



$$r_2 < 0 \ \&\& \ t_2 > 0$$

| Massive particle | |
|------------------|------------------------|
| Pole residue: | $-\frac{1}{r_2} > 0$ |
| Polarisations: | 1 |
| Square mass: | $-\frac{t_2}{r_2} > 0$ |
| Spin: | 0 |
| Parity: | Odd |

(no massless particles)

| | $\omega_{1+}^{\#1} \alpha\beta$ | $\omega_{1+}^{\#2} \alpha\beta$ | $f_{1+}^{\#1} \alpha\beta$ | $\omega_{1-}^{\#1} \alpha$ | $\omega_{1-}^{\#2} \alpha$ | $f_{1-}^{\#1} \alpha$ | $f_{1-}^{\#2} \alpha$ |
|-----------------------------------------|---------------------------------|---------------------------------|----------------------------|----------------------------|----------------------------|-----------------------|-----------------------|
| $\omega_{1+}^{\#1} \dagger \alpha\beta$ | $\frac{2t_2}{3}$ | $\frac{\sqrt{2}t_2}{3}$ | $\frac{1}{3}i\sqrt{2}kt_2$ | 0 | 0 | 0 | 0 |
| $\omega_{1+}^{\#2} \dagger \alpha\beta$ | $\frac{\sqrt{2}t_2}{3}$ | $\frac{t_2}{3}$ | $\frac{ikt_2}{3}$ | 0 | 0 | 0 | 0 |
| $f_{1+}^{\#1} \dagger \alpha\beta$ | $-\frac{1}{3}i\sqrt{2}kt_2$ | $-\frac{1}{3}i\frac{t_2}{3}$ | $\frac{k^2t_2}{3}$ | 0 | 0 | 0 | 0 |
| $\omega_{1-}^{\#1} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $\omega_{1-}^{\#2} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $f_{1-}^{\#1} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $f_{1-}^{\#2} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | $\sigma_{1+}^{\#1} \alpha\beta$ | $\sigma_{1+}^{\#2} \alpha\beta$ | $\tau_{1+}^{\#1} \alpha\beta$ | $\sigma_{1-}^{\#1} \alpha$ | $\sigma_{1-}^{\#2} \alpha$ | $\tau_{1-}^{\#1} \alpha$ | $\tau_{1-}^{\#2} \alpha$ |
|-----------------------------------------|-------------------------------------|----------------------------------|------------------------------------|----------------------------|----------------------------|--------------------------|--------------------------|
| $\sigma_{1+}^{\#1} \dagger \alpha\beta$ | $\frac{6}{(3+k^2)^2t_2}$ | $\frac{3\sqrt{2}}{(3+k^2)^2t_2}$ | $\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$ | 0 | 0 | 0 | 0 |
| $\sigma_{1+}^{\#2} \dagger \alpha\beta$ | $\frac{3\sqrt{2}}{(3+k^2)^2t_2}$ | $\frac{3}{(3+k^2)^2t_2}$ | $\frac{3ik}{(3+k^2)^2t_2}$ | 0 | 0 | 0 | 0 |
| $\tau_{1+}^{\#1} \dagger \alpha\beta$ | $-\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$ | $-\frac{3ik}{(3+k^2)^2t_2}$ | $\frac{3k^2}{(3+k^2)^2t_2}$ | 0 | 0 | 0 | 0 |
| $\sigma_{1-}^{\#1} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $\sigma_{1-}^{\#2} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $\tau_{1-}^{\#1} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $\tau_{1-}^{\#2} \dagger \alpha$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Lagrangian density

$$\begin{aligned} &\frac{2}{3}t_2\omega_{\kappa\lambda}^{\kappa\lambda}\omega_{\kappa\lambda}^{\prime}+\frac{1}{3}t_2\omega_{\kappa\lambda}^{\prime}\omega_{\kappa\lambda}^{\kappa\lambda}+f^{\alpha\beta}\tau_{\alpha\beta}+\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi}+ \\ &\frac{2}{3}r_2\partial^\beta\omega_{\kappa}^{\theta\alpha}\partial_\theta\omega_{\alpha\beta}^{\kappa}-\frac{1}{3}r_2\partial_2\partial_\theta\omega_{\alpha\beta}^{\kappa}\partial_\kappa\omega^{\alpha\beta\theta}-\frac{2}{3}r_2\partial_\theta\omega_{\alpha\beta}^{\kappa}\partial_\kappa\omega^{\theta\alpha\beta}+ \\ &\frac{1}{6}t_2\partial^\alpha f_{\theta\kappa}^{\kappa}\partial_\kappa f_{\alpha}^{\theta}-\frac{1}{6}t_2\partial_2\partial^\alpha f_{\kappa\theta}^{\kappa}\partial_\theta f_{\alpha}^{\theta}+\frac{1}{6}t_2\partial^\alpha f_{\kappa}^{\kappa}\partial_\theta f_{\alpha}^{\theta}+\frac{1}{3}t_2\omega_{\theta\kappa}^{\kappa}\partial^\kappa f_{\alpha\lambda}^{\lambda}-\frac{1}{3}t_2\omega_{\theta\kappa}^{\kappa}\partial^\kappa f^{\prime\theta}- \\ &\frac{2}{3}t_2\omega_{\kappa\theta}^{\kappa}\partial^\kappa f^{\prime\theta}-\frac{1}{3}t_2\omega_{\theta\kappa}^{\kappa}\partial^\kappa f^{\prime\theta}+\frac{2}{3}t_2\omega_{\theta\kappa}^{\kappa}\partial^\kappa f^{\prime\theta}-\frac{1}{6}t_2\partial_2\partial^\alpha f_{\kappa}^{\kappa}\partial^\kappa f_{\lambda\alpha}^{\lambda}- \\ &\frac{1}{6}t_2\partial_\kappa f_{\theta}^{\lambda}\partial^\kappa f_{\lambda}^{\theta}+\frac{1}{6}t_2\partial_2\partial_\kappa f_{\theta}^{\lambda}\partial^\kappa f_{\lambda}^{\theta}+\frac{1}{3}r_2\partial_\kappa\omega^{\alpha\beta\theta}\partial^\kappa\omega_{\alpha\beta\theta}+ \\ &\frac{2}{3}r_2\partial_\kappa\omega^{\theta\alpha\beta}\partial^\kappa\omega_{\alpha\beta\theta}-\frac{2}{3}r_2\partial^\beta\omega_{\alpha\beta}^{\alpha\lambda}\partial_\lambda\omega_{\alpha\beta}^{\prime}+\frac{2}{3}r_2\partial^\beta\omega_{\alpha\beta}^{\prime\lambda\alpha}\partial_\lambda\omega_{\alpha\beta}^{\prime} \end{aligned}$$

