Particle spectrograph

Wave operator and propagator

	$\sigma_{1^-}^{\#2\,\alpha}$	$\tau_{1^-}^{\#1\,\alpha}$	$\tau_{1^-}^{\#2\,\alpha}$
$\sigma_{1^+}^{\#1\,\alpha\beta}$	0	0	0
$\tau_{1^+}^{\#1\,\alpha\beta}$	0	0	0
$\sigma_{1^+}^{\#2\,\alpha\beta}$	0	0	0
$\tau_{1^+}^{\#1\,\alpha\beta}$	0	0	0
$\sigma_{1^-}^{\#1\,\alpha}$	$\frac{1}{\sqrt{2}\,(k^2+2\,k^4)\,(2\,r_3+r_5)}$	0	$-\frac{i}{k\,(1+2\,k^2)\,(2\,r_3+r_5)}$
$\sigma_{1^-}^{\#2\,\alpha}$	$\frac{6\,k^2\,(2\,r_3+r_5)+t_1}{2\,(k+2\,k^3)^2\,(2\,r_3+r_5)\,t_1}$	0	$\frac{i\,(6\,k^2\,(2\,r_3+r_5)+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,(2\,r_3+r_5)\,t_1}$
$\tau_{1^-}^{\#1\,\alpha}$	0	0	0
$\tau_{1^-}^{\#2\,\alpha}$	$-\frac{i\,(6\,k^2\,(2\,r_3+r_5)+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,(2\,r_3+r_5)\,t_1}$	0	$\frac{6\,k^2\,(2\,r_3+r_5)+t_1}{(1+2\,k^2)^2\,(2\,r_3+r_5)\,t_1}$

	$\sigma_{1^+}^{\#1\,\alpha\beta}$	$\sigma_{1^+}^{\#2\,\alpha\beta}$	$\tau_{1^+}^{\#1\,\alpha\beta}$	$\sigma_{1^-}^{\#1\,\alpha}$
$\sigma_{1^+}^{\#1\,\alpha\beta}$	0	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$-\frac{i\,\sqrt{2}\,k}{t_1+k^2\,t_1}$	0
$\sigma_{1^+}^{\#2\,\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	$\frac{-2\,k^2\,(2\,r_3+r_5)+t_1}{(1+k^2)^2\,t_1^2}$	$\frac{-2\,i\,k^3\,(2\,r_3+r_5)+i\,k\,t_1}{(1+k^2)^2\,t_1^2}$	0
$\tau_{1^+}^{\#1\,\alpha\beta}$	$\frac{i\,\sqrt{2}\,k}{t_1+k^2\,t_1}$	$\frac{i\,(2\,k^3\,(2\,r_3+r_5)-k\,t_1)}{(1+k^2)^2\,t_1^2}$	$\frac{-2\,k^4\,(2\,r_3+r_5)+k^2\,t_1}{(1+k^2)^2\,t_1^2}$	0
$\sigma_{1^-}^{\#1\,\alpha}$	0	0	0	$\frac{1}{k^2\,(2\,r_3+r_5)}$
$\sigma_{1^-}^{\#2\,\alpha}$	0	0	0	$\frac{1}{\sqrt{2}\,(k^2+2\,k^4)\,(2\,r_3+r_5)}$
$\tau_{1^-}^{\#1\,\alpha}$	0	0	0	0
$\tau_{1^-}^{\#2\,\alpha}$	0	0	0	$\frac{i}{k\,(1+2\,k^2)\,(2\,r_3+r_5)}$

	$\omega_{1^+}^{\#1\,\alpha\beta}$	$\omega_{1^+}^{\#2\,\alpha\beta}$	$f_{1^+}^{\#1\,\alpha\beta}$	$\omega_{1^-}^{\#1\,\alpha}$	$\omega_{1^-}^{\#2\,\alpha}$	$f_{1^-}^{\#1\,\alpha}$	$f_{1^-}^{\#2\,\alpha}$
$\omega_{1^+}^{\#1\,\alpha\beta}$	$k^2\,(2\,r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{i\,k\,t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1^+}^{\#2\,\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1^+}^{\#1\,\alpha\beta}$	$\frac{i\,k\,t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-}^{\#1\,\alpha}$	0	0	0	$k^2\,(2\,r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\,\sqrt{2}}$	0	0
$\omega_{1^-}^{\#2\,\alpha}$	0	0	0	$\frac{t_1}{3\,\sqrt{2}}$	$\frac{t_1}{3}$	0	0
$f_{1^-}^{\#1\,\alpha}$	0	0	0	0	0	0	$\frac{i\,k\,t_1}{3}$
$f_{1^-}^{\#2\,\alpha}$	0	0	0	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$	0	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$	$\frac{2\,k^2\,t_1}{3}$

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

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}$	$\frac{1}{6\,k^2\,r_3}$	0	0	0
$\tau_{0^+}^{\#1}$	0	0	0	0
$\tau_{0^+}^{\#2}$	0	0	0	0
$\sigma_{0^-}^{\#1}$	0	0	0	$\frac{1}{k^2\,r_2-t_1}$

