# PSALTer results panel

$$\mathcal{S} == \int\int\int\int ( \mathcal{A}^{\alpha\beta\chi}\ \sigma_{\alpha\beta\chi} + f^{\alpha\beta}\ \tau (\Delta+\mathcal{K})_{\alpha\beta} + \frac{1}{3} r_{3} (4 \partial_{\beta}\mathcal{A}_{\alpha\iota\theta} - 2 \partial_{\beta}\mathcal{A}_{\alpha\theta\iota} + 2 \partial_{\beta}\mathcal{A}_{\iota\theta\alpha} - \partial_{\iota}\mathcal{A}_{\alpha\beta\theta} + \partial_{\theta}\mathcal{A}_{\alpha\beta\iota} - 2 \partial_{\theta}\mathcal{A}_{\alpha\iota\beta}) \partial^{\theta}\mathcal{A}^{\alpha\beta\iota} - 2 r_{3} (\partial_{\beta}\mathcal{A}_{\iota}{}^{\theta}{}_{\theta} \partial^{\iota}\mathcal{A}^{\alpha\beta}{}_{\alpha} + \partial_{\iota}\mathcal{A}_{\beta}{}^{\theta}{}_{\theta} \partial^{\iota}\mathcal{A}^{\alpha\beta}{}_{\alpha} + \partial_{\alpha}\mathcal{A}^{\alpha\beta\iota} \partial_{\theta}\mathcal{A}_{\beta}{}^{\theta}{}_{\iota} - 2 \partial^{\iota}\mathcal{A}^{\alpha\beta}{}_{\alpha} \partial_{\theta}\mathcal{A}_{\beta}{}^{\theta}{}_{\iota} + \partial_{\alpha}\mathcal{A}^{\alpha\beta\iota} \partial_{\theta}\mathcal{A}_{\iota}{}^{\theta}{}_{\beta} - 2 \partial^{\iota}\mathcal{A}^{\alpha\beta}{}_{\alpha} \partial_{\theta}\mathcal{A}_{\iota}{}^{\theta}{}_{\beta} + 2 \partial_{\beta}\mathcal{A}_{\iota\theta\alpha} \partial^{\theta}\mathcal{A}^{\alpha\beta\iota}) + \frac{1}{6} t_{1} (2\ \mathcal{A}^{\alpha\iota}{}_{\alpha}\ \mathcal{A}_{\iota}{}^{\theta}{}_{\theta} - 4\ \mathcal{A}_{\alpha}{}^{\theta}{}_{\theta} \partial_{\iota}f^{\alpha\iota} + 4\ \mathcal{A}_{\iota}{}^{\theta}{}_{\theta} \partial^{\iota}f^{\alpha}{}_{\alpha} - 2 \partial_{\iota}f^{\theta}{}_{\theta} \partial^{\iota}f^{\alpha}{}_{\alpha} - 2 \partial_{\iota}f^{\alpha\iota} \partial_{\theta}f_{\alpha}{}^{\theta} + 4 \partial^{\iota}f^{\alpha}{}_{\alpha} \partial_{\theta}f_{\iota}{}^{\theta} - 6 \partial_{\alpha}f_{\iota\theta} \partial^{\theta}f^{\alpha\iota} - 3 \partial_{\alpha}f_{\theta\iota} \partial^{\theta}f^{\alpha\iota} + 3 \partial_{\iota}f_{\alpha\theta} \partial^{\theta}f^{\alpha\iota} + 3 \partial_{\theta}f_{\alpha\iota} \partial^{\theta}f^{\alpha\iota} + 3 \partial_{\theta}f_{\iota\alpha} \partial^{\theta}f^{\alpha\iota} + 6\ \mathcal{A}_{\alpha\theta\iota}\ (\mathcal{A}^{\alpha\iota\theta} + 2 \partial^{\theta}f^{\alpha\iota})) + r_{5} (\partial_{\iota}\mathcal{A}_{\theta}{}^{\kappa}{}_{\kappa} \partial^{\theta}\mathcal{A}^{\alpha\iota}{}_{\alpha} - \partial_{\theta}\mathcal{A}_{\iota}{}^{\kappa}{}_{\kappa} \partial^{\theta}\mathcal{A}^{\alpha\iota}{}_{\alpha} - (\partial_{\alpha}\mathcal{A}^{\alpha\iota\theta} - 2 \partial^{\theta}\mathcal{A}^{\alpha\iota}{}_{\alpha}) (\partial_{\kappa}\mathcal{A}_{\iota}{}^{\kappa}{}_{\theta} - \partial_{\kappa}\mathcal{A}_{\theta}{}^{\kappa}{}_{\iota}))) [t, x, y, z]\, dz\, dy\, dx\, dt$$

