Particle spectrograph

Wave operator and propagator

	$\sigma^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#2}_{1^+\,\alpha\beta}$	$\tau^{\#1}_{1^+\,\alpha\beta}$	$\sigma^{\#1}_{1^-\,\alpha}$	$\sigma^{\#2}_{1^-\,\alpha}$	$\tau^{\#1}_{1^-\,\alpha}$	$\tau^{\#2}_{1^-\,\alpha}$
$\sigma^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{1}{k^2 r_5}$	$-\frac{\sqrt{2}}{k^2 r_5+k^4 r_5}$	$-\frac{i\sqrt{2}}{k r_5+k^3 r_5}$	0	0	0	0
$\sigma^{\#2}_{1^+}\dagger^{\alpha\beta}$	$-\frac{\sqrt{2}}{k^2 r_5+k^4 r_5}$	$\frac{3k^2 r_5+2t_2}{(k+k^3)^2 r_5 t_2}$	$\frac{i(3k^2 r_5+2t_2)}{k(1+k^2)^2 r_5 t_2}$	0	0	0	0
$\tau^{\#1}_{1^+}\dagger^{\alpha\beta}$	$\frac{i\sqrt{2}}{k r_5+k^3 r_5}$	$-\frac{i(3k^2 r_5+2t_2)}{k(1+k^2)^2 r_5 t_2}$	$\frac{3k^2 r_5+2t_2}{(1+k^2)^2 r_5 t_2}$	0	0	0	0
$\sigma^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{1}{k^2 r_5}$	$\frac{\sqrt{2}}{k^2 r_5+2k^4 r_5}$	0	$\frac{2i}{k r_5+2k^3 r_5}$
$\sigma^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{\sqrt{2}}{k^2 r_5+2k^4 r_5}$	$\frac{3k^2 r_5+2t_3}{(k+2k^3)^2 r_5 t_3}$	0	$\frac{i\sqrt{2}(3k^2 r_5+2t_3)}{k(1+2k^2)^2 r_5 t_3}$
$\tau^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$\tau^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{2i}{k r_5+2k^3 r_5}$	$-\frac{i\sqrt{2}(3k^2 r_5+2t_3)}{k(1+2k^2)^2 r_5 t_3}$	0	$\frac{6k^2 r_5+4t_3}{(1+2k^2)^2 r_5 t_3}$

Quadratic (free) action

$$S == \iiiint\Big(\tfrac{1}{6}\big(-4t_3\,\omega^{\alpha\iota}{}_{\alpha}\,\omega_{\iota}{}^{\kappa}{}_{\kappa}+6f^{\alpha\beta}\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi}+8t_3\,\omega_{\alpha}{}^{\kappa}{}_{\kappa}\,\partial_{\iota}f^{\alpha\iota}-8t_3\,\omega_{\iota}{}^{\kappa}{}_{\kappa}\,\partial^{\iota}f^{\alpha}{}_{\alpha}+4t_3\,\partial_{\iota}f^{\kappa}{}_{\kappa}\,\partial^{\iota}f^{\alpha}{}_{\alpha}+4t_2\,\omega_{\iota\theta\alpha}\,\partial^{\theta}f^{\alpha\iota}+2t_2\,\partial_{\alpha}f_{\iota\theta}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\alpha}f_{\theta\iota}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\iota}f_{\alpha\theta}\,\partial^{\theta}f^{\alpha\iota}+t_2\,\partial_{\theta}f_{\alpha\iota}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\theta}f_{\iota\alpha}\,\partial^{\theta}f^{\alpha\iota}-4t_2\,\omega_{\alpha\theta\iota}(\omega^{\alpha\iota\theta}+\partial^{\theta}f^{\alpha\iota})+2t_2\,\omega_{\alpha\iota\theta}(\omega^{\alpha\iota\theta}+2\partial^{\theta}f^{\alpha\iota})+8r_2\,\partial_{\beta}\omega_{\alpha\iota\theta}\,\partial^{\theta}\omega^{\alpha\beta\iota}-4r_2\,\partial_{\beta}\omega_{\alpha\theta\iota}\,\partial^{\theta}\omega^{\alpha\beta\iota}+4r_2\,\partial_{\beta}\omega_{\iota\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\iota}-2r_2\,\partial_{\iota}\omega_{\alpha\beta\theta}\,\partial^{\theta}\omega^{\alpha\beta\iota}+2r_2\,\partial_{\theta}\omega_{\alpha\beta\iota}\,\partial^{\theta}\omega^{\alpha\beta\iota}-4r_2\,\partial_{\theta}\omega_{\alpha\iota\beta}\,\partial^{\theta}\omega^{\alpha\beta\iota}+6r_5\,\partial_{\iota}\omega_{\theta}{}^{\kappa}{}_{\kappa}\,\partial^{\theta}\omega^{\alpha\iota}{}_{\alpha}-6r_5\,\partial_{\theta}\omega_{\iota}{}^{\kappa}{}_{\kappa}\,\partial^{\theta}\omega^{\alpha\iota}{}_{\alpha}+4t_3\,\partial_{\iota}f^{\alpha\iota}\,\partial_{\kappa}f_{\alpha}{}^{\kappa}-8t_3\,\partial_{\iota}f^{\alpha}{}_{\alpha}\,\partial_{\kappa}f^{\iota\kappa}-6r_5\,\partial_{\alpha}\omega^{\alpha\iota\theta}\,\partial_{\kappa}\omega_{\iota}{}^{\kappa}{}_{\theta}+12r_5\,\partial^{\theta}\omega^{\alpha\iota}{}_{\alpha}\,\partial_{\kappa}\omega_{\iota}{}^{\kappa}{}_{\theta}+6r_5\,\partial_{\alpha}\omega^{\alpha\iota\theta}\,\partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\iota}-12r_5\,\partial^{\theta}\omega^{\alpha\iota}{}_{\alpha}\,\partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\iota}\big)\Big)[t,x,y,z]\,dz\,dy\,dx\,dt$$

