Particle spectrograph

Wave operator and propagator

Quadratic (free) action

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

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

$$\begin{array}{c|cc} & h^{\#1}_{0^+} & h^{\#2}_{0^+} \\ \hline h^{\#1}_{0^+}{}^{\dagger} & \alpha k^2 & 0 \\ h^{\#2}_{0^+}{}^{\dagger} & 0 & (-\alpha+\beta) k^2 \end{array}$$

(No source constraints)

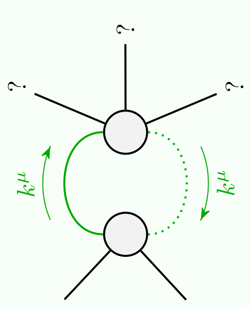
$$\begin{array}{c|c} & h^{\#1}_{1^-}{}_{\alpha} \\ \hline h^{\#1}_{1^-}{}^{\dagger\alpha} & \frac{1}{2} (-\alpha+\beta) k^2 \end{array}$$

$$\begin{array}{c|c} & \mathcal{T}^{\#2}_{2^+}{}_{\alpha\beta} \\ \hline \mathcal{T}^{\#1}_{2^+}{}^{\dagger\alpha\beta} & -\frac{2}{\alpha k^2} \end{array}$$

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

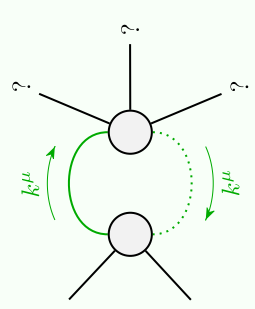
$$\begin{array}{c|c} & h^{\#1}_{2^+}{}_{\alpha\beta} \\ \hline h^{\#1}_{2^+}{}^{\dagger\alpha\beta} & -\frac{\alpha k^2}{2} \end{array}$$

Massive and massless spectra



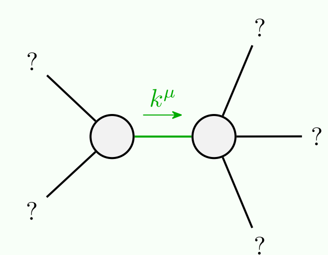
Quartic pole

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



Quartic pole

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

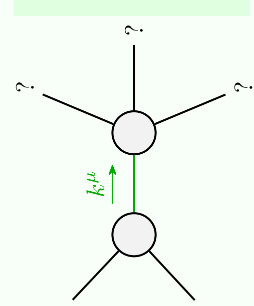


Quadratic pole

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

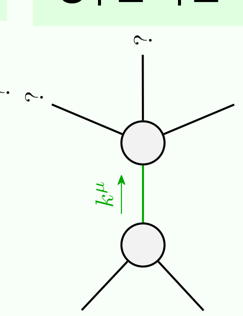
Quadratic pole

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



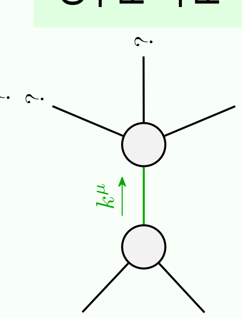
Quadratic pole

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



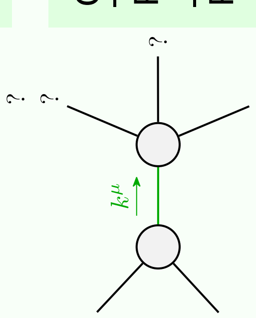
Quadratic pole

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

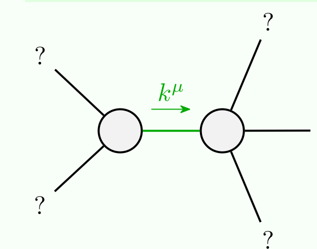


Quadratic pole

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



(No massive particles)

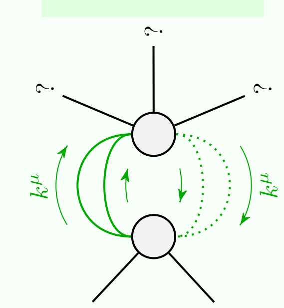


Quadratic pole

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

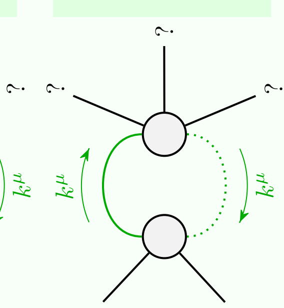
Hexic pole

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



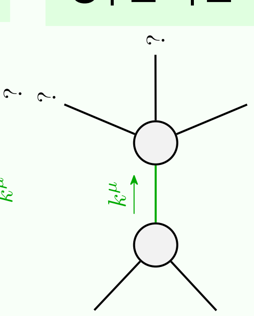
Quartic pole

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



Quadratic pole

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



Unitarity conditions

(Unitarity is demonstrably impossible)