Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S_F == \iiint (\tfrac{1}{3}(3\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + 3(2r_1 - 2r_3 - r_5)\,\partial_l\omega^{\kappa\lambda}{}_{\kappa}\,\partial^{\prime}\omega_{\lambda\ \alpha}^{\ \alpha} - 2r_1\,\partial^{\beta}\omega^{\theta\alpha}{}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa} - 2r_1\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta} - 6r_1\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} + 2r_1\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} + 6r_1\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} - 3r_5\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} - 6r_3\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} + 6r_1\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} - 6r_3\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} - 12r_1\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} + 12r_3\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} + 2r_1\,\partial_{\kappa}\omega^{\alpha\beta\theta}\,\partial^{\kappa}\omega_{\alpha\beta\theta} - 2r_1\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta} + 4r_1\,\partial^{\beta}\omega_{l}^{\ \lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}^{\ \prime} - 12r_3\,\partial^{\beta}\omega_{l}^{\ \lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}^{\ \prime} + 6r_1\,\partial_{\alpha}\omega_{\lambda\ \theta}^{\ \alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa} - 6r_1\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa} + 3r_5\,\partial_{\theta}\omega_{\lambda\ \alpha}^{\ \alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa})\,)[t, x, y, z]\,dl\,dz\,dl\,dy\,dl\,dx\,dl\,dt$$

$$\begin{array}{c|cc} & \sigma_{2^+}^{\#1\ \alpha\beta} & \sigma_{2^-}^{\#1\ \alpha\beta\chi} \\ \hline \sigma_{2^+}^{\#1\ \alpha\beta} & 0 & 0 \\ \sigma_{2^-}^{\#1\ \alpha\beta\chi} & 0 & \frac{1}{k^2 r_1} \end{array}$$

$$\begin{array}{c|cc} & \omega_{2^+}^{\#1\ \alpha\beta} & \omega_{2^-}^{\#1\ \alpha\beta\chi} \\ \hline \omega_{2^+}^{\#1\ \alpha\beta\ \dagger} & 0 & 0 \\ \omega_{2^-}^{\#1\ \alpha\beta\chi\ \dagger} & 0 & k^2 r_1 \end{array}$$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma_{0^-}^{\#1} == 0$	1
$\sigma_{1^-}^{\#2\ \alpha} == 0$	3
$\sigma_{1^+}^{\#2\ \alpha\beta} == 0$	3
$\sigma_{2^+}^{\#1\ \alpha\beta} == 0$	5
Total constraints:	12

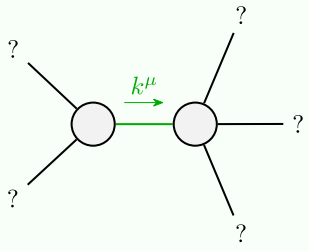
$$\begin{array}{c|cccc} & \omega_{1^+}^{\#1\ \alpha\beta} & \omega_{1^+}^{\#2\ \alpha\beta} & \omega_{1^-}^{\#1\ \alpha} & \omega_{1^-}^{\#2\ \alpha} \\ \hline \omega_{1^+}^{\#1\ \alpha\beta\ \dagger} & k^2(2r_3 + r_5) & 0 & 0 & 0 \\ \omega_{1^+}^{\#2\ \alpha\beta\ \dagger} & 0 & 0 & 0 & 0 \\ \omega_{1^-}^{\#1\ \alpha\ \dagger} & 0 & 0 & k^2(-r_1 + 2r_3 + r_5) & 0 \\ \omega_{1^-}^{\#2\ \alpha\ \dagger} & 0 & 0 & 0 & 0 \end{array}$$

$$\begin{array}{c|cccc} & \sigma_{1^+}^{\#1\ \alpha\beta} & \sigma_{1^+}^{\#2\ \alpha\beta} & \sigma_{1^-}^{\#1\ \alpha} & \sigma_{1^-}^{\#2\ \alpha} \\ \hline \sigma_{1^+}^{\#1\ \alpha\beta\ \dagger} & \frac{1}{k^2(2r_3+r_5)} & 0 & 0 & 0 \\ \sigma_{1^+}^{\#2\ \alpha\beta\ \dagger} & 0 & 0 & 0 & 0 \\ \sigma_{1^-}^{\#1\ \alpha\ \dagger} & 0 & 0 & \frac{1}{k^2(-r_1+2r_3+r_5)} & 0 \\ \sigma_{1^-}^{\#2\ \alpha\ \dagger} & 0 & 0 & 0 & 0 \end{array}$$

$$\begin{array}{c|cc} & \sigma_{0^+}^{\#1} & \sigma_{0^-}^{\#1} \\ \hline \sigma_{0^+}^{\#1\ \dagger} & \frac{1}{6k^2(-r_1+r_3)} & 0 \\ \sigma_{0^-}^{\#1\ \dagger} & 0 & 0 \end{array}$$

$$\begin{array}{c|cc} & \omega_{0^+}^{\#1} & \omega_{0^-}^{\#1} \\ \hline \omega_{0^+}^{\#1\ \dagger} & 6k^2(-r_1 + r_3) & 0 \\ \omega_{0^-}^{\#1\ \dagger} & 0 & 0 \end{array}$$

Massive and massless spectra



Quadratic pole

Pole residue:	$\frac{1}{r_1(r_1-2r_3-r_5)(2r_3+r_5)} > 0$
Polarisations:	2

(No massive particles)

Unitarity conditions

$r_1 < 0 \,\&\&\, (r_5 < r_1 - 2r_3 \,||\, r_5 > -2r_3) \,||\, r_1 > 0 \,\&\&\, -2r_3 < r_5 < r_1 - 2r_3$