| Source constraints | |
|--------------------------------------------------------------------|----|
| SO(3) irreps | # |
| $\tau_{0+}^{\#2} == 0$ | 1 |
| $\tau_{0+}^{\#1} == 0$ | 1 |
| $\sigma_{0+}^{\#1} == 0$ | 1 |
| $\tau_{1-}^{\#2\alpha} == 0$ | 3 |
| $\tau_{1-}^{\#1\alpha} == 0$ | 3 |
| $\sigma_{1-}^{\#2\alpha} == 0$ | 3 |
| $\sigma_{1-}^{\#1\alpha} == 0$ | 3 |
| $\tau_{1+}^{\#1\alpha\beta} + ik\sigma_{1+}^{\#1\alpha\beta} == 0$ | 3 |
| $\sigma_{1+}^{\#1\alpha\beta} == \sigma_{1+}^{\#2\alpha\beta}$ | 3 |
| $\sigma_{2-}^{\#1\alpha\beta\chi} == 0$ | 5 |
| $\tau_{2+}^{\#1\alpha\beta} == 0$ | 5 |
| $\sigma_{2+}^{\#1\alpha\beta} == 0$ | 5 |
| Total #: | 36 |

| | $\omega_{0+}^{\#1} \dagger$ | $f_{0+}^{\#1} \dagger$ | $f_{0+}^{\#2} \dagger$ | $\omega_{0-}^{\#1} \dagger$ |
|-----------------------------|-----------------------------|------------------------|------------------------|-----------------------------|
| $\omega_{0+}^{\#1} \dagger$ | 0 | 0 | 0 | 0 |
| $f_{0+}^{\#1} \dagger$ | 0 | 0 | 0 | 0 |
| $f_{0+}^{\#2} \dagger$ | 0 | 0 | 0 | 0 |
| $\omega_{0-}^{\#1} \dagger$ | 0 | 0 | 0 | $k^2r_2+t_2$ |

| | $\sigma_{0+}^{\#1} \dagger$ | $\tau_{0+}^{\#1} \dagger$ | $\tau_{0+}^{\#2} \dagger$ | $\sigma_{0-}^{\#1} \dagger$ |
|-----------------------------|-----------------------------|---------------------------|---------------------------|-----------------------------|
| $\sigma_{0+}^{\#1} \dagger$ | 0 | 0 | 0 | 0 |
| $\tau_{0+}^{\#1} \dagger$ | 0 | 0 | 0 | 0 |
| $\tau_{0+}^{\#2} \dagger$ | 0 | 0 | 0 | 0 |
| $\sigma_{0-}^{\#1} \dagger$ | 0 | 0 | 0 | $\frac{1}{k^2r_2+t_2}$ |

| | $\omega_{2+}^{\#1} \dagger \alpha\beta$ | $f_{2+}^{\#1} \dagger \alpha\beta$ | $\omega_{2-}^{\#1} \dagger \alpha\beta\chi$ |
|---------------------------------------------|-----------------------------------------|------------------------------------|---------------------------------------------|
| $\omega_{2+}^{\#1} \dagger \alpha\beta$ | 0 | 0 | 0 |
| $f_{2+}^{\#1} \dagger \alpha\beta$ | 0 | 0 | 0 |
| $\omega_{2-}^{\#1} \dagger \alpha\beta\chi$ | 0 | 0 | 0 |

| | $\sigma_{2+}^{\#1} \dagger \alpha\beta$ | $\tau_{2+}^{\#1} \dagger \alpha\beta$ | $\sigma_{2-}^{\#1} \dagger \alpha\beta\chi$ |
|---------------------------------------------|-----------------------------------------|---------------------------------------|---------------------------------------------|
| $\sigma_{2+}^{\#1} \dagger \alpha\beta$ | 0 | 0 | 0 |
| $\tau_{2+}^{\#1} \dagger \alpha\beta$ | 0 | 0 | 0 |
| $\sigma_{2-}^{\#1} \dagger \alpha\beta\chi$ | 0 | 0 | 0 |