Particle spectrograph

Wave operator and propagator

	$\omega_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\omega_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{1}{6}(6k^2 r_5 + t_1 + 4t_2)$	$-\frac{t_1 - 2t_2}{3\sqrt{2}}$	$-\frac{ik(t_1-2t_2)}{3\sqrt{2}}$	0	0	0	0
$\omega_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{t_1-2t_2}{3\sqrt{2}}$	$\frac{t_1+t_2}{3}$	$\frac{1}{3}ik(t_1+t_2)$	0	0	0	0
$f_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{ik(t_1-2t_2)}{3\sqrt{2}}$	$-\frac{1}{3}ik(t_1+t_2)$	$\frac{1}{3}k^2(t_1+t_2)$	0	0	0	0
$\omega_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	$k^2 r_5 - \frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	ikt_1
$\omega_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
$f_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$-ikt_1$	0	0	0

	$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ikt_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_{2^-}^{\#1}{}^{\dagger\alpha\beta\chi}$	0	0	$\frac{t_1}{2}$

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1}{}^{\dagger}$	$-\frac{1}{(1+2k^2)^2 t_1}$	$\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	0	0
$\tau_{0^+}^{\#1}{}^{\dagger}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_1}$	$-\frac{2k^2}{(1+2k^2)^2 t_1}$	0	0
$\tau_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$\frac{1}{k^2 r_2 + t_2}$

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

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1}{}^{\dagger}$	$-t_1$	$i\sqrt{2}\,kt_1$	0	0
$f_{0^+}^{\#1}{}^{\dagger}$	$-i\sqrt{2}\,kt_1$	$-2k^2 t_1$	0	0
$f_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1}{}^{\dagger}$	0	0	0	$k^2 r_2 + t_2$

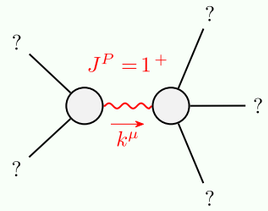
Quadratic (free) action

$$S = \iiint \Big(\tfrac{1}{6}(6t_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} - 12t_1\,\omega_{\alpha}{}^{\theta}\,\partial_{\prime}f^{\alpha\prime} + 12t_1 \omega_{\prime}{}^{\theta}\,\partial^{\prime}f^{\alpha}{}_{\alpha} - 6t_1\,\partial_{\prime}f^{\theta}\,\partial^{\prime}f^{\alpha}{}_{\alpha} - 6t_1\,\partial_{\prime}f^{\alpha\prime}\,\partial_{\theta}f_{\alpha}{}^{\theta} + 12t_1\,\partial^{\prime}f^{\alpha}{}_{\alpha}\,\partial_{\theta}f_{\prime}{}^{\theta} + 4t_1\,\omega_{\prime\theta\alpha}\,\partial^{\theta}f^{\alpha\prime} - 4t_1\,\partial_{\alpha}f_{\prime\theta}\,\partial^{\theta}f^{\alpha\prime} + 2t_2\,\partial_{\alpha}f_{\prime\theta}\,\partial^{\theta}f^{\alpha\prime} - 4t_1\,\omega_{\prime\theta\alpha}\,\partial^{\theta}f^{\alpha\prime} + 4t_2\,\omega_{\prime\theta\alpha}\,\partial^{\theta}f^{\alpha\prime} - 2t_1\,\partial_{\alpha}f_{\theta\prime}\,\partial^{\theta}f^{\alpha\prime} + 2t_1\,\partial_{\prime}f_{\alpha\theta}\,\partial^{\theta}f^{\alpha\prime} - 2t_2\,\partial_{\prime}f_{\alpha\theta}\,\partial^{\theta}f^{\alpha\prime} + 2t_1\,\partial_{\theta}f_{\alpha\prime}\,\partial^{\theta}f^{\alpha\prime} + 2t_2\,\partial_{\theta}f_{\alpha\prime}\,\partial^{\theta}f^{\alpha\prime} - 2t_1\,\partial_{\theta}f_{\prime\alpha}\,\partial^{\theta}f^{\alpha\prime} - 2t_2\,\partial_{\theta}f_{\prime\alpha}\,\partial^{\theta}f^{\alpha\prime} + 2(t_1+t_2)\,\omega_{\alpha\prime\theta}\,(\omega^{\alpha\prime\theta} + 2\,\partial^{\theta}f^{\alpha\prime}) + 2\,\omega_{\alpha\theta\prime}\,((t_1-2t_2)\,\omega^{\alpha\prime\theta} + 2(2t_1-t_2)\,\partial^{\theta}f^{\alpha\prime}) + 8r_2\,\partial_{\beta}\omega_{\alpha\prime\theta}\,\partial^{\theta}\omega^{\alpha\beta\prime} - 4r_2\,\partial_{\beta}\omega_{\alpha\theta\prime}\,\partial^{\theta}\omega^{\alpha\beta\prime} + 4r_2\,\partial_{\beta}\omega_{\prime\theta\alpha}\,\partial^{\theta}\omega^{\alpha\beta\prime} - 2r_2\,\partial_{\prime}\omega_{\alpha\beta\theta}\,\partial^{\theta}\omega^{\alpha\beta\prime} + 2r_2\,\partial_{\theta}\omega_{\alpha\beta\prime}\,\partial^{\theta}\omega^{\alpha\beta\prime} - 4r_2\,\partial_{\theta}\omega_{\alpha\prime\beta}\,\partial^{\theta}\omega^{\alpha\beta\prime} + 6r_5\,\partial_{\prime}\omega_{\theta}{}^{\kappa}\,\partial^{\theta}\omega_{\kappa}{}^{\alpha\prime} - 6r_5\,\partial_{\alpha}\omega^{\alpha\prime\theta}\,\partial_{\kappa}\omega_{\prime}{}^{\kappa}{}_{\theta} + 12r_5\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha}\,\partial_{\kappa}\omega_{\prime}{}^{\kappa}{}_{\theta} + 6r_5\,\partial_{\alpha}\omega^{\alpha\prime\theta}\,\partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\prime} - 12r_5\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha}\,\partial_{\kappa}\omega_{\theta}{}^{\kappa}{}_{\prime}\Big)[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

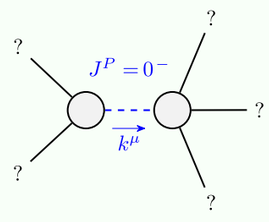
Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} - 2ik\,\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} + 2ik\,\sigma_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\tau_{1^+}^{\#1\,\alpha\beta} + ik\,\sigma_{1^+}^{\#2\,\alpha\beta} == 0$	3
$\tau_{2^+}^{\#1\,\alpha\beta} - 2ik\,\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	16

Massive and massless spectra



Massive particle	
Pole residue:	$\frac{-3t_1 t_2 (t_1+t_2) + 3r_5 (t_1{}^2 + 2t_2{}^2)}{r_5 (t_1+t_2)(-3t_1 t_2 + 2r_5 (t_1+t_2))} > 0$
Polarisations:	3
Square mass:	$-\frac{3t_1 t_2}{2r_5 t_1 + 2r_5 t_2} > 0$
Spin:	1
Parity:	Even



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

$r_2 < 0 \;\&\&\; r_5 > 0 \;\&\&\; t_1 < 0 \;\&\&\; t_2 > -t_1$