Particle spectrograph

Wave operator and propagator

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

$\sigma_{1^+}^{\#1}{}^{\alpha\beta}\dagger$ $\sigma_{1^+}^{\#2}{}^{\alpha\beta}\dagger$ $\tau_{1^+}^{\#1}{}^{\alpha\beta}\dagger$ $\sigma_{1^-}^{\#1}{}^{\alpha}\dagger$ $\sigma_{1^-}^{\#2}{}^{\alpha}\dagger$ $\tau_{1^-}^{\#1}{}^{\alpha}\dagger$ $\tau_{1^-}^{\#2}{}^{\alpha}\dagger$

Quadratic (free) action

$$S_F == \iiint\int\left(\frac{1}{6}(4t_3\,\omega_{\iota}^{\alpha\prime}\,\omega_{\kappa\alpha}{}^{\kappa}+4t_2\,\omega_{\iota}^{\kappa\lambda\prime}\,\omega_{\kappa\lambda}+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi}-6r_5\,\partial_{\iota}\omega^{\kappa\lambda}{}_{\kappa}\,\partial^{\prime}\omega_{\lambda}{}^{\alpha}{}_{\alpha}+4r_2\,\partial^{\beta}\omega^{\theta}{}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}-2r_2\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\alpha\beta\theta}-4r_2\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\partial_{\kappa}\omega^{\theta\alpha\beta}-6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\theta\kappa\lambda}+6r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+12r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\kappa\lambda\theta}+t_2\,\partial^{\alpha}f_{\kappa}{}^{\lambda}\,\partial^{\kappa}f_{\alpha\lambda}-4t_3\,\omega_{\kappa\alpha}{}^{\alpha}\,\partial^{\kappa}f_{\iota}^{\prime}-8t_3\,\partial^{\alpha}f_{\kappa\alpha}\,\partial^{\kappa}f_{\iota}^{\prime}+4t_3\,\partial_{\kappa}f_{\lambda}^{\lambda}\,\partial^{\kappa}f_{\iota}^{\prime}+2t_2\,\omega_{\iota\theta\kappa}\,\partial^{\kappa}f^{\prime\theta}-4t_2\,\omega_{\iota\kappa\theta}\,\partial^{\kappa}f^{\prime\theta}-2t_2\,\omega_{\theta\iota\kappa}\,\partial^{\kappa}f^{\prime\theta}+4t_2\,\omega_{\theta\kappa\iota}\,\partial^{\kappa}f^{\prime\theta}+4t_3\,\omega_{\iota\alpha}{}^{\alpha}\,\partial^{\kappa}f^{\prime}{}_{\kappa}+4t_3\,\omega_{\iota\lambda}{}^{\lambda}\,\partial^{\kappa}f^{\prime}{}_{\kappa}-t_2\,\partial^{\alpha}f^{\lambda}{}_{\kappa}\,\partial^{\kappa}f_{\lambda\alpha}-t_2\,\partial_{\kappa}f_{\theta}{}^{\lambda}\,\partial^{\kappa}f_{\lambda}{}^{\theta}+4t_3\,\partial^{\alpha}f^{\lambda}{}_{\alpha}\,\partial^{\kappa}f_{\lambda\kappa}+2r_2\,\partial_{\kappa}\omega^{\alpha\beta\theta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}+t_2\,\partial_{\kappa}f_{\theta}{}^{\lambda}\,\partial^{\kappa}f_{\lambda}{}^{\theta}+4t_3\,\partial^{\alpha}f^{\lambda}{}_{\alpha}\,\partial^{\kappa}f_{\lambda\kappa}+2r_2\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}+4r_2\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta}-4r_2\,\partial^{\beta}\omega_{\iota}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime}+4r_2\,\partial^{\beta}\omega_{\iota}^{\lambda\alpha}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime}+6r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa}-6r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa})\right)[t,x,y,z]\,dz\,dy\,dx\,dt$$

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

$\omega_{1^+}^{\#1}{}^{\alpha\beta}\dagger$ $\omega_{1^+}^{\#2}{}^{\alpha\beta}\dagger$ $f_{1^+}^{\#1}{}^{\alpha\beta}\dagger$ $\omega_{1^-}^{\#1}{}^{\alpha}\dagger$ $\omega_{1^-}^{\#2}{}^{\alpha}\dagger$ $f_{1^-}^{\#1}{}^{\alpha}\dagger$ $f_{1^-}^{\#2}{}^{\alpha}\dagger$

	$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	0	0	0
$\tau_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	0	0	0
$\sigma_{2^-}^{\#1}{}^{\alpha\beta\chi}\dagger$	0	0	0

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

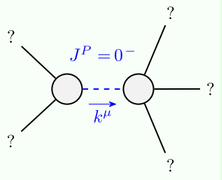
	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	0	0	0
$f_{2^+}^{\#1}{}^{\alpha\beta}\dagger$	0	0	0
$\omega_{2^-}^{\#1}{}^{\alpha\beta\chi}\dagger$	0	0	0

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}\dagger$	t_3	$-i\sqrt{2}\,k t_3$	0	0
$f_{0^+}^{\#1}\dagger$	$i\sqrt{2}\,k t_3$	$2k^2 t_3$	0	0
$f_{0^+}^{\#2}\dagger$	0	0	0	0
$\omega_{0^-}^{\#1}\dagger$	0	0	0	$k^2 r_2+t_2$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	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
$\tau_{1^+}^{\#1\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\alpha\beta} == 0$	3
$\sigma_{2^-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2^+}^{\#1\alpha\beta} == 0$	5
$\sigma_{2^+}^{\#1\alpha\beta} == 0$	5
Total constraints:	26

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

$r_2 < 0 \;\&\&\; t_2 > 0$