

Wave operator and propagator

Quadratic (free) action

$$S^F_{\equiv\equiv}$$

$$\begin{aligned} & \int \int \int (\frac{1}{3} (-3 t_1 \omega_{\lambda'}^{\alpha\prime} \omega_{\kappa\alpha}^{\kappa} \omega_{\kappa\lambda}^{\kappa\lambda} \omega_{\kappa\lambda}'^{\prime} + t_1 \omega_{\kappa\lambda}'^{\prime} \omega_{\kappa\lambda}^{\kappa\lambda} + 3 f^{\alpha\beta} \tau_{\alpha\beta} + 3 \omega_{\alpha\beta}^{\alpha\beta}) \\ & \sigma_{\alpha\beta\chi} + 6 r_1 \partial_{\lambda} \omega_{\kappa}^{\kappa\lambda} \partial' / \omega_{\lambda}^{\alpha} - 2 r_1 \partial^{\beta} \omega_{\alpha}^{\theta\alpha} \partial_{\kappa} \partial_{\theta} \omega_{\alpha\beta}^{\kappa} + 2 r_2 \partial^{\beta} \omega_{\alpha}^{\theta\alpha} \partial_{\kappa} \partial_{\theta} \omega_{\alpha\beta}^{\kappa} - \\ & 2 r_1 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\alpha\beta}^{\alpha\theta} - r_2 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\alpha\beta}^{\alpha\theta} + 2 r_1 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} - \\ & 2 r_2 \partial_{\theta} \omega_{\alpha\beta}^{\kappa} \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} + 6 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\theta\kappa\lambda} - 6 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\theta\kappa\lambda} + \\ & 6 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega_{\lambda}^{\kappa\lambda\theta} - 12 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega_{\lambda}^{\kappa\lambda\theta} - t_1 \partial^{\alpha} f_{\theta\kappa} \partial^{\kappa} f_{\alpha}^{\theta} - 2 t_1 \partial^{\alpha} f_{\kappa\theta} \partial^{\kappa} f_{\alpha}^{\theta} - \\ & t_1 \partial^{\alpha} f_{\alpha\lambda}^{\lambda} \partial^{\kappa} f_{\alpha\lambda}^{\kappa} + 3 t_1 \omega_{\kappa\alpha}^{\alpha} \partial^{\kappa} f_{\lambda}^{\prime} + 3 t_1 \omega_{\kappa\lambda}^{\lambda} \partial^{\kappa} f_{\lambda}^{\prime} + 6 t_1 \partial^{\alpha} f_{\kappa\alpha} \partial^{\kappa} f_{\lambda}^{\prime} - \\ & 3 t_1 \partial_{\kappa} f_{\lambda}^{\lambda} \partial^{\kappa} f_{\lambda}^{\prime} + t_1 \omega_{\theta\kappa} \partial^{\kappa} f_{\lambda}^{\theta\beta} + 4 t_1 \omega_{\lambda\kappa\theta} \partial^{\kappa} f_{\lambda}^{\prime\theta} - t_1 \omega_{\theta\kappa\lambda} \partial^{\kappa} f_{\lambda}^{\prime\theta} + \\ & 2 t_1 \omega_{\theta\kappa\lambda} \partial^{\kappa} f_{\lambda}^{\prime\theta} - 3 t_1 \omega_{\lambda\alpha}^{\alpha} \partial^{\kappa} f_{\lambda}^{\prime} - 3 t_1 \omega_{\lambda\lambda}^{\lambda} \partial^{\kappa} f_{\lambda}^{\prime} + t_1 \partial^{\alpha} f_{\lambda}^{\alpha} \partial^{\kappa} f_{\lambda}^{\lambda} + \\ & t_1 \partial_{\kappa} f_{\theta}^{\lambda} \partial^{\kappa} f_{\lambda}^{\theta} + 2 t_1 \partial_{\kappa} f_{\theta}^{\lambda} \partial^{\kappa} f_{\lambda}^{\theta} - 3 t_1 \partial^{\alpha} f_{\lambda}^{\alpha} \partial^{\kappa} f_{\lambda}^{\theta} + 2 r_1 \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} \partial^{\kappa} \omega_{\alpha\beta} + \\ & r_2 \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} \partial^{\kappa} \omega_{\alpha\beta} - 2 r_1 \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} \partial^{\kappa} \omega_{\alpha\beta} + 2 r_2 \partial_{\kappa} \omega_{\alpha\beta}^{\theta\alpha\beta} \partial^{\kappa} \omega_{\alpha\beta} + 2 r_1 \partial^{\beta} \omega_{\lambda}^{\alpha\lambda} \\ & \partial_{\lambda} \omega_{\alpha\beta}^{\prime} - 2 r_2 \partial^{\beta} \omega_{\lambda}^{\alpha\lambda} \partial_{\lambda} \omega_{\alpha\beta}^{\prime} - 8 r_1 \partial^{\beta} \omega_{\lambda}^{\alpha\lambda} \partial_{\lambda} \omega_{\alpha\beta}^{\prime} + 2 r_2 \partial^{\beta} \omega_{\lambda}^{\alpha\lambda} \partial_{\lambda} \omega_{\alpha\beta}^{\prime} - \\ & 6 r_1 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial^{\lambda} \omega_{\lambda}^{\theta\kappa} + 6 r_1 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial^{\lambda} \omega_{\lambda}^{\theta\kappa})) [t, x, y, z] dz dy dx dt \end{aligned}$$

