

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S_F == \iiint \{ (\frac{1}{6} (4 t_2 \omega_{\lambda'}^{\kappa\lambda} \omega_{\kappa\lambda'}' + 2 t_2 \omega_{\kappa\lambda'}' \omega_{\kappa\lambda}^{\kappa\lambda} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + 12 r_1 \partial_{\lambda'} \omega_{\kappa}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\alpha} - 4 r_1 \partial_1^{\beta} \omega_{\kappa}^{\theta\alpha} \partial_{\theta} \omega_{\alpha\beta}^{\kappa} + 4 r_2 \partial_2^{\beta} \omega_{\kappa}^{\theta\alpha} \partial_{\theta} \omega_{\alpha\beta}^{\kappa} - 4 r_1 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\lambda}^{\alpha} - 2 r_2 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\lambda}^{\alpha\beta\theta} + 4 r_1 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\lambda}^{\theta\alpha\beta} - 4 r_2 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\lambda}^{\theta\alpha\beta} + 12 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega_{\lambda}^{\theta\kappa\lambda} - 12 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\theta\kappa\lambda} + 12 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\theta\kappa\lambda} - 24 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\kappa\lambda\theta} + t_2 \partial^{\alpha} f_{\alpha}^{\kappa} \partial_{\kappa} f_{\theta}^{\lambda} \partial_{\lambda}^{\theta} - t_2 \partial^{\alpha} f_{\alpha}^{\kappa} \partial_{\theta}^{\lambda} \partial_{\kappa} f_{\alpha}^{\theta} + t_2 \partial^{\alpha} f_{\alpha}^{\kappa} \partial_{\kappa} f_{\lambda}^{\theta} + t_2 \partial_{\kappa} f_{\lambda}^{\theta} \partial_{\theta}^{\lambda} \partial_{\kappa} f_{\alpha}^{\theta} + 4 r_1 \partial_{\kappa} \omega_{\alpha\beta\theta}^{\kappa} \partial^{\kappa} \omega_{\alpha\beta\theta} - 4 r_1 \partial_{\kappa} \omega_{\alpha\beta\theta}^{\kappa} \partial^{\alpha\beta} \omega_{\alpha\beta\theta} + 4 r_2 \partial_{\kappa} \omega_{\alpha\beta\theta}^{\kappa} \partial^{\alpha\beta} \omega_{\alpha\beta\theta} + 4 r_1 \partial^{\beta} \omega_{\alpha\beta}^{\lambda} \partial_{\lambda} \omega_{\alpha\beta}^{\lambda} - 4 r_2 \partial^{\beta} \omega_{\alpha\beta}^{\lambda} \partial_{\lambda} \omega_{\alpha\beta}^{\lambda} - 12 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial^{\lambda} \omega_{\kappa}^{\theta\kappa} + 12 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial^{\lambda} \omega_{\kappa}^{\theta\kappa}) [t, x, y, z] dz dy dx dt$$

	$\omega_{1+}^{\#1+\alpha\beta}$	$\omega_{1+}^{\#2+\alpha\beta}$	$f_{1+}^{\#1+\alpha\beta}$	$\omega_{1-}^{\#1-\alpha}$	$\omega_{1-}^{\#2-\alpha}$	$f_{1-}^{\#1-\alpha}$	$f_{1-}^{\#2-\alpha}$
$\omega_{1+}^{\#1+\alpha\beta}$	$\frac{2t_2}{3}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\omega_{1+}^{\#2+\alpha\beta}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$f_{1+}^{\#1+\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{1}{3}ikt_2$	$\frac{k^2t_2}{3}$	0	0	0	0
$\omega_{1-}^{\#1-\alpha}$	0	0	0	$-k^2r_1$	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

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

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

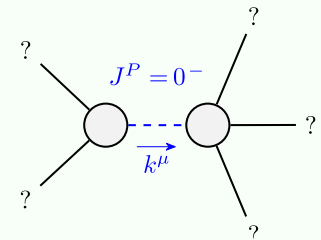
	$\sigma_{0+}^{\#1}$	$\tau_{0+}^{\#1}$	$\tau_{0+}^{\#2}$	$\sigma_{0-}^{\#1}$
$\sigma_{0+}^{\#1}$	0	0	0	0
$\tau_{0+}^{\#1}$	0	0	0	0
$\tau_{0+}^{\#2}$	0	0	0	0
$\sigma_{0-}^{\#1}$	0	0	0	$\frac{1}{k^2r_2+t_2}$

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
$\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#1\alpha\beta} == 0$	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

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

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

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