Particle spectrograph

Wave operator and propagator

$\tau_{1}^{\#2}{}_{\alpha}$	0	0	0	- <u>i</u> kr5+2 k³ r5	$\frac{i(6k^2r_5+t_1)}{\sqrt{2}k(1+2k^2)^2r_5t_1}$	0	$\frac{6k^2r_5+t_1}{(1+2k^2)^2r_5t_1}$	
$\tau_{1}^{\#1}{}_{\alpha}$	0	0 0		0 0		0	0	
$\sigma_{1}^{\#2}{}_{\alpha}$	0	0	0	$-\frac{1}{\sqrt{2} (k^2 r_5 + 2 k^4 r_5)}$	$\frac{6k^2 r_5 + t_1}{2(k+2k^3)^2 r_5 t_1}$	0	$-\frac{i(6k^2r_5+t_1)}{\sqrt{2}k(1+2k^2)^2r_5t_1}$	
$\sigma_{1}^{\#1}{}_{\alpha}$	0	0	0	$\frac{1}{k^2 r_5}$	$-\frac{1}{\sqrt{2}\;(k^2r_5+2k^4r_5)}$	0	$\frac{i}{k r_5 + 2 k^3 r_5}$	
$\tau_{1}^{\#1}_{+}$	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$-\frac{i(2k^3r_5-kt_1)}{(1+k^2)^2t_1^2}$	$\frac{-2k^4r_5+k^2t_1}{(1+k^2)^2t_1^2}$	0	0	0	0	
$\sigma_{1}^{\#2}{}_{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{-2k^2r_5+t_1}{(1+k^2)^2t_1^2}$	$\frac{i(2k^3r_5-kt_1)}{(1+k^2)^2t_1^2}$	0	0	0	0	
$\sigma_{1}^{\#1}{}_{+}\alpha\beta$	0	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	0	0	0	0	
	$_{1}^{#1}+^{\alpha\beta}$	$_{1}^{#2}$ $+^{\alpha\beta}$	$_{1}^{#1}+^{\alpha\beta}$	$\sigma_{1}^{\#1} + \alpha$	$\sigma_{1}^{#2} + \alpha$	$\tau_1^{\#1} +^{\alpha}$	$\tau_1^{\#2} +^{\alpha}$	

