

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

$$S = \iiint (\gamma \mathcal{B}_\alpha \mathcal{B}^\alpha + \mathcal{B}^\alpha \mathcal{J}_\alpha + 2 \alpha (-\partial_\alpha \mathcal{B}_\beta + \partial_\beta \mathcal{B}_\alpha) \partial^\beta \mathcal{B}^\alpha) [t, x, y, z] dz dy dx dt$$

$\mathcal{B}_{1-}^{\#1} +^\alpha$ 

$\mathcal{B}_{1-}^{\#1} \alpha$   
 $\gamma + 2 \alpha k^2$

(No source constraints)

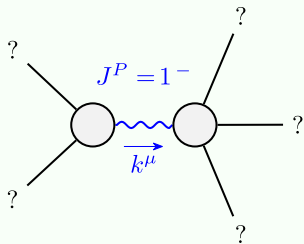
$\mathcal{J}_{1-}^{\#1} +^\alpha$ 

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

$\mathcal{J}_{0+}^{\#1} +$   
 $\gamma \quad 1_-$

$\mathcal{B}_{0+}^{\#1} +$   
 $\gamma$   
 $\mathcal{B}_{0+}^{\#1}$

## Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{2 \alpha} > 0$
Polarisations:	3
Square mass:	$-\frac{\gamma}{2 \alpha} > 0$
Spin:	1
Parity:	Odd

(No massless particles)

## Unitarity conditions

$$\alpha < 0 \ \&\& \ \gamma > 0$$