beta}_{\ \ \alpha} + 12\, r_1\, \partial_\iota \omega_{\beta\ \theta}^{\ \theta}\, \partial^\iota \omega^{\alpha\beta}_{\ \ \alpha} + 12\, r_1\, \partial^\iota \omega^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \omega_{\beta\ \iota}^{\ \theta} - 12\, r_1\, \partial_\alpha \omega^{\alpha\beta\iota}_{\ \ \ \beta}\, \partial_\theta \omega_{\iota\ \beta}^{\ \theta} + 24\, r_1\, \partial^\iota \omega^{\alpha\beta}_{\ \ \alpha}\, \partial_\theta \omega_{\iota\ \beta}^{\ \theta} + 4\, t_2\ \omega_{\iota\theta\alpha}\, \partial^\theta f^{\alpha\iota} + 2\, t_2\, \partial_\alpha f_{\iota\theta}\, \partial^\theta f^{\alpha\iota} - t_2\, \partial_\iota f_{\theta\alpha}\, \partial^\theta f^{\alpha\iota} - 4\, t_2\ \omega_{\alpha\theta\iota}\, (\omega^{\alpha\iota\theta} + \partial^\theta f^{\alpha\iota}) + t_2\, \partial_\theta f_{\alpha\iota}\, \partial^\theta f^{\alpha\iota} + t_2\, \partial_\theta f_{\alpha\iota}\, \partial^\theta f^{\alpha\iota} - 8\, r_1\, \partial_\beta \omega_{\alpha\iota\theta}\, \partial^\theta \omega^{\alpha\beta\iota} + 2\, t_2\ \omega_{\alpha\iota\theta}\, (\omega^{\alpha\iota\theta} + 2\, \partial^\theta f^{\alpha\iota}) - 8\, r_1\, \partial_\beta \omega_{\alpha\iota\theta}\, \partial^\theta \omega^{\alpha\beta\iota} + 8\, r_2\, \partial_\beta \omega_{\alpha\iota\theta}\, \partial^\theta \omega^{\alpha\beta\iota} + 4\, r_1\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota} - 16\, r_1\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota} + 4\, r_2\, \partial_\beta \omega_{\iota\theta\alpha}\, \partial^\theta \omega^{\alpha\beta\iota} - 4\, r_1\, \partial_\iota \omega_{\alpha\beta\theta}\, \partial^\theta \omega^{\alpha\beta\iota} + 4\, r_1\, \partial_\theta \omega_{\alpha\beta\iota}\, \partial^\theta \omega^{\alpha\beta\iota} + 2\, r_2\, \partial_\theta \omega_{\alpha\beta\iota}\, \partial^\theta \omega^{\alpha\beta\iota} - 4\, r_2\, \partial_\theta \omega_{\alpha\iota\beta}\, \partial^\theta \omega^{\alpha\beta\iota})) [t,\, x,\, y,\, z]\, dz\, dy\, dx\, dt$$

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

	$\sigma_{1^-}^{\#1}{}_\alpha$	$\sigma_{1^-}^{\#2}{}_\alpha$	$\tau_{1^-}^{\#1}{}_\alpha$	$\tau_{1^-}^{\#2}{}_\alpha$
$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\frac{6}{(3+k^2)^2\,t_2}$	$\frac{3\,\sqrt{2}}{(3+k^2)^2\,t_2}$	$-\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,t_2}$	0
$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\frac{3\,\sqrt{2}}{(3+k^2)^2\,t_2}$	$\frac{3}{(3+k^2)^2\,t_2}$	$-\frac{3\,i\,k}{(3+k^2)^2\,t_2}$	0
$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\frac{3\,i\,\sqrt{2}\,k}{(3+k^2)^2\,t_2}$	$\frac{3\,i\,k}{(3+k^2)^2\,t_2}$	$\frac{3\,k^2}{(3+k^2)^2\,t_2}$	0
$\sigma_{1^-}^{\#1}{}_\alpha$	0	0	0	$-\frac{1}{k^2\,r_1}$
$\sigma_{1^-}^{\#2}{}_\alpha$	0	0	0	0
$\tau_{1^-}^{\#1}{}_\alpha$	0	0	0	0
$\tau_{1^-}^{\#2}{}_\alpha$	0	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	$k^2\,r_2 + t_2$

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

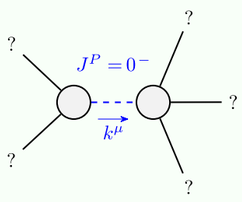
	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}\,\dagger$	0	0	0	0
$\tau_{0^+}^{\#1}\,\dagger$	0	0	0	0
$\tau_{0^+}^{\#2}\,\dagger$	0	0	0	0
$\sigma_{0^-}^{\#1}\,\dagger$	0	0	0	$\frac{1}{k^2\,r_2 + t_2}$

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

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

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

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