# Wave operator

| | $0^+_{.}\mathcal{A}^{\parallel}$ | $0^+_{.}f^{\parallel}$ | $0^+_{.}f^{\perp}$ | $0^-_{.}\mathcal{A}^{\parallel}$ |
|---|---|---|---|---|
| $0^+_{.}\mathcal{A}^{\parallel}\,\dagger$ | $6 k^2 r_{3}$ | 0 | 0 | 0 |
| $0^+_{.}f^{\parallel}\,\dagger$ | 0 | 0 | 0 | 0 |
| $0^+_{.}f^{\perp}\,\dagger$ | 0 | 0 | 0 | 0 |
| $0^-_{.}\mathcal{A}^{\parallel}\,\dagger$ | 0 | 0 | 0 | $k^2 r_{2} - t_{1}$ |

| | $1^+_{.}\mathcal{A}^{\parallel}{}_{\alpha\beta}$ | $1^+_{.}\mathcal{A}^{\perp}{}_{\alpha\beta}$ | $1^+_{.}f^{\parallel}{}_{\alpha\beta}$ | $1^-_{.}\mathcal{A}^{\parallel}{}_{\alpha}$ | $1^-_{.}\mathcal{A}^{\perp}{}_{\alpha}$ | $1^-_{.}f^{\parallel}{}_{\alpha}$ | $1^-_{.}f^{\perp}{}_{\alpha}$ |
|---|---|---|---|---|---|---|---|
| $1^+_{.}\mathcal{A}^{\parallel}\,\dagger^{\alpha\beta}$ | $k^2 (2 r_{3} + r_{5}) - \frac{t_{1}}{2}$ | $-\frac{t_{1}}{\sqrt{2}}$ | $-\frac{i k t_{1}}{\sqrt{2}}$ | 0 | 0 | 0 | 0 |
| $1^+_{.}\mathcal{A}^{\perp}\,\dagger^{\alpha\beta}$ | $-\frac{t_{1}}{\sqrt{2}}$ | 0 | 0 | 0 | 0 | 0 | 0 |
| $1^+_{.}f^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{i k t_{1}}{\sqrt{2}}$ | 0 | 0 | 0 | 0 | 0 | 0 |
| $1^-_{.}\mathcal{A}^{\parallel}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $k^2 (2 r_{3} + r_{5}) + \frac{t_{1}}{6}$ | $\frac{t_{1}}{3\sqrt{2}}$ | 0 | $\frac{i k t_{1}}{3}$ |
| $1^-_{.}\mathcal{A}^{\perp}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $\frac{t_{1}}{3\sqrt{2}}$ | $\frac{t_{1}}{3}$ | 0 | $\frac{1}{3} i \sqrt{2}\ k t_{1}$ |
| $1^-_{.}f^{\parallel}\,\dagger^{\alpha}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $1^-_{.}f^{\perp}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $-\frac{1}{3} i k t_{1}$ | $-\frac{1}{3} i \sqrt{2}\ k t_{1}$ | 0 | $\frac{2 k^2 t_{1}}{3}$ |

