Particle spectrograph

Wave operator and propagator

$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$-\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	0	0	0	0
$\frac{1}{(1+k^2)^2 t_1}$	$\frac{ik}{(1+k^2)^2 t_1}$	0	0	0	0
$-\frac{ik}{(1+k^2)^2 t_1}$	$\frac{k^2}{(1+k^2)^2 t_1}$	0	0	0	0
0	0	$\frac{6}{(3+4k^2)^2 t_1}$	$\frac{6\sqrt{2}}{(3+4k^2)^2 t_1}$	0	$\frac{12ik}{(3+4k^2)^2 t_1}$
0	0	$\frac{6\sqrt{2}}{(3+4k^2)^2 t_1}$	$\frac{12}{(3+4k^2)^2 t_1}$	0	$\frac{12i\sqrt{2}\,k}{(3+4k^2)^2 t_1}$
0	0	0	0	0	0
0	0	$-\frac{12ik}{(3+4k^2)^2 t_1}$	$-\frac{12i\sqrt{2}\,k}{(3+4k^2)^2 t_1}$	0	$\frac{24k^2}{(3+4k^2)^2 t_1}$

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

Quadratic (free) action

$S ==$

$$\iiint\!\!\int \left(\tfrac{1}{6}\left(2\,t_1\,\omega^{\alpha\prime}{}_{\alpha}\,\omega_{\prime}{}^{\theta}{}_{\theta}+6\,f^{\alpha\beta}\,\tau_{\alpha\beta}+6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-4\,t_1\,\omega^{\alpha}{}_{\theta}\,\partial_{\prime}f^{\alpha\prime}+4\,t_1\,\omega_{\prime}{}^{\theta}{}_{\theta}\right.\right.$$
$$\partial^{\prime}f^{\alpha}{}_{\alpha}-2\,t_1\,\partial_{\prime}f^{\theta}{}_{\theta}\,\partial^{\prime}f^{\alpha}{}_{\alpha}-24\,r_3\,\partial_{\beta}\omega_{\prime}{}^{\theta}{}_{\theta}\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha}-2\,t_1\,\partial_{\prime}f^{\alpha\prime}\,\partial_{\theta}f^{\theta}{}_{\alpha}+$$
$$4\,t_1\,\partial^{\prime}f^{\alpha}{}_{\alpha}\,\partial_{\theta}f_{\prime}{}^{\theta}-24\,r_3\,\partial_{\alpha}\omega^{\alpha\beta\prime}\,\partial_{\theta}\omega_{\prime}{}^{\theta}{}_{\beta}+48\,r_3\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha}\,\partial_{\theta}\omega_{\prime}{}^{\theta}{}_{\beta}-6\,t_1\,\partial_{\alpha}f_{\prime\theta}\,\partial^{\theta}f^{\alpha\prime}-$$
$$3\,t_1\,\partial_{\alpha}f_{\theta\prime}\,\partial^{\theta}f^{\alpha\prime}+3\,t_1\,\partial_{\theta}f_{\alpha\prime}\,\partial^{\theta}f^{\alpha\prime}+3\,t_1\,\partial_{\theta}f_{\prime\alpha}\,\partial^{\theta}f^{\alpha\prime}+$$
$$6\,t_1\,\omega_{\alpha\theta\prime}\,(\omega^{\alpha\prime\theta}+2\,\partial^{\theta}f^{\alpha\prime})+8\,r_2\,\partial_{\beta}\omega_{\alpha\prime\theta}\,\partial^{\theta}\omega^{\alpha\beta\prime}-4\,r_2\,\partial_{\beta}\omega_{\alpha\theta\prime}\,\partial^{\theta}\omega^{\alpha\beta\prime}+$$
$$4\,r_2\,\partial_{\beta}\omega_{\prime\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\prime}-24\,r_3\,\partial_{\beta}\omega_{\prime\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\prime}-2\,r_2\,\partial_{\prime}\omega_{\alpha\beta\theta}\,\partial^{\theta}\omega^{\alpha\beta\prime}+$$
$$\left.\left.2\,r_2\,\partial_{\theta}\omega_{\alpha\beta\prime}\,\partial^{\theta}\omega^{\alpha\beta\prime}-4\,r_2\,\partial_{\theta}\omega_{\alpha\prime\beta}\,\partial^{\theta}\omega^{\alpha\beta\prime}\right)\right)[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
0	0	0	$\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ikt_1}{3}$
0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}i\sqrt{2}\,kt_1$
0	0	0	0	0	0	0
0	0	0	$-\frac{1}{3}ikt_1$	$-\frac{1}{3}i\sqrt{2}\,kt_1$	0	$\frac{2k^2t_1}{3}$

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

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\alpha} + 2\,i\,k\,\sigma_{1^-}^{\#1\alpha} == 0$	3
$\tau_{1^-}^{\#1\alpha} == 0$	3
$\sigma_{1^-}^{\#1\alpha} == \sigma_{1^-}^{\#2\alpha}$	3
$\tau_{1^+}^{\#1\alpha\beta} + i\,k\,\sigma_{1^+}^{\#2\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\alpha\beta} - 2\,i\,k\,\sigma_{2^+}^{\#1\alpha\beta} == 0$	5
Total constraints:	19

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

$\frac{1}{6k^2 r_3}$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$\frac{1}{k^2 r_2 - t_1}$

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

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

$6k^2 r_3$	0	0	0
0	0	0	0
0	0	0	0
0	0	0	$k^2 r_2 - t_1$

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

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

$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$\frac{ikt_1}{\sqrt{2}}$	$k^2 t_1$	0
0	0	$\frac{t_1}{2}$

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

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

$-\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	0
$\frac{4k^2}{(1+2k^2)^2 t_1}$	0
0	$\frac{2}{t_1}$

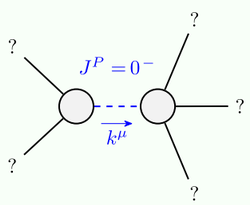
$\tau_{2^+}^{\#1}{}^{\dagger}{}_{\alpha\beta}$ | $\sigma_{2^-}^{\#1}{}^{\dagger}{}_{\alpha\beta\chi}$

$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$

$\frac{2}{(1+2k^2)^2 t_1}$
$\frac{2i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$
0

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

Massive and massless spectra



Massive particle

Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$\frac{t_1}{r_2} > 0$
Spin:	0
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_2 < 0 \;\&\&\; t_1 < 0$