Particle spectrograph

Wave operator and propagator

$$S = \int\int\int\int (\phi\, \mathcal{T} + h^{\alpha\beta}\, \mathcal{T}_{\alpha\beta} + \frac{1}{2}\beta\, \partial_\alpha\phi\, \partial^\alpha\phi + \frac{1}{8}\alpha\,(24(1+\phi)\,\partial_\alpha h^\beta{}_\beta\,\partial^\alpha\phi - 8\,\partial_\alpha h^\beta{}_\beta\,\partial^\alpha\phi + 8\,\partial^\alpha\phi\,\partial_\beta h^\beta{}_\alpha - 4\,\partial_\beta\partial_\alpha h^{\alpha\beta} + 4\,\partial_\beta\partial^\beta h^\alpha{}_\alpha - \partial_\beta h^\chi{}_\chi\,\partial^\beta h^\alpha{}_\alpha + 2\,\partial^\beta h^\alpha{}_\alpha\,\partial_\chi h^\chi{}_\beta - 2\,\partial_\beta h_{\alpha\chi}\,\partial^\chi h^{\alpha\beta} + \partial_\chi h_{\alpha\beta}\,\partial^\chi h^{\alpha\beta}) - \zeta\,(16\,\partial_\beta\partial_\alpha\phi\,\partial^\beta\partial^\alpha\phi + 8\,\partial_\beta\partial_\alpha h^\chi{}_\chi\,\partial^\beta\partial^\alpha\phi - 8\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial_\alpha h^\chi{}_\beta - 8\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial_\beta h^\chi{}_\alpha + 8\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial^\chi h_{\alpha\beta} + 8\,\partial_\alpha\partial^\alpha\phi\,(4\,\partial_\beta\partial^\beta\phi - \partial_\chi\partial_\beta h^{\beta\chi} + \partial_\chi\partial^\chi h^\beta{}_\beta) + \partial_\chi\partial_\beta h^\delta\,\partial^\chi\partial^\beta h^\alpha{}_\delta + 2\,\partial^\chi\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial_\chi h^\delta{}_\beta + 2\,\partial^\chi\partial_\alpha h^\alpha{}_\beta\,\partial_\delta\partial_\chi h^{\delta\beta} - 4\,\partial^\chi\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial^\delta h_{\beta\chi} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial_\delta\partial^\delta h_{\alpha\beta} - 4\,\partial^\chi\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial^\delta h_{\beta\chi} + 2\,\partial^\chi\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial^\delta h_{\beta\chi}) + \epsilon\,(12\,\partial_\alpha\partial^\alpha\phi\,(3\,\partial_\beta\partial^\beta\phi - \partial_\chi\partial_\beta h^{\beta\chi} + \partial_\chi\partial^\chi h^\beta{}_\beta) + \partial_\beta\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial_\chi h^{\chi\delta} + \partial_\beta\partial^\beta h^\alpha{}_\alpha\,(-2\,\partial_\delta\partial_\chi h^{\chi\delta} + \partial_\delta\partial^\delta h^\chi{}_\chi)) + \zeta\,(4\,\partial_\alpha\partial^\alpha\phi\,\partial_\beta\partial^\beta\phi + 8\,\partial_\beta\partial_\alpha\phi\,\partial^\beta\partial^\alpha\phi + 4\,\partial_\beta\partial_\alpha h^\chi{}_\chi\,\partial^\beta\partial^\alpha\phi - 4\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial_\alpha h^\chi{}_\beta - 4\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial_\beta h^\chi{}_\alpha + 4\,\partial^\beta\partial^\alpha\phi\,\partial_\chi\partial^\chi h_{\alpha\beta} - \partial_\chi\partial_\beta h^{\beta\chi}\,\partial^\delta\partial^\alpha h^\alpha{}_\delta - \partial_\chi\partial_\beta h^{\alpha\beta}\,\partial^\delta\partial^\chi h^\alpha{}_\delta - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\alpha h^\alpha{}_\delta + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\beta h^\alpha{}_\delta + \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial^\beta h_{\beta\delta} - \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial_\beta h^\beta{}_\delta + \partial_\chi\partial^\chi h^\beta{}_\beta\,\partial^\delta\partial^\alpha h_{\alpha\delta} - \partial_\chi\partial^\chi h^\beta{}_\beta\,\partial^\delta\partial_\alpha h^\alpha{}_\delta + \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial_\beta h^\beta{}_\delta - \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial^\beta h_{\beta\delta} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\alpha h_{\beta\delta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\beta h_{\alpha\delta} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial^\chi h_{\alpha\beta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial^\alpha h_{\beta\delta} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\chi h_{\alpha\beta} - \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial^\beta h_{\beta\delta} + \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial_\beta h^\beta{}_\delta - \partial_\chi\partial^\chi h^\beta{}_\beta\,\partial^\delta\partial^\alpha h_{\alpha\delta} + \partial_\chi\partial^\chi h^\beta{}_\beta\,\partial^\delta\partial_\alpha h^\alpha{}_\delta - \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial_\beta h^\beta{}_\delta + \partial_\chi\partial^\chi h^\alpha{}_\alpha\,\partial^\delta\partial^\beta h_{\beta\delta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\alpha h_{\beta\delta} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\beta h_{\alpha\delta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial^\chi h_{\alpha\beta} + \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial^\alpha h_{\beta\delta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial^\delta\partial_\chi h_{\alpha\beta}))\,[t,\, x,\, y,\, z]\,dt\; dx\; dy\; dz$$

