

Particle spectrograph

Wave operator and propagator

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \alpha\beta$	$\tau_{1+}^{\#1} \alpha\beta$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{1}{k^2(2r_3+r_5)}$	$-\frac{\sqrt{2}}{k^2(1+k^2)(2r_3+r_5)}$	0	0	0	0
$\sigma_{1+}^{\#2} \dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{k^2(1+k^2)(2r_3+r_5)}$	$\frac{3k^2(2r_3+r_5)+2t_2}{(k+k^3)^2(2r_3+r_5)t_2}$	0	0	0	0
$\tau_{1+}^{\#1} \dagger^{\alpha\beta}$	$\frac{i\sqrt{2}}{k(1+k^2)(2r_3+r_5)}$	$-\frac{i(3k^2(2r_3+r_5)+2t_2)}{k(1+k^2)^2(2r_3+r_5)t_2}$	0	0	0	0
$\sigma_{1-}^{\#1} \dagger^{\alpha}$	0	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	0	$\frac{2\sqrt{2}}{k^2(1+2k^2)(r_3+2r_5)}$	$\frac{3k^2(r_3+2r_5)+4t_3}{(k+2k^3)^2(r_3+2r_5)t_3}$	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	0
$\tau_{1-}^{\#2} \dagger^{\alpha}$	0	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	$\frac{6k^2(r_3+2r_5)+8t_3}{(1+2k^2)^2(r_3+2r_5)t_3}$

$\sigma_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#1} \dagger$	$\tau_{0+}^{\#2} \dagger$	$\sigma_{0-}^{\#1} \dagger$
$\sigma_{0+}^{\#1} \dagger$	$\frac{1}{(1+2k^2)^2t_3}$	0	0
$\tau_{0+}^{\#1} \dagger$	$\frac{i\sqrt{2}k}{(1+2k^2)^2t_3}$	0	0
$\tau_{0+}^{\#2} \dagger$	0	0	0
$\sigma_{0-}^{\#1} \dagger$	0	0	$\frac{1}{t_2}$

$\omega_{0+}^{\#1} \dagger$	$f_{0+}^{\#1} \dagger$	$f_{0+}^{\#2} \dagger$	$\omega_{0-}^{\#1} \dagger$
$\omega_{0+}^{\#1} \dagger$	t_3	0	0
$f_{0+}^{\#1} \dagger$	$i\sqrt{2}kt_3$	0	0
$f_{0+}^{\#2} \dagger$	0	0	0
$\omega_{0-}^{\#1} \dagger$	0	0	t_2

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2} \alpha$
$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$k^2(2r_3+r_5)+\frac{2t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\omega_{1+}^{\#2} \dagger^{\alpha\beta}$	$\frac{\sqrt{2}t_2}{3}$	$\frac{t_2}{3}$	0	0	0	0
$f_{1+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{1}{3}ikt_2$	0	0	0	0
$\omega_{1-}^{\#1} \dagger^{\alpha}$	0	0	$k^2(\frac{r_3}{2}+r_5)+\frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	0	$-\frac{2}{3}ikt_3$
$\omega_{1-}^{\#2} \dagger^{\alpha}$	0	0	$-\frac{\sqrt{2}t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_3$
$f_{1-}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0
$f_{1-}^{\#2} \dagger^{\alpha}$	0	0	$\frac{2ikt_3}{3}$	$-\frac{1}{3}i\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$

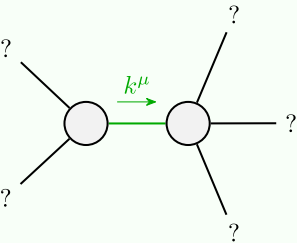
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$f_{2+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2-}^{\#1} \alpha\beta\chi$
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{3k^2r_3}{2}$	0
$f_{2+}^{\#1} \dagger^{\alpha\beta}$	0	0
$\omega_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	0	0

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

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} - 2ik\sigma_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} + 2ik\sigma_{1-}^{\#2\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\sigma_{2-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	21

