

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

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

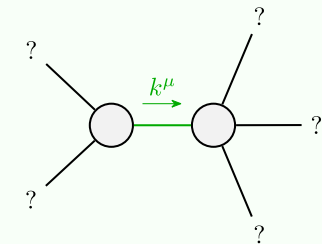
Source constraints

SO(3) irreps	Fundamental fields	Multiplicities
$\mathcal{T}^{\#2}_{0^+} == 0$	$\partial_\beta \partial_\alpha \mathcal{T}^{\alpha\beta} == 0$	1
$\mathcal{T}^{\#1\alpha}_{1^-} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \mathcal{T}^{\beta\chi} == \partial_\chi \partial^\chi \partial_\beta \mathcal{T}^{\alpha\beta}$	3
Total constraints/gauge generators:		4

$$\begin{matrix} & \mathcal{T}^{\#1\alpha}_{1^-} \\ \mathcal{T}^{\#1\alpha}_{1^-} + \alpha & \boxed{0} \\ & \boxed{0} \\ & h^{\#1\alpha}_{1^-} \end{matrix}$$

$$\begin{matrix} & \mathcal{T}^{\#1}_{0^+} & \mathcal{T}^{\#2}_{0^+} & & \\ \mathcal{T}^{\#1\alpha}_{0^+} + & \boxed{\frac{1}{\alpha k^2}} & \boxed{0} & & \mathcal{T}^{\#1\alpha}_{2^+} + \alpha\beta \\ \mathcal{T}^{\#2\alpha}_{0^+} + & \boxed{0} & \boxed{0} & & \boxed{-\frac{2}{\alpha k^2}} \mathcal{T}^{\#1\alpha}_{2^+} + \alpha\beta \\ & h^{\#1\alpha}_{0^+} & h^{\#2\alpha}_{0^+} & & \\ h^{\#1\alpha}_{0^+} + & \boxed{\alpha k^2} & \boxed{0} & & h^{\#1\alpha}_{2^+} + \alpha\beta \\ h^{\#2\alpha}_{0^+} + & \boxed{0} & \boxed{0} & & \boxed{-\frac{\alpha k^2}{2}} h^{\#1\alpha}_{2^+} + \alpha\beta \end{matrix}$$

## Massive and massless spectra



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

(No massive particles)

## Unitarity conditions

$\alpha < 0$