

Particle spectrograph

Wave operator and propagator

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{1}{k^2(2r_3+r_5)}$	0	0	0	0
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	0	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	0	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^{\alpha}$	0	$\frac{2}{k^2(r_3+2r_5)}$	$\frac{2\sqrt{2}}{k^2(1+2k^2)(r_3+2r_5)}$	0	$\frac{4i}{k(1+2k^2)(r_3+2r_5)}$
$\sigma_{1-}^{\#2} \dagger^{\alpha}$	0	$\frac{2\sqrt{2}}{k^2(1+2k^2)(r_3+2r_5)}$	$\frac{3k^2(r_3+2r_5)+4t_3}{(k+2k^2)^2(r_3+2r_5)t_3}$	0	$\frac{i\sqrt{2}(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$
$\tau_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0
$\tau_{1-}^{\#2} \dagger^{\alpha}$	0	$-\frac{4i}{k(1+2k^2)(r_3+2r_5)}$	$-\frac{i\sqrt{2}(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$	0	$\frac{6k^2(r_3+2r_5)+8t_3}{(1+2k^2)^2(r_3+2r_5)t_3}$

Quadratic (free) action

$S_F ==$

$$\iiint (\frac{1}{6} (4t_3 \omega_{\lambda}^{\alpha} \omega_{\kappa}^{\alpha} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 3 r_3 \partial_{\lambda} \omega_{\kappa}^{\alpha} \partial' \omega_{\lambda}^{\alpha} - 6 r_5 \partial_{\lambda} \omega_{\kappa}^{\alpha} \partial' \omega_{\lambda}^{\alpha} + 3 r_3 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\theta\kappa\lambda} - 6 r_5 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\theta\kappa\lambda} - 3 r_3 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega^{\theta\kappa\lambda} + 6 r_5 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega^{\theta\kappa\lambda} - 3 r_3 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\kappa\lambda\theta} - 6 r_5 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\kappa\lambda\theta} + 12 r_5 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial_{\kappa} \omega^{\kappa\lambda\theta} - 4 t_3 \omega_{\kappa\alpha}^{\alpha} \partial^{\kappa} f'_{\lambda} - 4 t_3 \omega_{\kappa\alpha}^{\alpha} \partial^{\kappa} f'_{\lambda} - 4 t_3 \omega_{\kappa\alpha}^{\alpha} \partial^{\kappa} f'_{\lambda} + 4 t_3 \omega_{\lambda\alpha}^{\alpha} \partial^{\kappa} f'_{\kappa} + 4 t_3 \omega_{\lambda\alpha}^{\alpha} \partial^{\kappa} f'_{\kappa} + 4 t_3 \omega_{\lambda\alpha}^{\alpha} \partial^{\kappa} f'_{\kappa} - 24 r_3 \partial^{\theta} \omega_{\lambda}^{\alpha} \partial_{\alpha} \omega_{\theta}^{\lambda\alpha} - 3 r_3 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\theta\kappa} + 6 r_5 \partial_{\alpha} \omega_{\lambda}^{\alpha} \partial_{\theta} \omega^{\theta\kappa} + 3 r_3 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial' \omega_{\alpha}^{\theta\kappa} - 6 r_5 \partial_{\theta} \omega_{\lambda}^{\alpha} \partial' \omega_{\alpha}^{\theta\kappa})) [t, x, y, z] dz dy dx dt$$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2} \alpha$
$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$k^2(2r_3+r_5)$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	0	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	0	0	0	0	0
$\omega_{1-}^{\#1} \dagger^{\alpha}$	0	0	$k^2(\frac{3}{2}+r_5)+\frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	$-\frac{2}{3}i k t_3$
$\omega_{1-}^{\#2} \dagger^{\alpha}$	0	0	$-\frac{\sqrt{2}t_3}{3}$	$\frac{t_3}{3}$	$\frac{1}{3}i\sqrt{2} k t_3$
$f_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0
$f_{1-}^{\#2} \dagger^{\alpha}$	0	0	$\frac{2i k t_3}{3}$	$-\frac{1}{3}i\sqrt{2} k t_3$	$\frac{2k^2 t_3}{3}$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\sigma_0^{\#1} == 0$	1
$\tau_0^{\#2} == 0$	1
$\tau_0^{\#1} - 2i k \sigma_0^{\#1} == 0$	1
$\tau_1^{\#2\alpha} + 2i k \sigma_1^{\#2\alpha} == 0$	3
$\tau_1^{\#1\alpha} == 0$	3
$\tau_1^{\#1\alpha\beta} == 0$	3
$\sigma_1^{\#2\alpha\beta} == 0$	3
$\sigma_2^{\#1\alpha\beta\chi} == 0$	5
$\tau_2^{\#1\alpha\beta} == 0$	5
Total constraints:	25

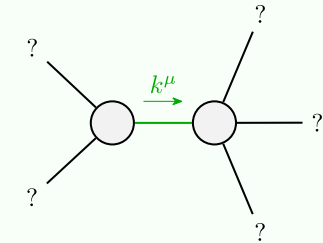
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2-}^{\#1} \alpha\beta\chi$
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{3k^2 r_3}{2}$	0
$f_{2+}^{\#1} \dagger^{\alpha\beta}$	0	0
$\omega_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	0	0

$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{2-}^{\#1} \alpha\beta\chi$
$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{2}{3k^2 r_3}$	0
$\tau_{2+}^{\#1} \dagger^{\alpha\beta}$	0	0
$\sigma_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	0	0

$\sigma_0^{\#1} \dagger$	$\tau_0^{\#1}$	$\tau_0^{\#2}$	$\sigma_0^{\#1}$
$\sigma_0^{\#1} \dagger$	$\frac{1}{(1+2k^2)^2 t_3}$	$-\frac{i\sqrt{2} k}{(1+2k^2)^2 t_3}$	0
$\tau_0^{\#1} \dagger$	$\frac{i\sqrt{2} k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0
$\tau_0^{\#2} \dagger$	0	0	0
$\sigma_0^{\#1} \dagger$	0	0	0

$\omega_0^{\#1} \dagger$	$f_0^{\#1}$	$f_0^{\#2}$	$\omega_0^{\#1}$
$\omega_0^{\#1} \dagger$	t_3	$-i\sqrt{2} k t_3$	0
$f_0^{\#1} \dagger$	$i\sqrt{2} k t_3$	$2k^2 t_3$	0
$f_0^{\#2} \dagger$	0	0	0
$\omega_0^{\#1} \dagger$	0	0	0

Massive and massless spectra



Quadratic pole

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

Polarisations: 2

(No massive particles)

Unitarity conditions

$r_3 < 0 \&\& (r_5 < -\frac{r_3}{2} \parallel r_5 > -2r_3) \parallel r_3 > 0 \&\& -2r_3 < r_5 < -\frac{r_3}{2}$