Quadratic (free) action
S== $\int\int\int\int(\frac{1}{6}(-4t_3\omega_{\alpha}^{\alpha'}\omega_{\kappa}^{\kappa}+6f^{\alpha\beta}\tau_{\alpha\beta}+6\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi}+8t_3\omega_{\alpha\kappa}^{\kappa}\partial_{\lceil}f^{\alpha\lceil}-8t_3\omega_{\lceil\kappa}^{\kappa}\partial_{\rceil}f^{\alpha\rceil}+4t_3\partial_{\lceil}f^{\alpha\rceil}\partial_{\kappa}f_{\alpha}^{\kappa}-3r_3\partial_{\beta}\omega_{\lceil\theta}^{\theta}\partial_{\rceil}f_{\alpha}^{\alpha}-3r_3\partial_{\lceil}\omega_{\beta}^{\theta}\partial_{\rceil}\omega_{\alpha}^{\alpha\beta}-3r_3\partial_{\alpha}\omega^{\alpha\beta\lceil}-\partial_{\theta}\omega_{\beta\lceil}^{\theta}+6r_3\partial_{\lceil}\omega_{\alpha}^{\alpha\beta}\partial_{\theta}\omega_{\beta\lceil}^{\theta}-3r_3\partial_{\alpha}\omega^{\alpha\beta\lceil}\partial_{\theta}\omega_{\lceil\beta}^{\theta}+6r_3\partial_3\omega^{\alpha\beta}\partial_{\theta}\omega_{\lceil\beta}^{\theta}+4t_2\omega_{\lceil\theta\alpha}\partial^{\theta}f^{\alpha\lceil}+2t_2\partial_{\alpha}f_{\lceil\theta}\partial^{\theta}f^{\alpha\lceil}-t_2\partial_{\alpha}f_{\theta\lceil}\partial^{\theta}f^{\alpha\lceil}-t_2\partial_{\alpha}f_{\theta\lceil}\partial^{\theta}f^{\alpha\lceil}+t_2\partial_{\theta}f_{\alpha\lceil}\partial^{\theta}f^{\alpha\lceil}-t_2\partial_{\theta}f_{\lceil\alpha}\partial^{\theta}f^{\alpha\lceil}-4t_2\omega_{\alpha\theta\lceil}(\omega^{\alpha\lceil\theta}+\partial^{\theta}f^{\alpha\lceil})+2t_2\omega_{\alpha\lceil\theta}(\omega^{\alpha\lceil\theta}+2\partial^{\theta}f^{\alpha\lceil})-24r_3\partial_{\beta}\omega_{\lceil\theta\alpha}\partial^{\theta}\omega^{\alpha\beta\lceil}+6r_5\partial_{\lceil}\omega_{\theta\kappa}^{\kappa}\partial^{\theta}\omega_{\alpha}^{\alpha\lceil}-6r_5\partial_{\theta}\omega_{\lceil\kappa}^{\kappa}\partial^{\theta}\omega_{\alpha}^{\alpha\lceil}+4t_3\partial_{\lceil}f^{\alpha\lceil}\partial_{\kappa}f_{\alpha}^{\kappa}-8t_3\partial_3f_{\alpha}^{\alpha}\partial_{\kappa}f_{\lceil}^{\kappa}-6r_5\partial_{\alpha}\omega^{\alpha\lceil\theta}\partial_{\kappa}\omega_{\lceil\theta}^{\kappa}+12r_5\partial^{\theta}\omega_{\alpha}^{\alpha\lceil}\partial_{\kappa}\omega_{\lceil\theta}^{\kappa}+6r_5\partial_{\alpha}\omega^{\alpha\lceil\theta}\partial_{\kappa}\omega_{\theta\lceil}^{\kappa}-12r_5\partial^{\theta}\omega_{\alpha}^{\alpha\lceil}\partial_{\kappa}\omega_{\theta}^{\kappa})) [t, x, y, z] dz dy dx dt$

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

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