

Particle spectrograph

Wave operator and propagator

$\sigma_{1^+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1^+}^{\#2}$	$\tau_{1^+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1^+}^{\#1}$	$\sigma_{1^+}^{\#2}$	$\tau_{1^+}^{\#1}$	$\tau_{1^+}^{\#2}$
$\dfrac{1}{k^2(2r_3+r_5)}$	0	0	0	0	0	0
$\sigma_{1^+}^{\#2} \dagger^{\alpha\beta}$	0	0	0	0	0	0
$\tau_{1^+}^{\#1} \dagger^{\alpha\beta}$	0	0	0	0	0	0
$\sigma_{1^+}^{\#1} \dagger^{\alpha}$	0	0	$\dfrac{2}{k^2(r_3+2r_5)}$	$\dfrac{2\sqrt{2}}{k^2(1+2k^2)(r_3+2r_5)}$	0	$\dfrac{4i}{k(1+2k^2)(r_3+2r_5)}$
$\sigma_{1^+}^{\#2} \dagger^{\alpha}$	0	0	$\dfrac{2\sqrt{2}}{k^2(1+2k^2)(r_3+2r_5)}$	$\dfrac{3k^2(r_3+2r_5)+4t_3}{(k+2k^3)^2(r_3+2r_5)t_3}$	0	$\dfrac{i\sqrt{2}(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$
$\tau_{1^+}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0
$\tau_{1^+}^{\#2} \dagger^{\alpha}$	0	0	$-\dfrac{4i}{k(1+2k^2)(r_3+2r_5)}$	$-\dfrac{i\sqrt{2}(3k^2(r_3+2r_5)+4t_3)}{k(1+2k^2)^2(r_3+2r_5)t_3}$	0	$\dfrac{6k^2(r_3+2r_5)+8t_3}{(1+2k^2)^2(r_3+2r_5)t_3}$

$\omega_{1^+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1^+}^{\#2}$	$f_{1^+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1^+}^{\#1}$	$\omega_{1^+}^{\#2}$	$f_{1^+}^{\#1}$	$f_{1^+}^{\#2}$
$k^2(2r_3+r_5)$	0	0	0	0	0	0
$\omega_{1^+}^{\#2} \dagger^{\alpha\beta}$	0	0	0	0	0	0
$f_{1^+}^{\#1} \dagger^{\alpha\beta}$	0	0	0	0	0	0
$\omega_{1^+}^{\#1} \dagger^{\alpha}$	0	0	$k^2(\frac{r_3}{2}+r_5)+\frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	0	$-\frac{2}{3}i\sqrt{2}kt_3$
$\omega_{1^+}^{\#2} \dagger^{\alpha}$	0	0	$-\frac{\sqrt{2}t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3}i\sqrt{2}kt_3$
$f_{1^+}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0
$f_{1^+}^{\#2} \dagger^{\alpha}$	0	0	$\frac{2ikt_3}{3}$	$-\frac{1}{3}i\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$

