

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

$$S = - \int \int \int \int d^4x \left[ \frac{1}{2} \partial_\mu \mathcal{B}_{\alpha\beta} \partial^\mu \mathcal{B}^{\alpha\beta} + \mathcal{B}_{\alpha\beta} \mathcal{J}^{\alpha\beta} + \frac{1}{3} \gamma (-2 \partial_\beta \mathcal{B}_{\alpha\chi} + \partial_\chi \mathcal{B}_{\alpha\beta}) \partial^\chi \mathcal{B}^{\alpha\beta} \right]$$

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

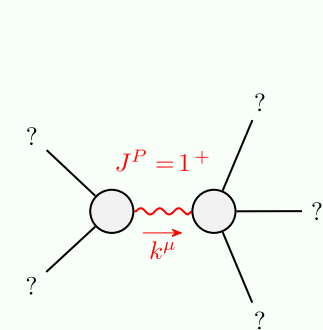
$\frac{1}{\delta + \frac{\gamma k^2}{3}}$	0
0	$\frac{1}{\delta}$

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

$\delta + \frac{\gamma k^2}{3}$	0
0	$\delta$

(No source constraints)

## Massive and massless spectra



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

(No massless particles)

## Unitarity conditions

$$\gamma > 0 \ \&\& \ \delta < 0$$