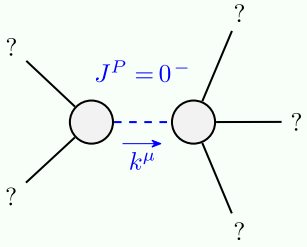


Particle spectrograph

Wave operator and propagator

Unitarity conditions



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)

Massive and massless spectra

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

Quadratic (free) action

$$S = \iiint \left(\frac{1}{6} (-4 t_3 \omega^\alpha{}_\alpha \omega^\kappa{}_{\kappa} + 6 f^{\alpha\beta\chi} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + 8 t_3 \omega^\kappa{}_\alpha \partial_\kappa f^\alpha{}_\alpha - 8 t_3 \omega^\kappa{}_{\kappa} \partial_\kappa f^\alpha{}_\alpha \right. \\ \left. \partial_\kappa f^\alpha{}_\alpha + 4 t_3 \partial_\kappa f^\kappa{}_\alpha \partial_\kappa f^\alpha{}_\alpha - 15 r_3 \partial_\beta \omega^\theta{}_{\theta} \partial_\theta \omega^\alpha{}_\alpha + 9 r_3 \partial_\theta \omega^\theta{}_{\beta} \partial_\beta \omega^\alpha{}_\alpha + \right. \\ \left. 9 r_3 \partial_\alpha \omega^{\alpha\beta}{}_{\beta} \partial_\beta \omega^\theta{}_{\theta} - 18 r_3 \partial_\theta \omega^{\alpha\beta}{}_\alpha \partial_\beta \omega^\theta{}_{\theta} - 15 r_3 \partial_\alpha \omega^{\alpha\beta}{}_{\beta} \partial_\beta \omega^\theta{}_{\theta} + \right. \\ \left. 30 r_3 \partial_\theta \omega^{\alpha\beta}{}_\alpha \partial_\beta \omega^\theta{}_{\theta} + 4 t_2 \omega_{\theta\alpha} \partial^\theta f^{\alpha\alpha} + 2 t_2 \partial_\alpha f_{\theta\theta} \partial^\alpha f^{\alpha\alpha} - t_2 \partial_\alpha f_{\theta\theta} \partial^\alpha f^{\alpha\alpha} - \right. \\ \left. t_2 \partial_\theta f_{\alpha\theta} \partial^\theta f^{\alpha\alpha} + t_2 \partial_\theta f_{\alpha\theta} \partial^\theta f^{\alpha\alpha} - t_2 \partial_\theta f_{\alpha\theta} \partial^\theta f^{\alpha\alpha} - 4 t_2 \omega_{\alpha\theta} (\omega^{\alpha\theta} + \partial^\theta f^{\alpha\alpha}) + \right. \\ \left. 2 t_2 \omega_{\alpha\theta} (\omega^{\alpha\theta} + 2 \partial^\theta f^{\alpha\alpha}) + 8 r_2 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta} - 4 r_2 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta} + 4 r_2 \right. \\ \left. \partial_\beta \omega_{\theta\alpha} \partial^\theta \omega^{\alpha\beta} - 24 r_3 \partial_\beta \omega_{\theta\alpha} \partial^\theta \omega^{\alpha\beta} - 2 r_2 \partial_\theta \omega_{\alpha\beta} \partial^\theta \omega^{\alpha\beta} + 2 r_2 \partial_\theta \omega_{\alpha\beta} \partial^\theta \omega^{\alpha\beta} - \right. \\ \left. 4 r_2 \partial_\theta \omega_{\alpha\beta} \partial^\theta \omega^{\alpha\beta} + 4 t_3 \partial_\theta f^{\alpha\alpha} \partial_\alpha f^\kappa{}_\kappa - 8 t_3 \partial_\theta f^\kappa{}_\alpha \partial_\alpha f^\kappa{}_\theta \right) [t, x, y, z] dz dy dx dt$$