			$\sigma_{2}^{\#1}$	αβ	$ au_{2}^{\#1}$	αβ	$\sigma_{2}^{\#1}$	αβχ	
	$\sigma_{2}^{\#1}$	$+^{\alpha\beta}$	2 (1+2 k ²	$\frac{1}{(t_1)^2 t_1}$	$\frac{2i \gamma}{(1+2k)}$	$\frac{\sqrt{2} k}{(2)^2 t_1}$	0		$\omega_{2^{+}}^{\#1}\dagger^{lphaeta}$
	$ au_{2}^{\#1}$	$+^{\alpha\beta}$	$\frac{2i\sqrt{3}}{(1+2k^2)}$	$\frac{\overline{2} k}{(2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2}$	$\frac{2}{(t_1)^2 t_1}$	0		$f_{2+}^{#1} \dagger^{\alpha\beta}$
3 +	$\sigma_2^{\#1}$	$\dagger^{\alpha\beta\chi}$	0		0		$\frac{2}{t_1}$	($\omega_2^{\#1} \dagger^{\alpha\beta\chi}$
$4t_1$ $f^{\alpha l}$ $d^{\alpha l}$ $d^{\alpha l}$ $d^{\alpha l}$ $d^{\alpha l}$ $d^{\alpha l}$		_				14			1
$^{2}_{3\chi}-4t_{1}\omega_{\alpha}^{\theta}\partial_{i}f^{\alpha'}+4t_{1}$ $^{\alpha}_{\alpha}\partial_{\theta}f_{i}^{\theta}-6t_{1}\partial_{\alpha}f_{i\theta}\partial^{\theta}f^{\alpha'}-$ $^{x'}+3t_{1}\partial_{\theta}f_{i\alpha}\partial^{\theta}f^{\alpha'}+$ $^{x'}+3t_{1}\partial_{\theta}f_{i\alpha}\partial^{\theta}f^{\alpha'}+$ $^{4}_{72}\partial_{\beta}\omega_{\alpha\theta'}\partial^{\theta}\omega^{\alpha\beta'}+4r_{2}$ $^{\theta}\omega^{\alpha\beta'}-4r_{2}\partial_{\theta}\omega_{\alpha\beta}\partial^{\theta}\omega^{\alpha\beta}$ $^{\theta}\partial_{\kappa}\omega_{i}^{\kappa}+12r_{5}\partial^{\theta}\omega^{\alpha'}$ $^{\theta}\partial_{\kappa}\omega_{i}^{\kappa}+12r_{5}\partial^{\theta}\omega^{\alpha'}$ $^{(\theta)}(t,x,y,z)dzdydxdt$	$f_{1^-}^{\#2} \alpha$	0	0	0	<u>ikt1</u> 3	$\frac{1}{3}\bar{l}\sqrt{2}kt_1$	0	$\frac{2k^2t_1}{3}$	
$t_1 \omega_{\alpha}^{\ \ell}$ $f_1 - 6t$ $f_1 - 6t$ $g_1 - 6t$ $g_2 - 6t$ $g_3 - 4t_2$ $g_3 - 4t_2$ $g_3 - 4t_3$ $g_3 - $	$f_{1^{ ext{-}}lpha}^{\#1}$	0	0	0	0	0	0	0	
Quadratic (free) action $S = \frac{1}{2}$ $\int \int \int \int \int \frac{1}{6} (2t_1 \omega^{\alpha l}_{\alpha} \omega_{, \theta}^{ \theta} + 6 f^{\alpha \beta} \tau_{\alpha \beta} + 6 \omega^{\alpha \beta \chi} \sigma_{\alpha \beta \chi} - 4t_1 \omega_{\alpha}^{ \theta} \partial_{,} f^{\alpha l} + 4t_1 \omega_{, \theta}^{ \theta}$ $= \frac{1}{2} \int \int \int \int \int \int \int \int \partial_{\alpha} f^{\alpha l} d^{\alpha l} $	$\omega_{1^{-}}^{\#2}{}_{\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	4 <u>1</u> 3	0	$-\frac{1}{3}\bar{l}\sqrt{2}kt_1$	
e) action $a \omega_{,\theta}^{\theta} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta},$ $a \omega_{,\theta}^{\theta} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta},$ $a \partial_{i} f^{\alpha}_{\alpha} - 2 t_{1} \partial_{i} f^{\alpha i} \partial_{\theta} f^{\alpha}_{\alpha} + 4 t_{1} \partial_{i} f^{\alpha}_{\alpha},$ $+ 3 t_{1} \partial_{i} f_{\alpha\theta} \partial^{\theta} f^{\alpha i} + 3 t_{1} \partial_{\theta} f_{\alpha i} \partial^{\theta} f^{\alpha i},$ $a + 2 \partial^{\theta} f^{\alpha i} + 8 r_{2} \partial_{\beta} \omega_{\alpha i\theta} \partial^{\theta} \omega^{\alpha\beta} - 4 r_{2} \partial_{\beta} \omega_{\alpha\beta},$ $b + 2 \partial^{\theta} f^{\alpha i} + 8 r_{2} \partial_{\beta} \omega_{\alpha i\theta} \partial^{\theta} \omega^{\alpha\beta} - 4 r_{2} \partial_{\beta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta\theta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega_{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega^{\alpha\beta} + 2 r_{2} \partial_{\theta} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta} \partial^{\phi} \omega^{\alpha\beta} + 2 r_{2} \partial_{\phi} \omega^{\alpha\beta},$ $c + 2 \partial_{i} \omega_{\alpha\beta}$	$\omega_{1^{^{-}}\alpha}^{\#1}$	0	0	0	$k^2 r_5 + \frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$-\frac{1}{3}$ $i k t_1$	nerators icities
$\frac{1}{1 + 6 f^{\alpha}} + 6 f^{\alpha}$ $2 t_{1} \partial_{j} \partial_{j}$ $f^{\alpha} \partial_{j} \partial_{j}$ $3 \partial_{j} \partial_{j} \partial_{j}$ $\partial_{j} \partial_{k} \partial_{j} \partial_{j}$	$f_{1}^{\#1}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0	uge generato Multiplicities
action $ \begin{array}{ccc} \alpha & \omega_{l}^{\theta} \\ \alpha & \omega_{l}^{\theta} \\ \theta & \partial' f^{\alpha} \\ + 3t_{1}\partial \\ + 2t_{2}\partial^{\theta} \\ 2r_{2}\partial_{l}\omega \\ 2r_{2}\partial_{l}\omega \\ \omega'' - 6r_{5} \\ \omega''' + 6r_{5} \end{array} $	$\omega_{1}^{\#2}_{\alpha\beta} \ f_{1}^{\#1}_{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0	nts/gau
Quadratic (free) action $S == \begin{cases} S == \\ \iiint_{\epsilon} (2t_1 \ \omega^{\alpha'}_{\alpha} \ \omega'_{\beta} + \\ \partial' f^{\alpha}_{\alpha} - 2t_1 \partial_i f^{\theta}_{\beta} \partial' f^{\alpha}_{\alpha} - 2 \\ 3t_1 \partial_{\alpha} f_{\theta_i} \partial^{\theta} f^{\alpha'} + 3t_1 \partial_i f^{\theta}_{\alpha} \\ 6t_1 \ \omega_{\alpha\theta_i} (\omega^{\alpha'\theta} + 2 t_2 \partial^{\theta} f^{\alpha'} \\ \delta \mu_{i\theta\alpha} \partial^{\theta} \omega^{\alpha\beta'} - 2 t_2 \partial_i \mu_{\alpha} \\ 6t_5 \partial_i \omega_{\theta_i}^{\kappa} \partial^{\theta} \omega^{\alpha\beta'} - 2 t_2 \partial_i \mu_{\alpha} \\ 6t_5 \partial_i \omega_{\theta_i}^{\kappa} \partial^{\theta} \omega^{\alpha'}_{\alpha} - 6 t_5 \partial_i \omega_{\alpha'}^{\kappa} \\ \delta \kappa \omega_{i_{\theta_i}}^{\kappa} + 6 t_5 \partial_{\alpha} \omega^{\alpha'\theta} \partial_{\kappa} \omega^{\alpha'\theta$	$\omega_{1}^{\#1}{}_{\alpha\beta}$	`~×	$-\frac{t_1}{\sqrt{2}}$		0	0	0	0	Source constraints/gauge generators
Quadr. $S == \int \int \int \int \int \int_{6}^{1} \frac{1}{\alpha}$ $3t_{1} \partial_{\alpha}$ $6t_{1} \omega$ $\theta_{\beta} \omega_{\beta} \theta_{\beta}$ $6r_{5} \partial_{\gamma}$		$\omega_1^{\#1} + \alpha^{eta}$	$\omega_1^{\#2} + \alpha^{\beta}$	$f_1^{#1} + \alpha \beta$	$\omega_{1}^{\#1} +^{lpha}$	$\omega_{1}^{\#2} +^{\alpha}$	$f_{1}^{\#1} \uparrow^{lpha}$	$f_{1}^{#2} + \alpha$	Source cons

