Particle spectrograph

Wave operator and propagator

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

	$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^+}^{\#2}{}_{\alpha\beta}$
$\sigma_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$
$\sigma_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2 t_1}$	$\frac{1}{(1+k^2)^2 t_1}$
$\tau_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{i\sqrt{2}\,k}{t_1+k^2 t_1}$	$-\frac{i k}{(1+k^2)^2 t_1}$
$\sigma_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0
$\sigma_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0
$\tau_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0
$\tau_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0

Quadratic (free) action

$S =$

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

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$
$\omega_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i k t_1}{\sqrt{2}}$
$\omega_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0
$f_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	0	0
$\omega_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0
$\omega_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0
$f_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0
$f_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0

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

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$k^2 r_2 - t_1$

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$\tau_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$\frac{1}{k^2 r_2 - t_1}$

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{i k t_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

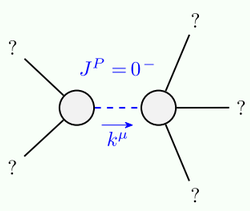
	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0
$\tau_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0
$\sigma_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	$\frac{2}{t_1}$

	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$
$\sigma_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{2 i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$
$\tau_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{4 k^2}{(1+2k^2)^2 t_1}$
$\sigma_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	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:	20

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

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