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

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}$	$6\,k^2\,r_3$	0	0	0
$f_{0^+}^{\#1}$	0	0	0	0
$f_{0^+}^{\#2}$	0	0	0	0
$\omega_{0^-}^{\#1}$	0	0	0	$k^2\,r_2-t_1$

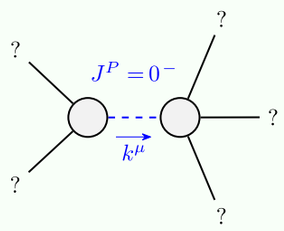
Quadratic (free) action

$$S == \iiint (f^{\alpha\beta}\,\tau_{\alpha\beta} + \omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} + \frac{1}{6}\,t_1\,(2\,\omega^{\alpha\prime}{}_{\alpha}\,\omega_{\prime}{}^{\theta}{}_{\theta} - 4\,\omega_{\alpha}{}^{\theta}\,\partial_{\prime} f^{\alpha\prime} + 4\,\omega_{\prime}{}^{\theta}\,\partial^{\prime} f^{\alpha}{}_{\alpha} - 2\,\partial_{\prime} f^{\alpha}{}_{\alpha} - 2\,\partial_{\prime} f^{\alpha\prime}{}_{\alpha} + 2\,\partial_{\prime} f^{\alpha\prime}{}_{\theta}\,\partial^{\theta} f^{\alpha}{}_{\alpha} + 4\,\partial^{\prime} f^{\alpha}{}_{\alpha} - 2\,\partial_{\prime} f^{\alpha\prime}{}_{\alpha} - 2\,\partial_{\theta} f^{\alpha}{}_{\prime}\,\partial^{\theta} f^{\alpha\prime}{}_{\alpha} - 2\,\partial_{\theta} f^{\alpha\prime}{}_{\prime}\,\partial^{\theta} f^{\alpha}{}_{\alpha} + 3\,\partial_{\theta} f^{\alpha\prime}{}_{\alpha}\,\partial^{\theta} f^{\alpha}{}_{\prime} + 3\,\partial_{\theta} f^{\alpha\prime}{}_{\prime}\,\partial^{\theta} f^{\alpha}{}_{\alpha} + 3\,\partial_{\prime} f_{\alpha\theta}\,\partial^{\theta} f^{\alpha\prime} + 3\,\partial_{\theta} f_{\alpha\prime}\,\partial^{\theta} f^{\alpha\prime} + 6\,\omega_{\alpha\theta\prime}\,(\omega^{\alpha\prime\theta} + 2\,\partial^{\theta} f^{\alpha\prime}) + \frac{1}{3}\,r_2\,(4\,\partial_{\beta}\omega_{\alpha\prime\theta} - 2\,\partial_{\beta}\omega_{\alpha\theta\prime} + 2\,\partial_{\beta}\omega_{\prime\theta\alpha} - \partial_{\prime}\omega_{\alpha\beta\theta} + \partial_{\theta}\omega_{\alpha\prime\beta} - 2\,\partial_{\theta}\omega_{\alpha\beta\prime})\,\partial^{\theta}\omega^{\alpha\beta\prime} - 2\,r_3\,(\partial_{\beta}\omega_{\prime}{}^{\theta}{}_{\theta}\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha} + \partial_{\prime}\omega_{\beta}{}^{\theta}{}_{\theta}\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha} + \partial_{\alpha}\omega^{\alpha\beta\prime}\,\partial_{\theta}\omega_{\beta}{}^{\theta}{}_{\prime} - 2\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha}\,\partial_{\theta}\omega_{\beta}{}^{\theta}{}_{\prime} + \partial_{\theta}\omega_{\prime}{}^{\theta}{}_{\beta} - 2\,\partial^{\prime}\omega^{\alpha\beta}{}_{\alpha}\,\partial_{\theta}\omega_{\prime}{}^{\theta}{}_{\beta} + 2\,\partial_{\beta}\omega_{\prime\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\prime}) + r_5\,(\partial_{\prime}\omega_{\theta}{}^{\kappa}{}_{\kappa}\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha} - \partial_{\alpha}\omega^{\alpha\prime}{}_{\alpha}\,\partial^{\theta}\omega^{\alpha\prime}{}_{\theta} - (\partial_{\alpha}\omega^{\alpha\prime\theta} - 2\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha})\,(\partial_{\kappa}\omega_{\prime}{}^{\kappa}{}_{\theta} - \partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\prime})))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

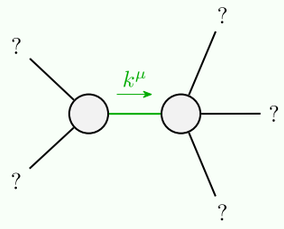
Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} + 2\,i\,k\,\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	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:	16

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



Quadratic pole	
Pole residue:	$-\frac{1}{(2\,r_3+r_5)\,t_1^2} > 0$
Polarisations:	2

Unitarity conditions

$r_2 < 0 \;\&\&\; r_5 < -2\,r_3 \;\&\&\; t_1 < 0$