| | $2^+_{.}\mathcal{A}^{\parallel}{}_{\alpha\beta}$ | $2^+_{.}f^{\parallel}{}_{\alpha\beta}$ | $2^-_{.}\mathcal{A}^{\parallel}{}_{\alpha\beta\chi}$ |
|---|---|---|---|
| $2^+_{.}\mathcal{A}^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{t_{1}}{2}$ | $-\frac{i k t_{1}}{\sqrt{2}}$ | 0 |
| $2^+_{.}f^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{i k t_{1}}{\sqrt{2}}$ | $k^2 t_{1}$ | 0 |
| $2^-_{.}\mathcal{A}^{\parallel}\,\dagger^{\alpha\beta\chi}$ | 0 | 0 | $\frac{t_{1}}{2}$ |

# Saturated propagator

| | $0^+_{.}\sigma^{\parallel}$ | $0^+_{.}\tau^{\parallel}$ | $0^+_{.}\tau^{\perp}$ | $0^-_{.}\sigma^{\parallel}$ |
|---|---|---|---|---|
| $0^+_{.}\sigma^{\parallel}\,\dagger$ | $\frac{1}{6 k^2 r_{3}}$ | 0 | 0 | 0 |
| $0^+_{.}\tau^{\parallel}\,\dagger$ | 0 | 0 | 0 | 0 |
| $0^+_{.}\tau^{\perp}\,\dagger$ | 0 | 0 | 0 | 0 |
| $0^-_{.}\sigma^{\parallel}\,\dagger$ | 0 | 0 | 0 | $\frac{1}{k^2 r_{2} - t_{1}}$ |

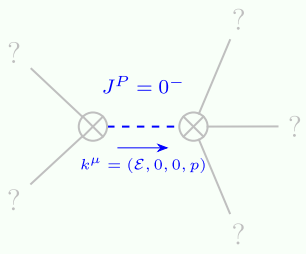
| | $1^+_{.}\sigma^{\parallel}{}_{\alpha\beta}$ | $1^+_{.}\sigma^{\perp}{}_{\alpha\beta}$ | $1^+_{.}\tau^{\parallel}{}_{\alpha\beta}$ | $1^-_{.}\sigma^{\parallel}{}_{\alpha}$ | $1^-_{.}\sigma^{\perp}{}_{\alpha}$ | $1^-_{.}\tau^{\parallel}{}_{\alpha}$ | $1^-_{.}\tau^{\perp}{}_{\alpha}$ |
|---|---|---|---|---|---|---|---|
| $1^+_{.}\sigma^{\parallel}\,\dagger^{\alpha\beta}$ | 0 | $-\frac{\sqrt{2}}{t_{1}+k^2 t_{1}}$ | $-\frac{i\sqrt{2}\,k}{t_{1}+k^2 t_{1}}$ | 0 | 0 | 0 | 0 |
| $1^+_{.}\sigma^{\perp}\,\dagger^{\alpha\beta}$ | $-\frac{\sqrt{2}}{t_{1}+k^2 t_{1}}$ | $\frac{-2 k^2 (2 r_{3}+r_{5})+t_{1}}{(1+k^2)^2 t_{1}^2}$ | $\frac{-2 i k^3 (2 r_{3}+r_{5})+i k t_{1}}{(1+k^2)^2 t_{1}^2}$ | 0 | 0 | 0 | 0 |
| $1^+_{.}\tau^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{i\sqrt{2}\,k}{t_{1}+k^2 t_{1}}$ | $\frac{i (2 k^3 (2 r_{3}+r_{5})-k t_{1})}{(1+k^2)^2 t_{1}^2}$ | $\frac{-2 k^4 (2 r_{3}+r_{5})+k^2 t_{1}}{(1+k^2)^2 t_{1}^2}$ | 0 | 0 | 0 | 0 |
| $1^-_{.}\sigma^{\parallel}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $\frac{1}{k^2 (2 r_{3}+r_{5})}$ | $-\frac{1}{\sqrt{2}\,(k^2+2 k^4)(2 r_{3}+r_{5})}$ | 0 | $-\frac{i}{k (1+2 k^2)(2 r_{3}+r_{5})}$ |
| $1^-_{.}\sigma^{\perp}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $-\frac{1}{\sqrt{2}\,(k^2+2 k^4)(2 r_{3}+r_{5})}$ | $\frac{6 k^2 (2 r_{3}+r_{5})+t_{1}}{2 (k+2 k^3)^2 (2 r_{3}+r_{5}) t_{1}}$ | 0 | $\frac{i (6 k^2 (2 r_{3}+r_{5})+t_{1})}{\sqrt{2}\,k (1+2 k^2)^2 (2 r_{3}+r_{5}) t_{1}}$ |
| $1^-_{.}\tau^{\parallel}\,\dagger^{\alpha}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $1^-_{.}\tau^{\perp}\,\dagger^{\alpha}$ | 0 | 0 | 0 | $\frac{i}{k (1+2 k^2)(2 r_{3}+r_{5})}$ | $-\frac{i (6 k^2 (2 r_{3}+r_{5})+t_{1})}{\sqrt{2}\,k (1+2 k^2)^2 (2 r_{3}+r_{5}) t_{1}}$ | 0 | $\frac{6 k^2 (2 r_{3}+r_{5})+t_{1}}{(1+2 k^2)^2 (2 r_{3}+r_{5}) t_{1}}$ |