$\omega_{1+}^{\#1+ \alpha\beta}$	$\omega_{1+}^{\#2+ \alpha\beta}$	$f_{1+}^{\#1+ \alpha\beta}$	$\omega_{1-}^{\#1- \alpha}$	$\omega_{1-}^{\#2- \alpha}$	$f_{1-}^{\#1- \alpha}$	$f_{1-}^{\#2- \alpha}$
$\omega_{1+}^{\#1+ \alpha\beta} \frac{2 t_2}{3}$	$\frac{\sqrt{2} t_2}{3}$	$\frac{1}{3} i \sqrt{2} k t_2$	0	0	0	0
$\omega_{1+}^{\#2+ \alpha\beta} \frac{\sqrt{2} t_2}{3}$	$\frac{t_2}{3}$	$\frac{i k t_2}{3}$	0	0	0	0
$f_{1+}^{\#1+ \alpha\beta} - \frac{1}{3} i \sqrt{2} k t_2$	$-\frac{1}{3} i k t_2$	$\frac{k^2 t_2}{3}$	0	0	0	0
$\omega_{1-}^{\#1- \alpha}$	0	0	$\frac{1}{6} (-9 k^2 r_3 + 4 t_3)$	$-\frac{\sqrt{2} t_3}{3}$	0	$-\frac{2}{3} i k t_3$
$\omega_{1-}^{\#2+ \alpha}$	0	0	$-\frac{\sqrt{2} t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3} i \sqrt{2} k t_3$
$f_{1-}^{\#1- \alpha}$	0	0	0	0	0	0
$f_{1-}^{\#2+ \alpha}$	0	0	$\frac{2 i k t_3}{3}$	$-\frac{1}{3} i \sqrt{2} k t_3$	0	$\frac{2 k^2 t_3}{3}$

Source constraints/gauge generators	Multiplicities
$\text{SO}(3)$ irreps	
$\tau_{0+}^{\#2} == 0$	1
$\tau_{0+}^{\#1} - 2 i k \sigma_{0+}^{\#1} == 0$	1
$\tau_{1-}^{\#2\alpha} + 2 i k \sigma_{1-}^{\#2\alpha} == 0$	3
$\tau_{1-}^{\#1\alpha} == 0$	3
$\tau_{1+}^{\#1\alpha\beta} + i k \sigma_{1+}^{\#1\alpha\beta} == 0$	3
$\sigma_{1+}^{\#1\alpha\beta} == \sigma_{1+}^{\#2\alpha\beta}$	3
$\sigma_{2-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	24

$\sigma_{0+}^{\#1+}$	$\tau_{0+}^{\#1+}$	$\tau_{0+}^{\#2+}$	$\sigma_{0-}^{\#1+}$
$\sigma_{0+}^{\#1+} \frac{1}{(1+2 k^2)^2 t_3}$	$-\frac{i \sqrt{2} k}{(1+2 k^2)^2 t_3}$	0	0
$\tau_{0+}^{\#1+} \frac{i \sqrt{2} k}{(1+2 k^2)^2 t_3}$	$\frac{2 k^2}{(1+2 k^2)^2 t_3}$	0	0
$\tau_{0+}^{\#2+}$	0	0	0
$\sigma_{0-}^{\#1+}$	0	0	$\frac{1}{k^2 r_2 + t_2}$

$\sigma_{2+}^{\#1+ \alpha\beta}$	$\tau_{2+}^{\#1+ \alpha\beta}$	$\sigma_{2-}^{\#1+ \alpha\beta\chi}$
$\sigma_{2+}^{\#1+ \alpha\beta} - \frac{2}{3 k^2 r_3}$	0	0
$\tau_{2+}^{\#1+ \alpha\beta}$	0	0
$\sigma_{2-}^{\#1+ \alpha\beta\chi}$	0	0

$\omega_{0+}^{\#1+}$	$f_{0+}^{\#1+}$	$f_{0+}^{\#2+}$	$\omega_{0-}^{\#1+}$
$\omega_{0+}^{\#1+} t_3$	$-i \sqrt{2} k t_3$	0	0
$f_{0+}^{\#1+} i \sqrt{2} k t_3$	$2 k^2 t_3$	0	0
$f_{0+}^{\#2+}$	0	0	0
$\omega_{0-}^{\#1+}$	0	0	$k^2 r_2 + t_2$

$\omega_{2+}^{\#1+ \alpha\beta}$	$f_{2+}^{\#1+ \alpha\beta}$	$\omega_{2-}^{\#1+ \alpha\beta\chi}$
$\omega_{2+}^{\#1+ \alpha\beta} - \frac{3 k^2 r_3}{2}$	0	0
$f_{2+}^{\#1+ \alpha\beta}$	0	0
$\omega_{2-}^{\#1+ \alpha\beta\chi}$	0	0