

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

$$\begin{aligned} S = & \iiint \{ (\frac{1}{6} (6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + 4 t_2 \omega_{\theta\alpha} \partial^\theta f^{\alpha\iota} + 2 t_2 \partial_\alpha f_{\theta} \partial^\theta f^{\alpha\iota} - t_2 \partial_\alpha f_{\theta\iota} \partial^\theta f^{\alpha\iota} - t_2 \partial_\theta f_{\alpha\iota} \partial^\theta f^{\alpha\iota} + t_2 \partial_\theta f_{\alpha\iota} \partial^\theta f^{\alpha\iota} - t_2 \partial_\theta f_{\iota\alpha} \partial^\theta f^{\alpha\iota} - \\ & 4 t_2 \omega_{\alpha\theta\iota} (\omega^{\alpha\iota\theta} + \partial^\theta f^{\alpha\iota}) + 2 t_2 \omega_{\alpha\iota\theta} (\omega^{\alpha\iota\theta} + 2 \partial^\theta f^{\alpha\iota}) + 8 r_2 \partial_\beta \omega_{\alpha\iota\theta} \partial^\theta \omega^{\alpha\beta\iota} - \\ & 4 r_2 \partial_\beta \omega_{\alpha\theta\iota} \partial^\theta \omega^{\alpha\beta\iota} + 4 r_2 \partial_\beta \omega_{\iota\theta\alpha} \partial^\theta \omega^{\alpha\beta\iota} - 2 r_2 \partial_\iota \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta\iota} + \\ & 2 r_2 \partial_\theta \omega_{\alpha\beta\iota} \partial^\theta \omega^{\alpha\beta\iota} - 4 r_2 \partial_\theta \omega_{\alpha\iota\beta} \partial^\theta \omega^{\alpha\beta\iota} + 6 r_5 \partial_\iota \omega_{\theta}^\kappa \partial^\theta \omega_{\alpha}^\kappa - \\ & 6 r_5 \partial_\theta \omega_{\iota}^\kappa \partial^\theta \omega_{\alpha}^\kappa - 6 r_5 \partial_\alpha \omega^{\alpha\iota\theta} \partial_\kappa \omega_{\theta}^\kappa + 12 r_5 \partial^\theta \omega_{\alpha}^\kappa \partial_\kappa \omega_{\theta}^\kappa + \\ & 6 r_5 \partial_\alpha \omega^{\alpha\iota\theta} \partial_\kappa \omega_{\theta}^\kappa - 12 r_5 \partial^\theta \omega_{\alpha}^\kappa \partial_\kappa \omega_{\theta}^\kappa) [t, x, y, z] d^3z dy dx dt \end{aligned}$$

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

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

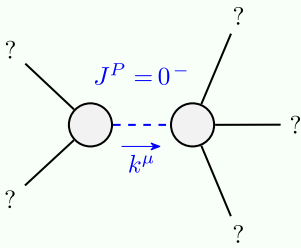
	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^+}^{\#1}$		$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^+}^{\#1}$
$\omega_{0^+}^{\#1} \dagger$	0	0	0	0	$\sigma_{0^+}^{\#1} \dagger$	0	0	0	0
$f_{0^+}^{\#1} \dagger$	0	0	0	0	$\tau_{0^+}^{\#1} \dagger$	0	0	0	0
$f_{0^+}^{\#2}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

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

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

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

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

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