| | $2^+_{.}\sigma^{\parallel}{}_{\alpha\beta}$ | $2^+_{.}\tau^{\parallel}{}_{\alpha\beta}$ | $2^-_{.}\sigma^{\parallel}{}_{\alpha\beta\chi}$ |
|---|---|---|---|
| $2^+_{.}\sigma^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{2}{(1+2 k^2)^2 t_{1}}$ | $-\frac{2 i\sqrt{2}\,k}{(1+2 k^2)^2 t_{1}}$ | 0 |
| $2^+_{.}\tau^{\parallel}\,\dagger^{\alpha\beta}$ | $\frac{2 i\sqrt{2}\,k}{(1+2 k^2)^2 t_{1}}$ | $\frac{4 k^2}{(1+2 k^2)^2 t_{1}}$ | 0 |
| $2^-_{.}\sigma^{\parallel}\,\dagger^{\alpha\beta\chi}$ | 0 | 0 | $\frac{2}{t_{1}}$ |

# Source constraints

| Spin-parity form | Covariant form | Multiplicities |
|---|---|---|
| $0^+_{.}\tau^{\perp} == 0$ | $\partial_{\beta}\partial_{\alpha}\tau (\Delta+\mathcal{K})^{\alpha\beta} == 0$ | 1 |
| $0^+_{.}\tau^{\parallel} == 0$ | $\partial_{\beta}\partial_{\alpha}\tau (\Delta+\mathcal{K})^{\alpha\beta} == \partial_{\beta}\partial^{\beta}\tau (\Delta+\mathcal{K})^{\alpha}{}_{\alpha}$ | 1 |
| $2 i k\ 1^-_{.}\sigma^{\perp\alpha} + 1^-_{.}\tau^{\perp\alpha} == 0$ | $\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau (\Delta+\mathcal{K})^{\alpha\beta} + 2 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\sigma^{\beta\alpha\chi}$ | 3 |
| $1^-_{.}\tau^{\parallel\alpha} == 0$ | $\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau (\Delta+\mathcal{K})^{\beta\alpha}$ | 3 |
| $i k\ 1^+_{.}\sigma^{\perp\alpha\beta} + 1^+_{.}\tau^{\parallel\alpha\beta} == 0$ | $\partial_{\chi}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\beta\chi} + \partial_{\chi}\partial^{\beta}\tau (\Delta+\mathcal{K})^{\chi\alpha} + \partial_{\chi}\partial^{\chi}\tau (\Delta+\mathcal{K})^{\alpha\beta} + 2 \partial_{\delta}\partial_{\chi}\partial^{\alpha}\sigma^{\chi\beta\delta} + 2 \partial_{\delta}\partial^{\delta}\partial_{\chi}\sigma^{\chi\alpha\beta} == \partial_{\chi}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\chi\beta} + \partial_{\chi}\partial^{\beta}\tau (\Delta+\mathcal{K})^{\alpha\chi} + \partial_{\chi}\partial^{\chi}\tau (\Delta+\mathcal{K})^{\beta\alpha} + 2 \partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\chi\alpha\delta}$ | 3 |