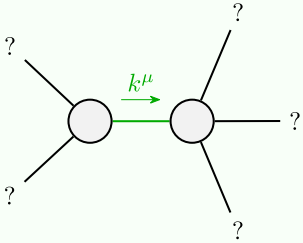
Quadratic (free) action

$$S = \iiint (f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - \frac{1}{2} r_3 (\partial_\beta \omega_{ \theta}^{ \theta} \partial'_\theta \omega^{\alpha\beta}_{ \alpha} + \partial'_\theta \omega_{ \beta}^{ \theta} \partial'_\theta \omega^{\alpha\beta}_{ \alpha} + \partial_\alpha \omega^{\alpha\beta\prime}_{ \beta} \partial_\theta \omega_{ \beta}^{ \theta} - 2 \partial'_\theta \omega^{\alpha\beta}_{ \alpha} \partial_\theta \omega_{ \beta}^{ \theta} - 2 \partial'_\theta \omega^{\alpha\beta}_{ \alpha} \partial_\theta \omega_{ \beta}^{ \theta} + 8 \partial_\beta \omega_{ \theta}^{ \theta} \partial^\theta \omega^{\alpha\beta\prime}_{ \alpha}) - \frac{2}{3} t_3 (\omega^{\alpha\prime}_{ \alpha} \omega_{ \alpha}^{ \prime} - 2 \omega_{ \alpha}^{ \prime} \partial'_\theta f^{\alpha\prime}_{ \alpha} + 2 \omega_{ \alpha}^{ \prime} \partial'_\theta f^{\alpha\prime}_{ \alpha} - \partial'_\theta f^{\alpha\prime}_{ \alpha} \partial'_\theta f^{\alpha\prime}_{ \alpha} - \partial'_\theta f^{\alpha\prime}_{ \alpha} \partial'_\theta f^{\alpha\prime}_{ \alpha} + 2 \partial'_\theta f^{\alpha\prime}_{ \alpha} \partial_\theta f^{\alpha\prime}_{ \alpha} + r_5 (\partial_\theta \omega_{ \theta}^{ \theta} \partial^\theta \omega_{ \theta}^{ \theta} - \partial_\theta \omega_{ \theta}^{ \theta} \partial^\theta \omega_{ \theta}^{ \theta} - \partial_\theta \omega_{ \theta}^{ \theta} \partial^\theta \omega_{ \theta}^{ \theta} - \partial_\theta \omega_{ \theta}^{ \theta} \partial^\theta \omega_{ \theta}^{ \theta})) [t, x, y, z] dz dy dx dt$$

Source constraints/gauge generators	Multiplicities
SO(3) irreps	
$\sigma_0^{\#1} == 0$	1
$\tau_0^{\#2} == 0$	1
$\tau_0^{\#1} - 2ik\sigma_0^{\#1} == 0$	1
$\tau_1^{\#2\alpha} + 2ik\sigma_1^{\#2\alpha} == 0$	3
$\tau_1^{\#1\alpha} == 0$	3
$\tau_1^{\#1\alpha\beta} == 0$	3
$\sigma_1^{\#2\alpha\beta} == 0$	3
$\sigma_2^{\#1\alpha\beta\chi} == 0$	5
$\tau_2^{\#1\alpha\beta} == 0$	5
Total constraints:	25

$\sigma_0^{\#1} \dagger^{\alpha\beta}$	$\tau_0^{\#1}$	$\tau_0^{\#2}$	$\sigma_0^{\#1}$
$\dfrac{1}{(1+2k^2)^2}t_3$	$-\dfrac{i\sqrt{2}k}{(1+2k^2)^2}t_3$	0	0
$\tau_0^{\#1} \dagger^{\alpha\beta}$	$\dfrac{i\sqrt{2}k}{(1+2k^2)^2}t_3$	0	0
$\tau_0^{\#2} \dagger^{\alpha\beta}$	0	0	0
$\sigma_0^{\#1} \dagger^{\alpha}$	0	0	0
$\omega_{2^+}^{\#1} \dagger^{\alpha\beta}$	$\dfrac{3k^2r_3}{2}$	0	$\omega_{2^+}^{\#1} f_{2^+}^{\#1} \omega_{2^+}^{\#1\alpha\beta\chi}$
$f_{2^+}^{\#1} \dagger^{\alpha\beta}$	0	0	0
$\omega_{2^+}^{\#1} \dagger^{\alpha\beta\chi}$	0	0	0
$\sigma_{2^+}^{\#1} \dagger^{\alpha\beta}$	$-\dfrac{2}{3k^2}r_3$	0	$\sigma_{2^+}^{\#1} \tau_{2^+}^{\#1} \sigma_{2^+}^{\#1\alpha\beta\chi}$
$\tau_{2^+}^{\#1} \dagger^{\alpha\beta}$	0	0	0
$\sigma_{2^+}^{\#1} \dagger^{\alpha\beta\chi}$	0	0	0

Massive and massless spectra



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

(No massive particles)

Unitarity conditions

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