						; ;	$\omega_0^{*+} f_0^*$	$\omega_{0}^{\#1}$ † 0 0	$f_{0}^{#1} + 0 0$	$f_{0}^{#2} + 0 0$
luge generators	Multiplicities	1	1	1	3	3	3	L		<u> T (</u>
Source constraints/gauge generators	SO(3) irreps	$\tau_{0+}^{#2} == 0$	$\tau_{0+}^{\#1} == 0$	$\sigma_{0+}^{\#1} == 0$	$t_1^{\#2}\alpha + 2ik \sigma_1^{\#2}\alpha == 0$	$t_1^{\#1}{}^{\alpha} == 0$	$\tau_{1}^{\#1}\alpha\beta + ik \ \sigma_{1}^{\#2}\alpha\beta == 0$) -	i otal constraints:

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

 $-\frac{ikt_1}{\sqrt{2}}$

 $k^2 t_1$

0

0

0

0

0

0

0

 $\tau_{0}^{\#1}$ †

 $\sigma_0^{\#1}\,\dagger$

0

0

0

Massive and massless spectra

? Massive particle Pole residue:
$$-\frac{1}{r_2} > 0$$
 Polarisations: 1 Square mass: $\frac{t_1}{r_2} > 0$ Spin: 0 Parity: Odd

?						
? /	Quadratic pole					
?	Pole residue:	$-\frac{1}{r_5 t_1^2} > 0$				
?	Polarisations:	2				

Unitarity conditions

 $r_2 < 0 \&\& r_5 < 0 \&\& t_1 < 0$