

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

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

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

$\frac{1}{\frac{\beta(\beta-4\gamma)}{\beta-\gamma}+\alpha k^2}$	$\frac{\sqrt{3}\,\gamma}{\beta(\beta-4\gamma)+\alpha(\beta-\gamma)k^2}$
$\frac{\sqrt{3}\,\gamma}{\beta(\beta-4\gamma)+\alpha(\beta-\gamma)k^2}$	$\frac{1}{\beta+\gamma(-1-\frac{3\gamma}{\beta-3\gamma+\alpha k^2})}$

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

$\frac{\sqrt{3}\,\gamma}{\beta(\beta-4\gamma)+\alpha(\beta-\gamma)k^2}$	$\frac{1}{\beta+\gamma(-1-\frac{3\gamma}{\beta-3\gamma+\alpha k^2})}$
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$h_{0+}^{\#1} \dagger$ 

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

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

$-\sqrt{3}\,\gamma$	$\beta-\gamma$
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$\mathcal{T}_{2+}^{\#1} \dagger^{\alpha\beta}$ 

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

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

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

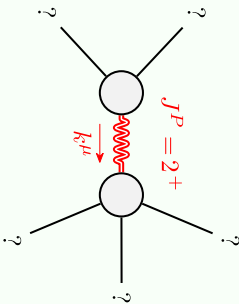
$\beta$
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(No source constraints)

## Massive and massless spectra

Massive particle	
Pole residue:	$\frac{\beta^2-2\,\beta\,\gamma+4\,\gamma^2}{\alpha(\beta-\gamma)^2} > 0$
Polarisations:	1
Square mass:	$-\frac{\beta(\beta-4\,\gamma)}{\alpha(\beta-\gamma)} > 0$
Spin:	0
Parity:	Even

(No massless particles)



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

## Unitarity conditions

(Unitarity is demonstrably impossible)