Spin-parity	form	Covariant	form	Multiplicities
$^{\#2}0^+\mathcal{T}$	$==0$	$\partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta}$	$== 0$	1
$^{\#1}1^-\mathcal{T}^\alpha$	$== 0$	$\partial_\chi\partial_\beta\partial^\alpha\mathcal{T}^{\beta\chi}$	$== \partial_\chi\partial^\chi\partial_\beta\mathcal{T}^{\alpha\beta}$	3
Total expected gauge generators:				4

	$^{\#1}0^+h$	$^{\#2}0^+h$	$^{\#1}0^+\phi$
$^{\#1}0^+h\dagger$	$-\frac{\alpha\,k^2}{4} + (3\,\epsilon - 4\,\zeta + \zeta)\,k^4$	0	$-\frac{1}{2}\sqrt{3}\,k^2\,(\alpha - 4\,(3\,\epsilon - 4\,\zeta + \zeta)\,k^2)$
$^{\#2}0^+h\dagger$	0	0	0
$^{\#1}0^+\phi\dagger$	$-\frac{1}{2}\sqrt{3}\,k^2\,(\alpha - 4\,(3\,\epsilon - 4\,\zeta + \zeta)\,k^2)$	0	$\frac{1}{2}k^2\,(-6\,\alpha + \beta + 24\,(3\,\epsilon - 4\,\zeta + \zeta)\,k^2)$

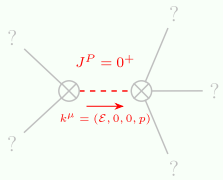
$^{\#1}1^-\mathcal{T}\dagger^\alpha$ = 0 ; $^{\#1}1^-h\alpha$ = 0 ; $^{\#1}1^-h\dagger^\alpha$

$^{\#1}2^+h\alpha\beta$ = $\frac{\alpha\,\vec{k}^2}{8} + (-\zeta + \zeta)\,k^4$; $^{\#1}2^+h\dagger^{\alpha\beta}$

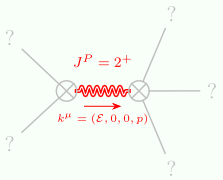
$^{\#1}2^+\mathcal{T}\alpha\beta$ = $\frac{8}{k^2\,(\alpha + 8\,(-\zeta + \zeta)\,k^2)}$; $^{\#1}2^+\mathcal{T}\dagger_{\alpha\beta}$

	$^{\#1}0^+\mathcal{T}$	$^{\#2}0^+\mathcal{T}$	$^{\#1}0^+\mathcal{J}$
$^{\#1}0^+\mathcal{T}\dagger$	$\frac{4\,(-6\,\alpha + \beta + 24\,(3\,\epsilon - 4\,\zeta + \zeta)\,k^2)}{-\alpha\,\beta\,\vec{k} + 4\,\beta\,(3\,\epsilon - 4\,\zeta + \zeta)\,k^4}$	0	$-\frac{4\sqrt{3}}{\beta\,\vec{k}}$
$^{\#2}0^+\mathcal{T}\dagger$	0	0	0
$^{\#1}0^+\mathcal{J}\dagger$	$-\frac{4\sqrt{3}}{\beta\,\vec{k}}$	0	$\frac{2}{\beta\,\vec{k}}$

Massive and massless spectra



Massive particle



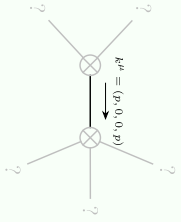
Massive particle

Poleresidue:	$\frac{4}{\alpha} > 0$
Squaremass:	$\frac{\alpha}{4\,(3\,\epsilon - 4\,\zeta + \zeta)} > 0$
Spin:	0
Parity:	Even

Pole residue:	$-\frac{8}{\alpha} > 0$
Squaremass:	$\frac{\alpha}{8\,\zeta - 8\,\zeta} > 0$
Spin:	2
Parity:	Even

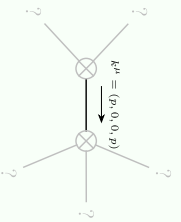
Polarisations:	Poleresidue:
1	$\frac{1}{\beta} > 0$

Massless particle



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

Massless particle



Unitarity conditions