

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

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

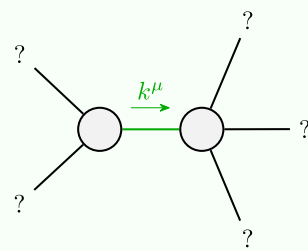
Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\mathcal{J}_0^{#1} == 0$	$\partial_\alpha \mathcal{J}^\alpha == 0$	1
Total constraints/gauge generators: 1		

$$\mathcal{J}_{1^-}^{#1} \dagger^\alpha \boxed{\frac{1}{2 \alpha k^2}} \mathcal{B}_{1^-}^{#1} \dagger^\alpha \boxed{2 \alpha k^2} \mathcal{J}_{0^+}^{#1} \dagger \boxed{0} \mathcal{B}_{0^+}^{#1} \dagger \boxed{0}$$

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

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

## Massive and massless spectra



Quadratic pole	
Pole residue:	$-\frac{1}{\alpha} > 0$
Polarisations:	2

(No massive particles)

## Unitarity conditions

$$\alpha < 0$$