	$\omega^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#2}_{1^+\,\alpha\beta}$	$f^{\#1}_{1^+\,\alpha\beta}$	$\omega^{\#1}_{1^-\,\alpha}$	$\omega^{\#2}_{1^-\,\alpha}$	$f^{\#1}_{1^-\,\alpha}$	$f^{\#2}_{1^-\,\alpha}$
$\omega^{\#1}_{1^+}\dagger^{\alpha\beta}$	$k^2 r_5+\frac{2t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}i\sqrt{2}\,k t_2$	0	0	0	0
$\omega^{\#2}_{1^+}\dagger^{\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i k t_2}{3}$	0	0	0	0
$f^{\#1}_{1^+}\dagger^{\alpha\beta}$	$-\frac{1}{3}i\sqrt{2}\,k t_2$	$-\frac{1}{3}i k t_2$	$\frac{k^2 t_2}{3}$	0	0	0	0
$\omega^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	$k^2 r_5+\frac{2t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	0	$-\frac{2}{3}i k t_3$
$\omega^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}\,k t_3$
$f^{\#1}_{1^-}\dagger^{\alpha}$	0	0	0	0	0	0	0
$f^{\#2}_{1^-}\dagger^{\alpha}$	0	0	0	$\frac{2 i k t_3}{3}$	$-\frac{1}{3}i\sqrt{2}\,k t_3$	0	$\frac{2k^2 t_3}{3}$

	$\sigma^{\#1}_{2^+\,\alpha\beta}$	$\tau^{\#1}_{2^+\,\alpha\beta}$	$\sigma^{\#1}_{2^-\,\alpha\beta\chi}$
$\sigma^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$\tau^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$\sigma^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	0

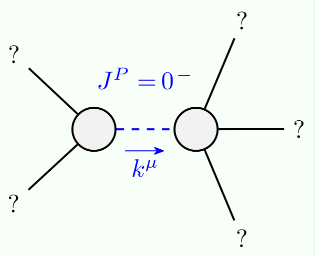
	$\omega^{\#1}_{2^+\,\alpha\beta}$	$f^{\#1}_{2^+\,\alpha\beta}$	$\omega^{\#1}_{2^-\,\alpha\beta\chi}$
$\omega^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$f^{\#1}_{2^+}\dagger^{\alpha\beta}$	0	0	0
$\omega^{\#1}_{2^-}\dagger^{\alpha\beta\chi}$	0	0	0

	$\omega^{\#1}_{0^+}$	$f^{\#1}_{0^+}$	$f^{\#2}_{0^+}$	$\omega^{\#1}_{0^-}$
$\omega^{\#1}_{0^+}\dagger$	t_3	$-i\sqrt{2}\,k t_3$	0	0
$f^{\#1}_{0^+}\dagger$	$i\sqrt{2}\,k t_3$	$2k^2 t_3$	0	0
$f^{\#2}_{0^+}\dagger$	0	0	0	0
$\omega^{\#1}_{0^-}\dagger$	0	0	0	$k^2 r_2+t_2$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau^{\#2}_{0^+} == 0$	1
$\tau^{\#1}_{0^+} - 2ik\,\sigma^{\#1}_{0^+} == 0$	1
$\tau^{\#2}_{1^-}{}^{\alpha} + 2ik\,\sigma^{\#2}_{1^-}{}^{\alpha} == 0$	3
$\tau^{\#1}_{1^-}{}^{\alpha} == 0$	3
$\tau^{\#1}_{1^+}{}^{\alpha\beta} + ik\,\sigma^{\#2}_{1^+}{}^{\alpha\beta} == 0$	3
$\sigma^{\#1}_{2^-}{}^{\alpha\beta\chi} == 0$	5
$\tau^{\#1}_{2^+}{}^{\alpha\beta} == 0$	5
$\sigma^{\#1}_{2^+}{}^{\alpha\beta} == 0$	5
Total constraints:	26

	$\sigma^{\#1}_{0^+}$	$\tau^{\#1}_{0^+}$	$\tau^{\#2}_{0^+}$	$\sigma^{\#1}_{0^-}$
$\sigma^{\#1}_{0^+}\dagger$	$\frac{1}{(1+2k^2)^2 t_3}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	0	0
$\tau^{\#1}_{0^+}\dagger$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0
$\tau^{\#2}_{0^+}\dagger$	0	0	0	0
$\sigma^{\#1}_{0^-}\dagger$	0	0	0	$\frac{1}{k^2 r_2+t_2}$

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

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