

Particle spectrograph

Wave operator and propagator

$$S = \iiint (\beta \mathcal{B}_{\alpha\beta} \mathcal{B}^{a\beta} + f^{a\beta} \tau_{a\beta} + \mathcal{B}^{a\beta} \tau_{a\beta} + c_3 (\partial_\mu f^\alpha_\alpha \partial^\beta f^\alpha_\alpha - 2 \partial^\beta f^\alpha_\alpha \partial_\mu f^\alpha_\alpha + \partial_\mu f^\alpha_\alpha \partial^\beta f^\alpha_\alpha) (\partial_\mu f^\alpha_\alpha \partial^\beta f^\alpha_\alpha + 2 \partial_\mu f^\alpha_\alpha \partial^\beta f^\alpha_\alpha) - \partial_\mu \mathcal{B}^{a\beta} \partial_\nu \mathcal{B}^\alpha_\alpha - 2 \partial^\beta f^\alpha_\alpha \partial_\mu \mathcal{B}^\alpha_\alpha - \frac{1}{3} \alpha (2 \partial_\mu \mathcal{B}^\alpha_\alpha \partial^\mu \mathcal{B}^\alpha_\alpha - \partial_\mu \mathcal{B}^\alpha_\alpha \partial^\mu \mathcal{B}^\alpha_\alpha) \partial^\mu \mathcal{B}^\alpha_\alpha + 2 c_1 (-2 \partial_\mu \partial_\nu f^\alpha_\alpha \partial^\mu f^\alpha_\alpha - \partial_\mu f^\alpha_\alpha \partial_\nu \mathcal{B}^\alpha_\alpha + \partial_\mu f^\alpha_\alpha \partial^\nu \mathcal{B}^\alpha_\alpha + 4 \partial_\mu \mathcal{B}^\alpha_\alpha \partial^\nu f^\alpha_\alpha + \partial_\mu f^\alpha_\alpha \partial^\nu \mathcal{B}^\alpha_\alpha + 2 \partial_\mu \mathcal{B}^\alpha_\alpha \partial^\nu \mathcal{B}^\alpha_\alpha)) [t, x, y, z] d z d y d x d t$$

	$\begin{smallmatrix} \#1 \\ 0^+ f \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 0^+ f \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 0^+ \tau \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 0^+ \tau \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 2^+ \tau \alpha \beta \end{smallmatrix}$
$\begin{smallmatrix} \#1 \\ 0^+ f \end{smallmatrix}$	$(4 c_1 + 3 c_3) k^2$	0	$\frac{1}{(4 c_1 + 3 c_3) k^2}$	0	$\frac{1}{4 c_1 k^2}$
$\begin{smallmatrix} \#2 \\ 0^+ f \end{smallmatrix}$	0	0	0	0	$4 c_1 k^2$

	$\begin{smallmatrix} \#1 \\ 1^+ f \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 1^+ f \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 1^+ \tau \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 1^+ \tau \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$
$\begin{smallmatrix} \#1 \\ 1^+ f \end{smallmatrix}$	$\frac{k^2_\alpha + \beta}{3}$	0	0	0	0	0
$\begin{smallmatrix} \#2 \\ 1^+ f \end{smallmatrix}$	0	0	0	0	0	0
$\begin{smallmatrix} \#1 \\ 1^+ \tau \end{smallmatrix}$	0	0	$\frac{1}{2} (4 c_1 + c_3) k^2 + \beta$	0	$\frac{(4 c_1 + c_3) k^2}{\sqrt{2}}$	$(4 c_1 + c_3) k^2$
$\begin{smallmatrix} \#2 \\ 1^+ \tau \end{smallmatrix}$	0	0	0	0	$\frac{(4 c_1 + c_3) k^2}{\sqrt{2}}$	0

	$\begin{smallmatrix} \#1 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#1 \\ 2^+ \tau \alpha \beta \end{smallmatrix}$	$\begin{smallmatrix} \#2 \\ 2^+ \tau \alpha \beta \end{smallmatrix}$
$\begin{smallmatrix} \#1 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	$\frac{1}{\frac{k^2_\alpha}{3} + \beta}$	0	0	0	0	0
$\begin{smallmatrix} \#2 \\ 1^+ \tau \alpha \beta \end{smallmatrix}$	0	0	0	0	0	0
$\begin{smallmatrix} \#1 \\ 2^+ \tau \alpha \beta \end{smallmatrix}$	0	0	$\frac{1}{\beta}$	0	$-\frac{1}{\sqrt{2} \beta}$	$\frac{1}{(4 c_1 + c_3) k^2} + \frac{1}{2 \beta}$
$\begin{smallmatrix} \#2 \\ 2^+ \tau \alpha \beta \end{smallmatrix}$	0	0	$-\frac{1}{\sqrt{2} \beta}$	0	$\frac{1}{(4 c_1 + c_3) k^2} + \frac{1}{2 \beta}$	0

Spin-parity form	Covariant form	Multiplicities
$\begin{smallmatrix} \#2 \\ 0^+ \tau \end{smallmatrix} = 0$	$\partial_\beta \partial_\alpha \tau^{a\beta} = 0$	1
$\begin{smallmatrix} \#1 \\ 1^+ \tau \end{smallmatrix} = 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} = \partial_\chi \partial^\alpha \partial_\beta \tau^{\beta\alpha}$	3
$\begin{smallmatrix} \#1 \\ 1^+ \tau \end{smallmatrix}^{a\beta} = 0$	$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\chi\alpha} + \partial_\chi \partial^\alpha \tau^{a\beta} = \partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{a\chi} + \partial_\chi \partial^\alpha \tau^{\beta\alpha}$	3
Total expected gauge generators:		7

Massive and massless spectra

Massless particle

Massive particle

Poleresidue:	$\frac{1}{c_1} > 0$
Polarisations:	2

Poleresidue:	$\frac{3}{\alpha} > 0$
Square mass:	$\frac{3\beta}{\alpha} > 0$
Spin:	1
Parity:	Even

Massless particle

Poleresidue:	$\frac{4 + (4 c_1 + c_3)^2}{c_1 (4 c_1 + c_3) (4 c_1 + 3 c_3)} > 0$
Polarisations:	1

Unitarity conditions