Particle spectrograph

Wave operator and propagator

$$\mathcal{S} == \iiiint \left(h^{\alpha\beta}\ \mathcal{T}_{\alpha\beta} + \beta\ \partial_{\alpha} h^{\alpha\beta}\ \partial_{\chi} h_{\beta}{}^{\chi} + \tfrac{1}{2}\ \alpha \left(\partial_{\beta} h^{\chi}{}_{\chi}\ \partial^{\beta} h^{\alpha}{}_{\alpha} - 2\ \partial^{\beta} h^{\alpha}{}_{\alpha}\ \partial_{\chi} h_{\beta}{}^{\chi} - \partial_{\chi} h_{\alpha\beta}\ \partial^{\chi} h^{\alpha\beta} \right) \right)[t, x, y, z]\, dz\, dy\, dx$$

$$\begin{array}{c|cc} & \overset{\#1}{0^+} h & \overset{\#2}{0^+} h \\ \hline \overset{\#1}{0^+} h^\dagger & \alpha\, k^2 & 0 \\ \overset{\#2}{0^+} h^\dagger & 0 & (-\alpha+\beta)\, k^2 \end{array} \qquad \begin{array}{c|cc} & \overset{\#1}{0^+} \mathcal{T} & \overset{\#2}{0^+} \mathcal{T} \\ \hline \overset{\#1}{0^+} \mathcal{T}^\dagger & \frac{1}{\alpha\, k^2} & 0 \\ \overset{\#2}{0^+} \mathcal{T}^\dagger & 0 & \frac{1}{(-\alpha+\beta)\, k^2} \end{array}$$

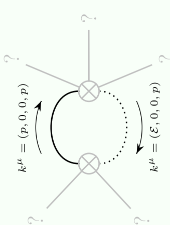
$$\begin{array}{c|c} & \overset{\#1}{1^-} h_\alpha \\ \hline \overset{\#1}{1^-} h^{\dagger\,\alpha} & \frac{1}{2}(-\alpha+\beta)\, k^2 \end{array}$$

(No source constraints)

$$\begin{array}{c|c} & \overset{\#1}{2^+} \mathcal{T}_{\alpha\beta} \\ \hline \overset{\#1}{2^+} \mathcal{T}^{\dagger\,\alpha\beta} & -\frac{2}{\alpha\, k^2} \end{array} \qquad \begin{array}{c|c} & \overset{\#1}{2^+} h_{\alpha\beta} \\ \hline \overset{\#1}{2^+} h^{\dagger\,\alpha\beta} & -\frac{\alpha\, k^2}{2} \end{array} \qquad \begin{array}{c|c} & \overset{\#1}{1^-} \mathcal{T}_{\alpha} \\ \hline \overset{\#1}{1^-} \mathcal{T}^{\dagger\,\alpha} & -\frac{2}{(\alpha-\beta)\, k^2} \end{array}$$

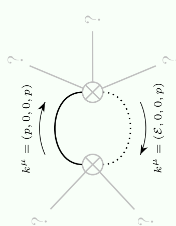
Massive and massless spectra

(No particles)



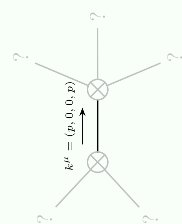
Quartic pole

Pole residue:	$0 < \frac{6\alpha+3\beta+\sqrt{3}\sqrt{12\alpha^2+12\alpha\beta+19\beta^2+64(\alpha-\beta)^2p^2}}{\alpha(\alpha-\beta)}$ && $\frac{6\alpha+3\beta+\sqrt{3}\sqrt{12\alpha^2+12\alpha\beta+19\beta^2+64(\alpha-\beta)^2p^2}}{\alpha(\alpha-\beta)} > 0$
Polarisations:	1



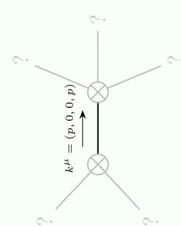
Quartic pole

Pole residue:	$0 < \frac{6\alpha+3\beta-\sqrt{3}\sqrt{12\alpha^2+12\alpha\beta+19\beta^2+64(\alpha-\beta)^2p^2}}{\alpha(\alpha-\beta)}$ && $\frac{6\alpha+3\beta-\sqrt{3}\sqrt{12\alpha^2+12\alpha\beta+19\beta^2+64(\alpha-\beta)^2p^2}}{\alpha(\alpha-\beta)} > 0$
Polarisations:	1



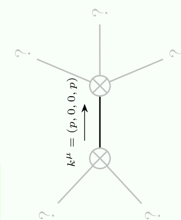
Massless particle

Pole residue:	$-\frac{2\alpha+\beta+\sqrt{20\alpha^2-36\alpha\beta+17\beta^2}}{\alpha^2-\alpha\beta} > 0$
Polarisations:	1



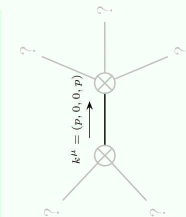
Massless particle

Pole residue:	$\frac{-2\alpha+\beta+\sqrt{20\alpha^2-36\alpha\beta+17\beta^2}}{\alpha(\alpha-\beta)} > 0$
Polarisations:	1



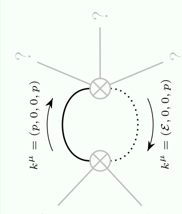
Massless particle

Pole residue:	$-\frac{1}{\alpha} > 0$
Polarisations:	2



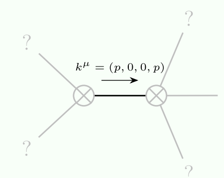
Massless particle

Pole residue:	$\frac{1}{\alpha} + \frac{1}{\alpha-\beta} > 0$
Polarisations:	2



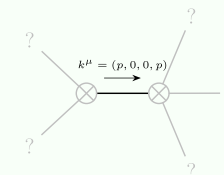
Quartic pole

Pole residue:	$0 < \frac{\beta}{\alpha^2-\alpha\beta}$ && $\frac{\beta}{\alpha^2-\alpha\beta} > 0$
Polarisations:	2



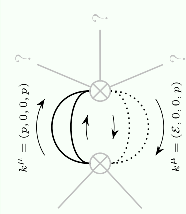
Massless particle

Pole residue:	$-\frac{1}{\alpha} + \frac{1}{-\alpha+\beta} > 0$
Polarisations:	2



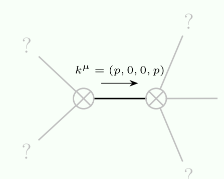
Massless particle

Pole residue:	$\frac{1}{\alpha} + \frac{5}{\alpha-\beta} > 0$
Polarisations:	1



Hexic pole

Pole residue:	$0 < \frac{2\alpha+\beta}{\alpha^2-\alpha\beta}$ && $\frac{2\alpha+\beta}{\alpha^2-\alpha\beta} > 0$
Polarisations:	1



Massless particle

Pole residue:	$-\frac{1}{\alpha} + \frac{5}{-\alpha+\beta} > 0$
Polarisations:	1

Unitarity conditions