

# PSALTer results panel

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

## Wave operator

$$\begin{array}{cc} \begin{array}{c} \Theta^+ h^\perp \\ \Theta^+ h^\perp \uparrow \end{array} & \begin{array}{c} \Theta^+ h^\parallel \\ \Theta^+ h^\parallel \uparrow \end{array} \\ \begin{array}{|c|} \hline \frac{1}{2} \left( \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \\ \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline \frac{1}{2} \left( 3 \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2 \\ \hline \end{array} \end{array} \begin{array}{c} 1^- h^\perp_{\alpha} \\ 1^- h^\perp_{\alpha} \uparrow \end{array} \begin{array}{|c|} \hline \frac{1}{2} \left( \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2 \\ \hline \end{array} \begin{array}{c} 2^+ h^\parallel_{\alpha\beta} \\ 2^+ h^\parallel_{\alpha\beta} \uparrow \end{array} \begin{array}{|c|} \hline -\frac{\alpha_{\dot{2}} k^2}{2} \\ \hline \end{array}$$

## Saturated propagator

$$\begin{array}{cc} \begin{array}{c} \Theta^+ \mathcal{T}^\perp \\ \Theta^+ \mathcal{T}^\perp \uparrow \end{array} & \begin{array}{c} \Theta^+ \mathcal{T}^\parallel \\ \Theta^+ \mathcal{T}^\parallel \uparrow \end{array} \\ \begin{array}{|c|} \hline \frac{2}{\left( \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2} \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \\ \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline \frac{2}{\left( 3 \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2} \\ \hline \end{array} \end{array} \begin{array}{c} 1^- \mathcal{T}^\perp_{\alpha} \\ 1^- \mathcal{T}^\perp_{\alpha} \uparrow \end{array} \begin{array}{|c|} \hline \frac{2}{\left( \alpha_{\dot{1}} - \alpha_{\dot{2}} \right) k^2} \\ \hline \end{array} \begin{array}{c} 2^+ \mathcal{T}^\parallel_{\alpha\beta} \\ 2^+ \mathcal{T}^\parallel_{\alpha\beta} \uparrow \end{array} \begin{array}{|c|} \hline -\frac{2}{\alpha_{\dot{2}} k^2} \\ \hline \end{array}$$

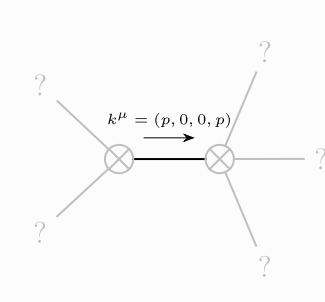
## Source constraints

(There are no source constraints and no gauge symmetries)

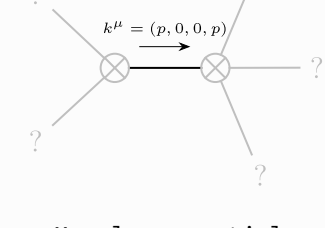
## Massive spectrum

(There are no massive particles)

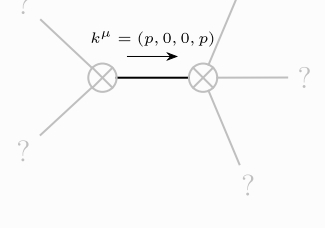
## Massless spectrum



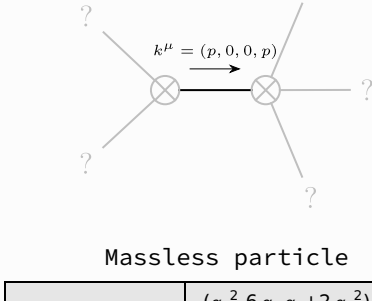
Massless particle	
Pole residue:	$-\frac{(\alpha_{\dot{1}} - 2 \alpha_{\dot{2}}) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	2



Massless particle	
Pole residue:	$\frac{(\alpha_{\dot{1}} - 2 \alpha_{\dot{2}}) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	2



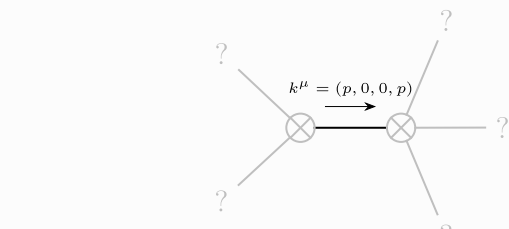
Massless particle	
Pole residue:	$-\frac{p^2}{\alpha_{\dot{2}}} > 0$
Polarisations:	2



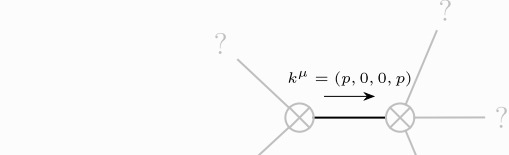
Massless particle	
Pole residue:	$-\frac{(\alpha_{\dot{1}}^2 - 6 \alpha_{\dot{1}} \alpha_{\dot{2}} + 2 \alpha_{\dot{2}}^2) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



