

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

$$S = \iiint (\mathcal{B}^\alpha \mathcal{J}_\alpha + \beta \partial_\alpha \mathcal{B}^\alpha \partial_\beta \mathcal{B}^\beta + \alpha \partial_\beta \mathcal{B}_\alpha \partial^\beta \mathcal{B}^\alpha) [t, x, y, z] dz dy dx dt$$

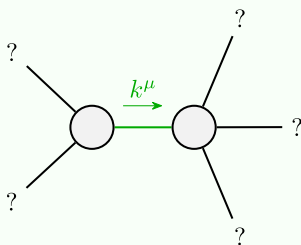
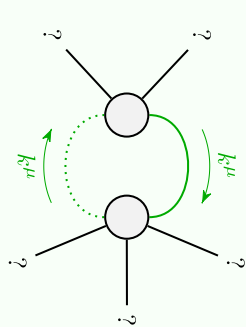
(No source constraints)

$\mathcal{J}_{0+}^{\#1} + \boxed{\frac{1}{(\alpha+\beta)k^2}}$

$\mathcal{J}_{1-}^{\#1} + \alpha \boxed{\frac{1}{\alpha k^2}}$

$\mathcal{B}_{0+}^{\#1} + \boxed{(\alpha+\beta)k^2} \mathcal{B}_{1-}^{\#1} + \alpha \boxed{\alpha k^2} \mathcal{B}_{1-}^{\#1}$

## Massive and massless spectra



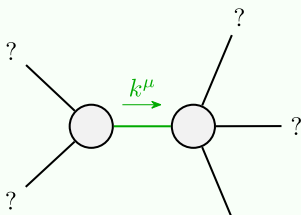
Quadratic pole

Pole residue:	$\frac{1}{\alpha} + \frac{1}{\alpha+\beta} > 0$
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Polarisations:	1
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(No massive particles)

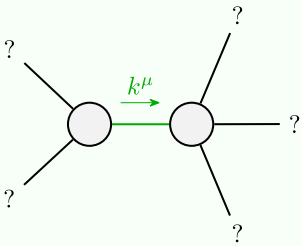
Quartic pole	
Pole residue:	$0 < -\frac{\beta}{\alpha(\alpha+\beta)} \&\& -\frac{\beta}{\alpha(\alpha+\beta)} > 0$
Polarisations:	1



Quadratic pole

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

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

(Unitarity is demonstrably impossible)