$\frac{6}{(3+2k^2)^2 t_1}$	$-\frac{6\sqrt{2}}{(3+2k^2)^2 t_1}$	$-\frac{6i\sqrt{2}k}{(3+2k^2)^2 t_1}$	0	0	0
$-\frac{6\sqrt{2}}{(3+2k^2)^2 t_1}$	$\frac{12}{(3+2k^2)^2 t_1}$	$\frac{12ik}{(3+2k^2)^2 t_1}$	0	0	0
$\frac{6i\sqrt{2}k}{(3+2k^2)^2 t_1}$	$-\frac{12ik}{(3+2k^2)^2 t_1}$	$\frac{12k^2}{(3+2k^2)^2 t_1}$	0	0	0
0	0	0	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	0	$\frac{2ik}{t_1+2k^2 t_1}$
0	0	0	$\frac{\sqrt{2}}{t_1+2k^2 t_1}$	0	$\frac{i\sqrt{2}k(2k^2 r_1+t_1)}{(t_1+2k^2 t_1)^2}$
0	0	0	0	0	0
0	0	0	$-\frac{2ik}{t_1+2k^2 t_1}$	$-\frac{i\sqrt{2}k(2k^2 r_1+t_1)}{(t_1+2k^2 t_1)^2}$	$\frac{2k^2(2k^2 r_1+t_1)}{(t_1+2k^2 t_1)^2}$

$\omega_1^{\#1} + \alpha\beta$	$\omega_1^{\#1}\alpha\beta$	$\omega_1^{\#2}$	$f_1^{\#1} + \alpha\beta$	$f_1^{\#1}\alpha\beta$	$\omega_1^{\#1}\alpha$	$\omega_1^{\#2}$	$f_1^{\#1}\alpha$	$f_1^{\#2}$
$\omega_1^{\#1} + \alpha\beta$	$\frac{t_1}{6}$	$-\frac{t_1}{3\sqrt{2}}$	$-\frac{t_1}{3\sqrt{2}}$	$-\frac{i k t_1}{3\sqrt{2}}$	0	0	0	0
$\omega_1^{\#2} + \alpha\beta$	$-\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	$\frac{t_1}{3}$	$\frac{i k t_1}{3}$	0	0	0	0
$f_1^{\#1} + \alpha\beta$	$\frac{i k t_1}{3\sqrt{2}}$	$-\frac{1}{3} i k t_1$	$\frac{k^2 t_1}{3}$	$\frac{k^2 t_1}{3}$	0	0	0	0
$\omega_1^{\#1} + \alpha$	0	0	0	0	$-k^2 r_1 - \frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$i k t_1$
$\omega_1^{\#2} + \alpha$	0	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_1^{\#1} + \alpha$	0	0	0	0	0	0	0	0
$f_1^{\#2} + \alpha$	0	0	0	0	$-i k t_1$	0	0	0

	$\sigma_0^{+\#1}$	$\tau_0^{+\#1}$	$\tau_0^{+\#2}$	$\sigma_0^{+\#1}$
$\sigma_0^{+\#1} \dagger$	$-\frac{1}{(1+2k^2)^2 t_1}$	$\frac{i\sqrt{2}k}{(1+2k^2)^2 t_1}$	0	0
$\tau_0^{+\#1} \dagger$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2 t_1}$	$-\frac{2k^2}{(1+2k^2)^2 t_1}$	0	0
$\tau_0^{+\#2} \dagger$	0	0	0	0
$\sigma_0^{-\#1} \dagger$	0	0	0	$\frac{1}{k^2 r_2}$

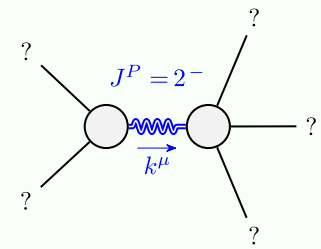
	$\sigma_{2^+}^{\#1} \alpha\beta$	$\tau_{2^+}^{\#1} \alpha\beta$	$\sigma_{2^-}^{\#1} \alpha\beta\chi$
$\sigma_{2^+}^{\#1} \dagger \alpha\beta$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2 t_1}$	0
$\tau_{2^+}^{\#1} \dagger \alpha\beta$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2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

	$\omega_{2^+}^{\#1} \alpha_\beta$	$f_{2^+}^{\#1} \alpha_\beta$	$\omega_{2^-}^{\#1} \alpha_\beta \chi$
$\omega_{2^+}^{\#1} \dagger \alpha_\beta$	$\frac{t_1}{2}$	$-\frac{ik t_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1} \dagger \alpha_\beta$	$\frac{ik t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_{2^-}^{\#1} \dagger \alpha_\beta \chi$	0	0	$k^2 r_1 + \frac{t_1}{2}$

	$\omega_0^{#1} \dagger$	$f_0^{#1}$	$f_0^{#2}$	$\omega_0^{#1}$
$\omega_0^{#1} \dagger$	$-t_1$	$i \sqrt{2} k t_1$	0	0
$f_0^{#1} \dagger$	$-i \sqrt{2} k t_1$	$-2 k^2 t_1$	0	0
$f_0^{#2} \dagger$	0	0	0	0
$\omega_0^{#1}$	0	0	0	$k^2 r_2$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^2 = 0$	1
$\tau_{0+}^{\#1} - 2 i k \sigma_{0+}^{\#1} = 0$	1
$\tau_{1-}^{2\alpha} + 2 i k \sigma_{1-}^{2\alpha} = 0$	3
$\tau_{1-}^{\#1\alpha} = 0$	3
$\tau_{1+}^{\#1\alpha\beta} - 2 i k \sigma_{1+}^{\#1\alpha\beta} = 0$	3
$2 \sigma_{1+}^{\#1\alpha\beta} + \sigma_{1+}^{\#2\alpha\beta} = 0$	3
$\tau_{2+}^{\#1\alpha\beta} - 2 i k \sigma_{2+}^{\#1\alpha\beta} = 0$	5
Total constraints:	19

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

(No massless particles)

Unitarity conditions

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