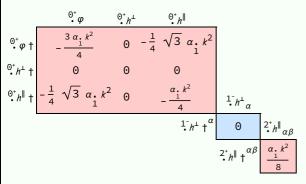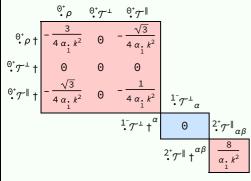# PSALTer results panel

$$S == \iiiint \left( \rho\,\varphi + h^{\alpha\beta}\ \mathcal{T}_{\alpha\beta} + \frac{1}{2}\,\alpha_2\,\partial_\alpha\varphi\,\partial^\alpha\varphi + \frac{1}{8}\,\alpha_1 \left( 12\,\partial_\alpha\partial^\alpha\varphi - 4\,\partial_\alpha h^\beta{}_\beta\,\partial^\alpha\varphi - 6\,\partial_\alpha\varphi\,\partial^\alpha\varphi + 4\,\partial^\alpha\varphi\,\partial_\beta h_\alpha{}^\beta - \right.\right.$$

$$4\,\partial_\beta\partial_\alpha h^{\alpha\beta} + 4\,\partial_\beta\partial^\beta h^\alpha{}_\alpha - \partial_\beta h^\chi{}_\chi\,\partial^\beta h^\alpha{}_\alpha + 2\,\partial^\beta h^\alpha{}_\alpha\,\partial_\chi h_\beta{}^\chi - 2\,\partial_\beta h_{\alpha\chi}\,\partial^\chi h^{\alpha\beta} + \partial_\chi h_{\alpha\beta}\,\partial^\chi h^{\alpha\beta} \Big) +$$

$$\alpha_5 \left( -2\,\partial_\beta\partial_\alpha h^\chi{}_\chi\,\partial^\beta\partial^\alpha\varphi - 2\,\partial_\beta\partial_\alpha\varphi\,\partial^\beta\partial^\alpha\varphi + 2\,\partial^\beta\partial^\alpha\varphi\,\partial_\chi\partial_\alpha h_\beta{}^\chi + 2\,\partial^\beta\partial^\alpha\varphi\,\partial_\chi\partial_\beta h_\alpha{}^\chi - 2\,\partial^\beta\partial^\alpha\varphi\,\partial_\chi\partial^\chi h_{\alpha\beta} + \right.$$

$$2\,\partial_\alpha\partial^\alpha\varphi \left( \partial_\beta\partial^\beta\varphi - \partial_\chi\partial_\beta h^{\beta\chi} + \partial_\chi\partial^\chi h^\beta{}_\beta \right) - \partial_\chi\partial_\beta h^\delta{}_\delta\,\partial^\chi\partial^\beta h^\alpha{}_\alpha - 2\,\partial^\chi\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial_\beta h_\chi{}^\delta - 2\,\partial^\chi\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial_\chi h_\beta{}^\delta +$$

$$4\,\partial^\chi\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial_\chi h_\beta{}^\delta + \partial_\beta\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial_\chi h^{\chi\delta} - 2\,\partial_\beta\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial_\chi h^{\chi\delta} - \partial_\chi\partial^\chi h^{\alpha\beta}\,\partial_\delta\partial^\delta h_{\alpha\beta} +$$

$$4\,\partial^\chi\partial_\alpha h^{\alpha\beta}\,\partial_\delta\partial^\delta h_{\beta\chi} - 2\,\partial^\chi\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial^\delta h_{\beta\chi} + \partial_\beta\partial^\beta h^\alpha{}_\alpha\,\partial_\delta\partial^\delta h^\chi{}_\chi + \partial_\beta\partial_\alpha h_{\chi\delta}\,\partial^\delta\partial^\chi h^{\alpha\beta} -$$

$$\left.\left.\partial_\chi\partial_\beta h_{\alpha\delta}\,\partial^\delta\partial^\chi h^{\alpha\beta} - \partial_\delta\partial_\beta h_{\alpha\chi}\,\partial^\delta\partial^\chi h^{\alpha\beta} + \partial_\delta\partial_\chi h_{\alpha\beta}\,\partial^\delta\partial^\chi h^{\alpha\beta} \right) \right)[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

