Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$S_F == \iiint (\tfrac{1}{6}(4\,t_2\;\omega_{\kappa\lambda}{}^{\prime}\;\omega_{\prime}{}^{\kappa\lambda} + 2\,t_2\;\omega_{\kappa\lambda}{}^{\prime}\;\omega^{\kappa\lambda}{}_{\prime} + 6\,f^{\alpha\beta}{}_{\tau}\,\tau_{\alpha\beta} + 6\,\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi} - 6\,r_5\,\partial_{\prime}\omega^{\kappa\lambda}{}_{\kappa} + \partial^{\prime}\omega_{\lambda}{}^{\alpha}{}_{\alpha} + 4\,r_2\,\partial^{\beta}\omega^{\theta\alpha}{}_{\kappa}\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa} - 2\,r_2\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\alpha\beta\theta} - 4\,r_2\,\partial_{\theta}\omega_{\alpha\beta}{}^{\kappa}\,\partial_{\kappa}\omega^{\theta\alpha\beta} - 6\,r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\theta\kappa\lambda} - 6\,r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} + 12\,r_5\,\partial_{\theta}\omega_{\lambda}{}^{\alpha}{}_{\alpha}\,\partial_{\kappa}\omega^{\kappa\lambda\theta} + t_2\,\partial^{\alpha}f_{\theta\kappa}\,\partial^{\kappa}f_{\alpha}{}^{\theta} - t_2\,\partial^{\alpha}f_{\kappa\theta}\,\partial^{\kappa}f_{\alpha}{}^{\theta} + t_2\,\partial^{\alpha}f^{\lambda}{}_{\kappa}\,\partial^{\kappa}f_{\alpha\lambda} + 2\,t_2\;\omega_{\iota\theta\kappa}\,\partial^{\kappa}f^{\iota\theta} - 2\,t_2\;\omega_{\theta\iota\kappa}\,\partial^{\kappa}f^{\iota\theta} + 4\,t_2\;\omega_{\theta\kappa\iota}\,\partial^{\kappa}f^{\iota\theta} - t_2\,\partial^{\alpha}f^{\lambda}{}_{\kappa}\,\partial^{\kappa}f_{\lambda\alpha} - t_2\,\partial_{\kappa}f_{\lambda}{}^{\theta}\,\partial^{\kappa}f_{\theta}{}^{\lambda} + 2\,r_2\,\partial_{\kappa}\omega^{\alpha\beta\theta}\,\partial^{\kappa}\omega_{\alpha\beta\theta} + 4\,r_2\,\partial^{\beta}\omega_{\iota}{}^{\alpha\lambda}\,\partial_{\lambda}\omega_{\alpha\beta}{}^{\prime} + 4\,r_2\,\partial_{\kappa}\omega^{\theta\alpha\beta}\,\partial^{\kappa}\omega_{\alpha\beta\theta} - 6\,r_5\,\partial_{\alpha}\omega_{\lambda}{}^{\alpha}{}_{\theta}\,\partial^{\lambda}\omega^{\theta\kappa}{}_{\kappa})](t,\,x,\,y,\,z]\,d\!\!\!^{-}z\,d\!\!\!^{-}y\,d\!\!\!^{-}x\,d\!\!\!^{-}t$$

$\sigma_{1^+}^{\#1}{}_{\alpha\beta}$	$\tau_{1^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{1^-}^{\#1}{}_{\alpha}$	$\sigma_{1^-}^{\#2}{}_{\alpha}$	$\tau_{1^-}^{\#1}{}_{\alpha}$	$\tau_{1^-}^{\#2}{}_{\alpha}$
$-\frac{\sqrt{2}}{k^2\,r_5+k^4\,r_5}$	$-\frac{i\,\sqrt{2}}{k\,r_5+k^3\,r_5}$	0	0	0	0
$\frac{3\,k^2\,r_5+2\,t_2}{(k+k^3)^2\,r_5\,t_2}$	$\frac{i\,(3\,k^2\,r_5+2\,t_2)}{k\,(1+k^2)^2\,r_5\,t_2}$	0	0	0	0
$-\frac{i\,(3\,k^2\,r_5+2\,t_2)}{k\,(1+k^2)^2\,r_5\,t_2}$	$\frac{3\,k^2\,r_5+2\,t_2}{(1+k^2)^2\,r_5\,t_2}$	0	$\frac{1}{k^2\,r_5}$	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

$\omega_{1^+}^{\#2}{}_{\alpha\beta}$	$f_{1^+}^{\#1}{}_{\alpha\beta}$	$\omega_{1^-}^{\#1}{}_{\alpha}$	$\omega_{1^-}^{\#2}{}_{\alpha}$	$f_{1^-}^{\#1}{}_{\alpha}$	$f_{1^-}^{\#2}{}_{\alpha}$
$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$	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	$k^2\,r_5$	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

$\omega_{1^+}^{\#1}{}_{\alpha\beta}$
$k^2\,r_5+\frac{2\,t_2}{3}$
$\frac{\sqrt{2}\,t_2}{3}$
$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_2$
0
0
0
0

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

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

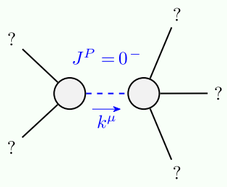
$\sigma_{2^+}^{\#1}{}^{\dagger}{}_{\alpha\beta}$	$\tau_{2^+}^{\#1}{}_{\alpha\beta}$	$\sigma_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$\tau_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\sigma_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0	0	0

$\omega_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$f_{2^+}^{\#1}{}_{\alpha\beta}$	$\omega_{2^-}^{\#1}{}_{\alpha\beta\chi}$
$\omega_{2^+}^{\#1}{}_{\alpha\beta}$	0	0	0
$f_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0
$\omega_{2^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	0	0	0

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2} == 0$	1
$\tau_{0^+}^{\#1} == 0$	1
$\sigma_{0^+}^{\#1} == 0$	1
$\tau_{1^-}^{\#2\,\alpha} == 0$	3
$\tau_{1^-}^{\#1\,\alpha} == 0$	3
$\sigma_{1^-}^{\#2\,\alpha} == 0$	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
$\sigma_{2^+}^{\#1\,\alpha\beta} == 0$	5
Total constraints:	30

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

$r_2 < 0 \;\&\&\; t_2 > 0$