

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

$S =$

$$\int \int \int \int (\beta (h_{\alpha\beta} h^{\alpha\beta} - h^\alpha_\alpha h^\beta_\beta) + h^{\alpha\beta} \mathcal{T}_{\alpha\beta} + \frac{1}{2} \alpha (\partial_\beta h^\chi_\chi \partial^\beta h^\alpha_\alpha + 2 \partial_\alpha h^{\alpha\beta} \partial_\chi h^\chi_\beta - 2 \partial^\beta h^\alpha_\alpha \partial_\chi h^\chi_\beta - \partial_\chi h_{\alpha\beta} \partial^\chi h^{\alpha\beta})) [t, x, y, z] dz dy dx dt$$

$h_{0+}^{\#1} \dagger$ 
 $h_{0+}^{\#2}$ 

$-2\beta + \alpha k^2$	$-\sqrt{3}\beta$
$-\sqrt{3}\beta$	$0$

$\mathcal{T}_{2+}^{\#1} \dagger^{\alpha\beta}$ 

$\frac{1}{\beta - \frac{\alpha k^2}{2}}$
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$h_{2+}^{\#1} \dagger^{\alpha\beta}$ 

$\beta - \frac{\alpha k^2}{2}$
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$\mathcal{T}_{0+}^{\#2} \dagger$ 
 $\mathcal{T}_{0+}^{\#1} \dagger$ 

$-\frac{1}{\sqrt{3}\beta}$	$0$
$\frac{2\beta - \alpha k^2}{3\beta^2}$	$-\frac{1}{\sqrt{3}\beta}$

 $\mathcal{T}_{0+}^{\#1}$ 
 $\mathcal{T}_{0+}^{\#2}$

$\mathcal{T}_{1-}^{\#1} \dagger^\alpha$ 

$\frac{1}{\beta}$
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$h_{1-}^{\#1} \dagger^\alpha$ 

$\beta$
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(No source constraints)

## Massive and massless spectra

Massive particle	
Pole residue:	$-\frac{2}{\alpha} > 0$
Polarisations:	5
Square mass:	$\frac{2\beta}{\alpha} > 0$
Spin:	2
Parity:	Even

(No massless particles)

## Unitarity conditions

$\alpha < 0 \ \&\& \ \beta < 0$