## Wave operator

| | $\overset{0^+}{\bullet}\varphi$ | $\overset{0^+}{\bullet}h^\perp$ | $\overset{0^+}{\bullet}h^\parallel$ | | |
|---|---|---|---|---|---|
| $\overset{0^+}{\bullet}\varphi\,\dagger$ | $-\frac{3\,\alpha_1\,k^2}{4}$ | $0$ | $-\frac{1}{4}\sqrt{3}\,\alpha_1\,k^2$ | | |
| $\overset{0^+}{\bullet}h^\perp\,\dagger$ | $0$ | $0$ | $0$ | | |
| $\overset{0^+}{\bullet}h^\parallel\,\dagger$ | $-\frac{1}{4}\sqrt{3}\,\alpha_1\,k^2$ | $0$ | $-\frac{\alpha_1\,k^2}{4}$ | $\overset{1^-}{\bullet}h^\perp{}_\alpha$ | |
| $\overset{1^-}{\bullet}h^\perp\,\dagger^\alpha$ | | | | $0$ | $\overset{2^+}{\bullet}h^\parallel{}_{\alpha\beta}$ |
| $\overset{2^+}{\bullet}h^\parallel\,\dagger^{\alpha\beta}$ | | | | | $\frac{\alpha_1\,k^2}{8}$ |

## Saturated propagator

| | $\overset{0^+}{\bullet}\rho$ | $\overset{0^+}{\bullet}\mathcal{T}^\perp$ | $\overset{0^+}{\bullet}\mathcal{T}^\parallel$ | | |
|---|---|---|---|---|---|
| $\overset{0^+}{\bullet}\rho\,\dagger$ | $-\frac{3}{4\,\alpha_1\,k^2}$ | $0$ | $-\frac{\sqrt{3}}{4\,\alpha_1\,k^2}$ | | |
| $\overset{0^+}{\bullet}\mathcal{T}^\perp\,\dagger$ | $0$ | $0$ | $0$ | | |
| $\overset{0^+}{\bullet}\mathcal{T}^\parallel\,\dagger$ | $-\frac{\sqrt{3}}{4\,\alpha_1\,k^2}$ | $0$ | $-\frac{1}{4\,\alpha_1\,k^2}$ | $\overset{1^-}{\bullet}\mathcal{T}^\perp{}_\alpha$ | |
| $\overset{1^-}{\bullet}\mathcal{T}^\perp\,\dagger^\alpha$ | | | | $0$ | $\overset{2^+}{\bullet}\mathcal{T}^\parallel{}_{\alpha\beta}$ |
| $\overset{2^+}{\bullet}\mathcal{T}^\parallel\,\dagger^{\alpha\beta}$ | | | | | $\frac{8}{\alpha_1\,k^2}$ |

## Source constraints

| Spin-parity form | Covariant form | Multiplicities |
|---|---|---|
| $\overset{0^+}{\bullet}\rho == \overset{0^+}{\bullet}\mathcal{T}^\parallel$ | $\partial_\alpha\partial^\alpha\rho + \partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta} == \partial_\beta\partial^\beta\mathcal{T}^\alpha{}_\alpha$ | 1 |
| $\overset{0^+}{\bullet}\mathcal{T}^\perp == 0$ | $\partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta} == 0$ | 1 |
| $\overset{1^-}{\bullet}\mathcal{T}^\perp{}^\alpha == 0$ | $\partial_\chi\partial_\beta\partial^\alpha\mathcal{T}^{\beta\chi} == \partial_\chi\partial^\chi\partial_\beta\mathcal{T}^{\alpha\beta}$ | 3 |
| Total expected gauge generators: | | 5 |

## Massive spectrum

(No particles)

## Massless spectrum



| Massless particle | | Massless particle | |
|---|---|---|---|
| Pole residue: | $\frac{1}{\alpha_1} > 0$ | Pole residue: | $\frac{p^2}{\alpha_1} > 0$ |
| Polarisations: | 1 | Polarisations: | 1 |

## Unitarity conditions

$$\alpha_1 > 0$$