Particle spectrograph

Wave operator and propagator

$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3-r_4)}$	$-\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3-r_4)}$	0	0	0	0
$\frac{k^2\,(6\,r_3-3\,r_4)+2\,t_2}{(k+k^3)^2\,(2\,r_3-r_4)\,t_2}$	$\frac{i\,(k^2\,(6\,r_3-3\,r_4)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3-r_4)\,t_2}$	0	0	0	0
$-\frac{i\,(k^2\,(6\,r_3-3\,r_4)+2\,t_2)}{k\,(1+k^2)^2\,(2\,r_3-r_4)\,t_2}$	$\frac{\frac{1}{r_3-\frac{r_4}{2}}+\frac{3\,k^2}{t_2}}{(1+k^2)^2}$	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

$\sigma_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\sigma_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$\tau_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\sigma_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\tau_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\tau_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$
$\frac{1}{k^2\,(2\,r_3-r_4)}$	$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3-r_4)}$	$\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3-r_4)}$	0	0	0	0
$-\frac{\sqrt{2}}{k^2\,(1+k^2)\,(2\,r_3-r_4)}$	$\frac{k^2\,(6\,r_3-3\,r_4)+2\,t_2}{(k+k^3)^2\,(2\,r_3-r_4)\,t_2}$	$\frac{i\,(k^2\,(6\,r_3-3\,r_4)+2\,t_2}{k\,(1+k^2)^2\,(2\,r_3-r_4)\,t_2}$	0	0	0	0
$\frac{i\,\sqrt{2}}{k\,(1+k^2)\,(2\,r_3-r_4)}$	$-\frac{i\,(k^2\,(6\,r_3-3\,r_4)+2\,t_2}{k\,(1+k^2)^2\,(2\,r_3-r_4)\,t_2}$	$\frac{\frac{1}{r_3-\frac{r_4}{2}}+\frac{3\,k^2}{t_2}}{(1+k^2)^2}$	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Quadratic (free) action

$$S == \iiint\Big(\frac{1}{6}\,(6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}+4\,t_2\,\omega_{\iota\theta\alpha}\,\partial^{\theta}f^{\alpha\iota}+2\,t_2\,\partial_{\alpha}f_{\iota\theta}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\alpha}f_{\theta\iota}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\theta}f_{\alpha\iota}\,\partial^{\theta}f^{\alpha\iota}-t_2\,\partial_{\theta}f_{\iota\alpha}\,\partial^{\theta}f^{\alpha\iota}-$$
$$2\,t_2\,\omega_{\alpha\iota\theta}\,(\omega^{\alpha\iota\theta}+2\,\partial^{\theta}f^{\alpha\iota})+8\,r_2\,\partial_{\beta}\omega_{\alpha\iota\theta}\,\partial^{\theta}\omega^{\alpha\beta\iota}-4\,t_2\,\omega_{\alpha\theta\iota}\,(\omega^{\alpha\iota\theta}+\partial^{\theta}f^{\alpha\iota})+4\,r_2\,\partial_{\beta}\omega_{\alpha\theta\iota}\,\partial^{\theta}\omega^{\alpha\beta\iota}+4\,r_2\,\partial_{\beta}\omega_{\iota\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\iota}-2\,r_2\,\partial_{\iota}\omega_{\alpha\beta\theta}\,\partial^{\theta}\omega^{\alpha\beta\iota}+2\,r_2\,\partial_{\theta}\omega_{\alpha\beta\iota}$$
$$\partial^{\theta}\omega^{\alpha\beta\iota}-12\,r_4\,\partial_{\theta}\omega_{\kappa}{}^{\lambda}{}_{\lambda}\,\partial^{\kappa}\omega^{\alpha\theta}{}_{\alpha}-12\,r_4\,\partial_{\alpha}\omega^{\alpha\theta\kappa}\,\partial_{\lambda}\omega^{\lambda}{}_{\kappa}{}^{\theta}+$$
$$24\,r_4\,\partial_{\beta}\omega_{\iota\lambda\alpha}\,\partial^{\lambda}\omega^{\alpha\beta\iota}-24\,r_3\,\partial^{\kappa}\omega^{\alpha\theta}{}_{\alpha}\,\partial_{\lambda}\omega^{\lambda}{}_{\kappa}{}^{\theta}\Big)[t,\,x,\,y,\,z]\,dt\,dz\,dy\,dx$$

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

$\omega_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\omega_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$f_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\omega_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\omega_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$f_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$f_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$
$k^2\,(2\,r_3-r_4)+\frac{2\,t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	0	0	0	0
$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$-\frac{1}{3}\,i\,k\,t_2$	0	0	0	0
$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	$-\frac{1}{3}\,i\,k\,t_2$	$\frac{k^2\,t_2}{3}$	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\frac{1}{-2\,k^2\,r_3+4\,k^2\,r_4}$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$\frac{1}{k^2\,r_2+t_2}$

$\sigma_{0^+}^{\#1}{}^{\dagger}$
$\tau_{0^+}^{\#1}{}^{\dagger}$
$\tau_{0^+}^{\#2}{}^{\dagger}$
$\sigma_{0^-}^{\#1}{}^{\dagger}$

$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$-2\,k^2\,(r_3-2\,r_4)$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$k^2\,r_2+t_2$

$\omega_{0^+}^{\#1}{}^{\dagger}$
$f_{0^+}^{\#1}{}^{\dagger}$
$f_{0^+}^{\#2}{}^{\dagger}$
$\omega_{0^-}^{\#1}{}^{\dagger}$

$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\frac{1}{k^2\,(-2\,r_3+r_4)}$	0	0
0	0	0
0	0	0

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

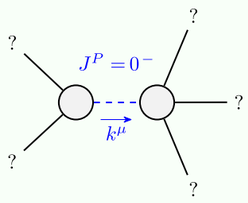
$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$k^2\,(-2\,r_3+r_4)$	0	0
0	0	0
0	0	0

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

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\sigma_{1^-}^{\#1\,\alpha} == 0$	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
Total constraints:	27

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

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