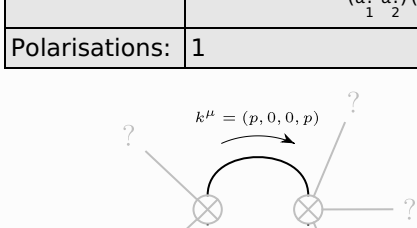
Massless particle	
Pole residue:	$\frac{(\alpha_{\dot{1}}^2 - 6 \alpha_{\dot{1}} \alpha_{\dot{2}} + 2 \alpha_{\dot{2}}^2) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



Massless particle	
Pole residue:	$-\frac{(2 \alpha_{\dot{1}}^2 - 5 \alpha_{\dot{1}} \alpha_{\dot{2}} + 2 \alpha_{\dot{2}}^2 + \sqrt{\alpha_{\dot{1}}^2 (4 \alpha_{\dot{1}}^2 - 8 \alpha_{\dot{1}} \alpha_{\dot{2}} + 5 \alpha_{\dot{2}}^2)}) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



Massless particle	
Pole residue:	$\frac{(-2 \alpha_{\dot{1}}^2 + 5 \alpha_{\dot{1}} \alpha_{\dot{2}} - 2 \alpha_{\dot{2}}^2 + \sqrt{\alpha_{\dot{1}}^2 (4 \alpha_{\dot{1}}^2 - 8 \alpha_{\dot{1}} \alpha_{\dot{2}} + 5 \alpha_{\dot{2}}^2)}) p^2}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1

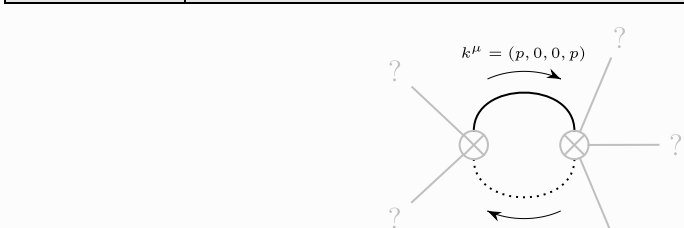


Massless particle	
Pole residue:	$-\frac{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1

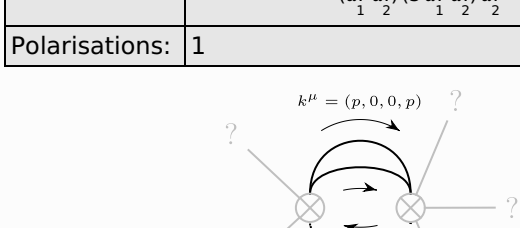
Quartic pole	
Pole residue:	$0 < -\frac{\alpha_{\dot{1}} p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} \ \&\& \ -\frac{\alpha_{\dot{1}} p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	2



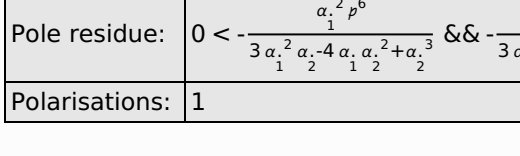
Quartic pole	
Pole residue:	$0 < -\frac{\alpha_{\dot{1}} (3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} \ \&\& \ -\frac{\alpha_{\dot{1}} (3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



Quartic pole	
Pole residue:	$0 < \frac{\alpha_{\dot{1}} (-3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} \ \&\& \ \frac{\alpha_{\dot{1}} (-3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



Quartic pole	
Pole residue:	$0 < \frac{\alpha_{\dot{1}} (-3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} \ \&\& \ \frac{\alpha_{\dot{1}} (-3 \alpha_{\dot{1}} + \sqrt{105 \alpha_{\dot{1}}^2 - 96 \alpha_{\dot{1}} \alpha_{\dot{2}} + 48 \alpha_{\dot{2}}^2}) p^4}{(\alpha_{\dot{1}} - \alpha_{\dot{2}}) (3 \alpha_{\dot{1}} - \alpha_{\dot{2}}) \alpha_{\dot{2}}} > 0$
Polarisations:	1



Hexic pole	
Pole residue:	$0 < -\frac{\alpha_{\dot{1}}^2 p^6}{3 \alpha_{\dot{1}}^2 \alpha_{\dot{2}} - 4 \alpha_{\dot{1}} \alpha_{\dot{2}}^2 + \alpha_{\dot{2}}^3} \ \&\& \ -\frac{\alpha_{\dot{1}}^2 p^6}{3 \alpha_{\dot{1}}^2 \alpha_{\dot{2}} - 4 \alpha_{\dot{1}} \alpha_{\dot{2}}^2 + \alpha_{\dot{2}}^3} > 0$
Polarisations:	1

## Gauge symmetries

(Not yet implemented in PSALTer)

## Unitarity conditions

(Unitarity is demonstrably impossible)

## Validity assumptions

(Not yet implemented in PSALTer)