| $-2 i k\ 2^+_{.}\sigma^{\parallel\alpha\beta} + 2^+_{.}\tau^{\parallel\alpha\beta} == 0$ | $-i (4 \partial_{\delta}\partial_{\chi}\partial^{\beta}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\chi\delta} + 2 \partial_{\delta}\partial^{\delta}\partial^{\beta}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\chi}{}_{\chi} - 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\beta\chi} - 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\alpha}\tau (\Delta+\mathcal{K})^{\chi\beta} - 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\beta}\tau (\Delta+\mathcal{K})^{\alpha\chi} - 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\beta}\tau (\Delta+\mathcal{K})^{\chi\alpha} + 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\chi}\tau (\Delta+\mathcal{K})^{\alpha\beta} + 3 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\chi}\tau (\Delta+\mathcal{K})^{\beta\alpha} + 4 i k^{\chi} \partial_{\epsilon}\partial_{\chi}\partial^{\beta}\partial^{\alpha}\sigma^{\delta}{}_{\delta}{}^{\epsilon} - 6 i k^{\chi} \partial_{\epsilon}\partial_{\delta}\partial_{\chi}\partial^{\alpha}\sigma^{\delta\beta\epsilon} - 6 i k^{\chi} \partial_{\epsilon}\partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\delta\alpha\epsilon} + 6 i k^{\chi} \partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial_{\chi}\sigma^{\alpha\beta\delta} + 6 i k^{\chi} \partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial_{\chi}\sigma^{\beta\alpha\delta} + 2\ \eta^{\alpha\beta} \partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial_{\chi}\tau (\Delta+\mathcal{K})^{\chi\delta} - 2\ \eta^{\alpha\beta} \partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial^{\delta}\tau (\Delta+\mathcal{K})^{\chi}{}_{\chi} - 4 i\ \eta^{\alpha\beta}\ k^{\chi} \partial_{\phi}\partial^{\phi}\partial_{\epsilon}\partial_{\chi}\sigma^{\delta}{}_{\delta}{}^{\epsilon}) == 0$ | 5 |
| Total expected gauge generators: | | 16 |

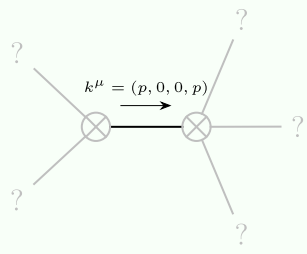
# Massive spectrum




Massive particle

| | |
|---|---|
| Pole residue: | $-\frac{1}{r_{2}} > 0$ |
| Square mass: | $\frac{t_{1}}{r_{2}} > 0$ |
| Spin: | 0 |
| Parity: | Odd |

# Massless spectrum




Massless particle

| | |
|---|---|
| Pole residue: | $-\frac{7}{2 r_{3}+r_{5}} + \frac{-2 t_{1} p^2 - 4 (2 r_{3}+r_{5}) p^4}{t_{1}^2} > 0$ |
| Polarisations: | 2 |

# Unitarity conditions

$r_{3} \in \mathbb{R}\ \&\&\ r_{2} < 0\ \&\&\ t_{1} < 0\ \&\&\ r_{5} < -2 r_{3}$