

# Particle spectrograph

## Wave operator and propagator

Quadratic (free) action

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

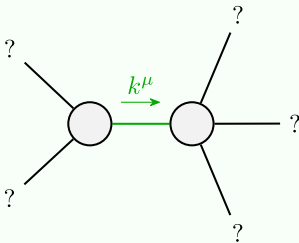
Source constraints

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

$$\begin{array}{c} \mathcal{T}^{\#1}_{2^+} \dagger^{\alpha\beta} \quad \boxed{\frac{1}{\alpha k^2}} \quad \begin{array}{c} \mathcal{T}^{\#1}_{2^+} \alpha\beta \\ h^{\#1}_{2^+} \alpha\beta \end{array} \quad \begin{array}{c} \mathcal{T}^{\#1}_{1^-} \alpha \\ h^{\#1}_{2^+} \alpha\beta \end{array} \quad \boxed{\alpha k^2} \quad \begin{array}{c} \mathcal{T}^{\#1}_{1^-} \alpha \\ h^{\#1}_{1^-} \alpha \end{array} \quad \begin{array}{c} \mathcal{T}^{\#1}_{1^-} \alpha \\ h^{\#1}_{1^-} \alpha \end{array} \quad \boxed{0} \quad \begin{array}{c} \mathcal{T}^{\#1}_{1^-} \alpha \\ h^{\#1}_{1^-} \alpha \end{array} \quad \boxed{0} \quad \begin{array}{c} \mathcal{T}^{\#1}_{1^-} \alpha \\ h^{\#1}_{1^-} \alpha \end{array} \end{array}$$

$$\begin{array}{c} \mathcal{T}^{\#1}_{0^+} \dagger \quad \mathcal{T}^{\#2}_{0^+} \\ \mathcal{T}^{\#1}_{0^+} \dagger \quad \begin{array}{|c|c|} \hline 0 & \frac{1}{\sqrt{3} \alpha k^2} \\ \hline \frac{1}{\sqrt{3} \alpha k^2} & -\frac{4}{3 \alpha k^2} \\ \hline \end{array} \\ \mathcal{T}^{\#2}_{0^+} \dagger \quad \begin{array}{|c|c|} \hline \frac{1}{\sqrt{3} \alpha k^2} & -\frac{4}{3 \alpha k^2} \\ \hline \frac{1}{\sqrt{3} \alpha k^2} & -\frac{4}{3 \alpha k^2} \\ \hline \end{array} \\ \begin{array}{c} h^{\#1}_{0^+} \dagger \quad h^{\#2}_{0^+} \\ h^{\#1}_{0^+} \dagger \quad \begin{array}{|c|c|} \hline 4 \alpha k^2 & \sqrt{3} \alpha k^2 \\ \hline \sqrt{3} \alpha k^2 & 0 \\ \hline \end{array} \\ h^{\#2}_{0^+} \dagger \quad \begin{array}{|c|c|} \hline 4 \alpha k^2 & \sqrt{3} \alpha k^2 \\ \hline \sqrt{3} \alpha k^2 & 0 \\ \hline \end{array} \end{array} \end{array}$$

## Massive and massless spectra



Quadratic pole	
Pole residue:	$\frac{1}{\alpha} > 0$
Polarisations:	3

(No massive particles)

## Unitarity conditions

$$\alpha > 0$$