

Particle spectrograph

Wave operator and propagator

$\sigma_{1+}^{\#1} \dagger^{\alpha\beta}$	$\sigma_{1+}^{\#2} \alpha\beta$	$\tau_{1+}^{\#1} \alpha\beta$	$\sigma_{1-}^{\#1} \alpha$	$\sigma_{1-}^{\#2} \alpha$	$\tau_{1-}^{\#1} \alpha$	$\tau_{1-}^{\#2} \alpha$
$\frac{2}{3k^2r_3}$	$-\frac{2\sqrt{2}}{3k^2r_3+3k^4r_3}$	$-\frac{2i\sqrt{2}}{3kr_3+3k^3r_3}$	0	0	0	0
$-\frac{2\sqrt{2}}{3k^2r_3+3k^4r_3}$	$\frac{9k^2r_3+4t_2}{3(k+k^3)^2r_3t_2}$	$\frac{i(9k^2r_3+4t_2)}{3k(1+k^2)^2r_3t_2}$	0	0	0	0
$\frac{2i\sqrt{2}}{3kr_3+3k^3r_3}$	$-\frac{i(9k^2r_3+4t_2)}{3k(1+k^2)^2r_3t_2}$	$\frac{9k^2r_3+4t_2}{3(1+k^2)^2r_3t_2}$	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Quadratic (free) action

S=

$$\iiint\left[\frac{1}{6}\left(6f^{\alpha\beta}\tau_{\alpha\beta}+6\omega^{\alpha\beta\chi}\sigma_{\alpha\beta\chi}-6r_3\partial_\beta\omega_{\beta}^{\theta}\partial'\omega_{\alpha}^{\alpha\beta}-6r_3\partial_\alpha\omega^{\alpha\beta}\partial_\theta\omega_{\beta}^{\theta}+12r_3\partial'\omega_{\alpha}^{\alpha\beta}\partial_\theta\omega_{\beta}^{\theta}+4t_2\omega_{\theta\alpha}^{\theta}\partial^\theta f^{\alpha\iota}+2t_2\partial_\alpha f_{\theta}^{\theta}\partial^\theta f^{\alpha\iota}-t_2\partial_\alpha f_{\theta}^{\theta}\partial^\theta f^{\alpha\iota}-t_2\partial_\iota f_{\alpha\theta}^{\theta}\partial^\theta f^{\alpha\iota}+t_2\partial_\theta f_{\alpha\iota}^{\theta}\partial^\theta f^{\alpha\iota}-t_2\partial_\theta f_{\iota\alpha}^{\theta}\partial^\theta f^{\alpha\iota}-4t_2\omega_{\alpha\theta\iota}(\omega^{\alpha\iota\theta}+\partial^\theta f^{\alpha\iota})+2t_2\omega_{\alpha\iota\theta}(\omega^{\alpha\iota\theta}+2\partial^\theta f^{\alpha\iota})+8r_2\partial_\beta\omega_{\alpha\iota\theta}\partial^\theta\omega^{\alpha\beta\iota}-4r_2\partial_\beta\omega_{\alpha\theta\iota}\partial^\theta\omega^{\alpha\beta\iota}+4r_2\partial_\beta\omega_{\iota\theta\alpha}\partial^\theta\omega^{\alpha\beta\iota}-24r_3\partial_\beta\omega_{\iota\theta\alpha}\partial^\theta\omega^{\alpha\beta\iota}-2r_2\partial_\iota\omega_{\alpha\beta\theta}\partial^\theta\omega^{\alpha\beta\iota}+2r_2\partial_\theta\omega_{\alpha\beta\iota}\partial^\theta\omega^{\alpha\beta\iota}-4r_2\partial_\theta\omega_{\alpha\iota\beta}\partial^\theta\omega^{\alpha\beta\iota})\right][t,x,y,z]dzd\boldsymbol{y}d\boldsymbol{x}dt$$

$\omega_{1+}^{\#1} \dagger^{\alpha\beta}$	$\omega_{1+}^{\#2} \alpha\beta$	$f_{1+}^{\#1} \alpha\beta$	$\omega_{1-}^{\#1} \alpha$	$\omega_{1-}^{\#2} \alpha$	$f_{1-}^{\#1} \alpha$	$f_{1-}^{\#2} \alpha$
$\frac{1}{6}(9k^2r_3+4t_2)$	$\frac{\sqrt{2}t_2}{3}$	$\frac{1}{3}i\sqrt{2}kt_2$	0	0	0	0
$\frac{\sqrt{2}t_2}{3}$	$\frac{t_2}{3}$	$\frac{ikt_2}{3}$	0	0	0	0
$-\frac{1}{3}i\sqrt{2}kt_2$	$-\frac{1}{3}ikt_2$	$\frac{k^2t_2}{3}$	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

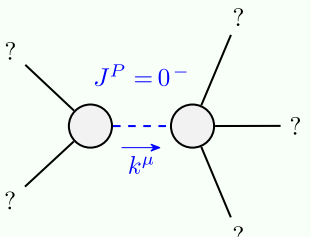
	$\omega_{2+}^{\#1} \alpha\beta$	$f_{2+}^{\#1} \alpha\beta$	$\omega_{2-}^{\#1} \alpha\beta\chi$		$\omega_{0+}^{\#1}$	$f_{0+}^{\#1}$	$f_{0+}^{\#2}$	$\omega_{0-}^{\#1}$
$\omega_{2+}^{\#1} \dagger^{\alpha\beta}$	$-\frac{3k^2r_3}{2}$	0	0	$\omega_{0+}^{\#1} \dagger$	0	0	0	0
$f_{2+}^{\#1} \dagger^{\alpha\beta}$	0	0	0	$f_{0+}^{\#1} \dagger$	0	0	0	0
$\omega_{2-}^{\#1} \dagger^{\alpha\beta\chi}$	0	0	0	$f_{0+}^{\#2} \dagger$	0	0	0	0
				$\omega_{0-}^{\#1} \dagger$	0	0	0	$k^2r_2+t_2$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0+}^{\#2} == 0$	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
$\tau_{1+}^{\#1\alpha\beta} + i k \sigma_{1+}^{\#2\alpha\beta} == 0$	3
$\sigma_{2-}^{\#1\alpha\beta\chi} == 0$	5
$\tau_{2+}^{\#1\alpha\beta} == 0$	5
Total constraints:	28

$\sigma_{2+}^{\#1} \dagger^{\alpha\beta}$	$\tau_{2+}^{\#1} \alpha\beta$	$\sigma_{2-}^{\#1} \alpha\beta\chi$
$-\frac{2}{3k^2r_3}$	0	0
0	0	0
0	0	0

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

Massive and massless spectra



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)

Unitarity conditions

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