

# Wave operator and propagator

$$\begin{aligned}
& \text{Quadratic (free) action} \\
S = & \int \int \int \left( \frac{1}{6} f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta x} \sigma_{\alpha\beta x} - 3 r_3 \partial_\beta \omega_{,\theta}^\theta \partial' \omega_{\alpha}^{\alpha\beta} - 3 r_3 \partial_i \omega_{\beta}^\theta \partial' \omega_{\alpha}^{\alpha\beta} - 3 \right. \\
& \quad \left. r_3 \partial_\alpha \omega^{\alpha\beta i} \partial_\theta \omega_{\beta,}^\theta + 6 r_3 \partial' \omega_{\beta,}^{\alpha\beta} \partial_\theta \omega_{\beta,}^\theta - \right. \\
& \quad \left. 3 r_3 \partial_\alpha \omega^{\alpha\beta i} \partial_\theta \omega_{i,}^\theta + 6 r_3 \partial' \omega_{\beta,}^{\alpha\beta} \partial_\theta \omega_{i,}^\theta + \right. \\
& \quad \left. 4 t_2 \omega_{i\theta\alpha} \partial^\theta f^{\alpha i} + 2 t_2 \partial_\alpha f_{,\theta}^\theta \partial^\theta f^{\alpha i} - t_2 \partial_\alpha f_{,\theta}^\theta \partial' f^{\alpha i} - \right. \\
& \quad \left. t_2 \partial_i f_{\alpha\theta} \partial^\theta f^{\alpha i} + t_2 \partial_\theta f_{\alpha i} \partial^\theta f^{\alpha i} - t_2 \partial_\theta f_{i\alpha} \partial^\theta f^{\alpha i} - \right. \\
& \quad \left. 4 t_2 \omega_{\theta\theta i} (\omega^{\alpha i\theta} + \partial^\theta f^{\alpha i}) + 2 t_2 \omega_{\alpha i\theta} (\omega^{\alpha i\theta} + 2 \partial^\theta f^{\alpha i}) - \right. \\
& \quad \left. 24 r_3 \partial_\beta \omega_{i\theta\alpha} \partial^\theta \omega_{\theta,}^{\alpha\beta i} + 6 r_5 \partial_i \omega_{\theta,}^\kappa \partial^\theta \omega_{\alpha,}^{\alpha i} - \right. \\
& \quad \left. 6 r_5 \partial_\theta \omega_{,\kappa}^\kappa \partial^\theta \omega_{\alpha,}^{\alpha i} - 6 r_5 \partial_\alpha \omega^{\alpha i\theta} \partial_\kappa \omega_{i,}^\kappa + \right. \\
& \quad \left. 12 r_5 \partial^\theta \omega_{\alpha,}^{\alpha i} \partial_\kappa \omega_{\theta,}^\kappa + 6 r_5 \partial_\alpha \omega^{\alpha i\theta} \partial_\kappa \omega_{\theta,}^\kappa - \right. \\
& \quad \left. 12 r_5 \partial^\theta \omega_{\alpha,}^{\alpha i} \partial_\kappa \omega_{\theta,}^\kappa \right) [t, x, y, z] dz dy dx dt
\end{aligned}$$

Quadratic pole	
Pole residue:	$-\frac{1}{r_3(2r_3+r_5)(r_3+2r_5)p^2} > 0$
Polarisations:	2

(No massive particles)

$$r_3 < 0 \&\& (r_5 < -\frac{r_3}{2} \parallel r_5 > -2r_3) \parallel r_3 > 0 \&\& -2r_3 < r_5 < -\frac{r_3}{2}$$

$$\begin{array}{c}
\omega_0^{\#1} \quad f_{0+}^{\#1} \quad f_{0+}^{\#2} \quad \omega_0^{\#1} \\
\omega_0^{\#1} \vdash \begin{array}{|c|c|c|c|} \hline 0 & 0 & 0 & 0 \\ \hline f_{0+}^{\#1} \vdash \begin{array}{|c|c|c|c|} \hline 0 & 0 & 0 & 0 \\ \hline f_{0+}^{\#2} \vdash \begin{array}{|c|c|c|c|} \hline 0 & 0 & 0 & 0 \\ \hline \omega_0^{\#1} \vdash \begin{array}{|c|c|c|c|} \hline 0 & 0 & 0 & t_2 \\ \hline \end{array} \\ \hline \omega_{2+}^{\#1} \alpha\beta \quad f_{2+}^{\#1} \alpha\beta \quad \omega_{2-}^{\#1} \alpha\beta\chi \\
\omega_{2+}^{\#1} \vdash \alpha\beta \quad \begin{array}{|c|c|c|} \hline -\frac{3k^2 r_3}{2} & 0 & 0 \\ \hline f_{2+}^{\#1} \vdash \alpha\beta \quad \begin{array}{|c|c|c|} \hline 0 & 0 & 0 \\ \hline \omega_{2-}^{\#1} \vdash \alpha\beta\chi \quad \begin{array}{|c|c|c|} \hline 0 & 0 & 0 \\ \hline \end{array} \\ \hline \end{array}
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