Particle spectrograph

Wave operator and propagator

$ au_1^{\#2}$	0	0	0	$-\frac{i}{kr_5+2k^3r_5}$	$\frac{i(6k^2r_5+t_1)}{\sqrt{2}k(1+2k^2)^2r_5t_1}$	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	$-\frac{i(6k^2r_5+t_1)}{\sqrt{2}k(1+2k^2)^2r_5t_1}$
$\sigma_{1}^{\#1}$	0	0	0	$\frac{1}{k^2 r_5}$	$-\frac{1}{\sqrt{2} \; (k^2 \; r_5 + 2 k^4 r_5)}$	0	$\frac{i}{k r_5 + 2 k^3 r_5}$
$\tau_{1}^{\#1}_{\alpha\beta}$	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$-\frac{i(2k^3r_5-kt_1)}{(1+k^2)^2t_1^2}$	$\frac{-2k^4r_5+k^2t_1}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_{1}^{\#2}$		$\frac{-2k^2r_5+t_1}{(1+k^2)^2t_1^2}$	$\frac{i(2k^3r_5-kt_1)}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_{1}^{\#1}{}_{lphaeta}$	0	$\frac{\sqrt{2}}{t_1 + k^2 t_1}$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	0	0	0	0
	$\sigma_1^{\#1} + \alpha^{\beta}$	$r_{1}^{#2} + \alpha \beta$	$\tau_1^{\#1} + \alpha \beta$	$\sigma_{1}^{\#1} \dagger^{lpha}$	$\sigma_{1}^{\#2} +^{lpha}$	$\tau_1^{\#_1} +^\alpha$	$\tau_1^{\#2} + ^{\alpha}$

Quadratic (free) Lagrangian density	
$rac{1}{3}t_1\;\omega_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{$	
$rac{2}{3}r_2\partial^eta\omega^{etalpha}_{} _{}\partial^{eta}\omega^{}_{\beta} - rac{1}{3}r_2\partial_{\theta}\omega^{}_{\beta} _{}\partial^{\kappa}\omega^{lphaetaeta} - rac{2}{3}r_2\partial_{\theta}\omega^{}_{\beta} _{}\partial^{\kappa}\omega^{etaeta}$	
$^{c_5}\partial_\alpha\omega_\lambda^{\ \alpha}_{\ \ \beta}\partial_\kappa\omega^{\theta\kappa\lambda} + r_5\partial_\theta\omega_\lambda^{\ \alpha}_{\ \ \alpha}\partial_\kappa\omega^{\theta\kappa\lambda} - r_5\partial_\alpha\omega_\lambda^{\ \alpha}_{\ \ \theta}\partial_\kappa\omega^{\kappa\lambda\theta} + 2r_5\partial_\theta\omega_\lambda^{\ \alpha}_{\ \ \alpha}\partial_\kappa\omega^{\kappa\lambda\theta} -$	
$\frac{1}{2}t_1\partial^{\alpha}f_{\theta_{\mathcal{K}}}\partial^{\kappa}f_{\alpha}^{\ \theta}-\frac{1}{2}t_1\partial^{\alpha}f_{\kappa\theta}\partial^{\kappa}f_{\alpha}^{\ \theta}-\frac{1}{2}t_1\partial^{\alpha}f^{\lambda}_{\ \kappa}\partial^{\kappa}f_{\alpha\lambda}+\frac{1}{3}t_1\ \omega_{\kappa\alpha}^{\ \alpha}\ \partial^{\kappa}f'_{\ \prime}+$	
$rac{1}{3}t_1\;\omega_{\kappa\lambda}^{\lambda}\;\partial^{\kappa}f'_{\prime}^{\prime}+rac{2}{3}t_1\partial^{\alpha}f_{lpha}^{\alpha}\partial^{\kappa}f'_{\prime}^{\prime}-rac{1}{3}t_1\partial_{\kappa}f^{\lambda}^{\lambda}\partial^{\kappa}f'_{\prime}^{\prime}+2t_1\;\omega_{\kappa\theta}^{\theta}\partial^{\kappa}f'^{\theta}-$	
$rac{1}{3}t_1\;\omega_{_{I}lpha}^{ \ \ lpha}\mathcal{F}_{_{K}}^{\prime}\;_{-rac{1}{3}}t_1\;\omega_{_{I}\lambda}^{ \lambda}\;\partial^{\kappa}f_{_{K}}^{\prime}\;_{+rac{1}{2}}t_1\;\partial^{lpha}f_{_{A}}^{\lambda}\;_{+rac{1}{2}}t_1\;\partial_{\kappa}f_{_{A}}^{ \lambda}\partial^{\kappa}f_{_{A}}^{ \lambda}\;_{+rac{1}{2}}t_1\;\partial_{\kappa}f_{_{A}}^{ \lambda}\partial^{\kappa}f_{_{A}}^{ \lambda}$	
$rac{1}{2}t_1\partial_{\kappa}f^{\lambda}_{\ \ \ }\partial^{\kappa}f_{\lambda}^{\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	
$rac{2}{3}r_2\partial^{eta}\omega_{\alpha}^{\ lpha\lambda}\partial_{\lambda}\omega_{lphaeta}^{\ \ \prime}+rac{2}{3}r_2\partial^{eta}\omega_{\lambda}^{\ \lambdalpha}\partial_{\lambda}\omega_{lphaeta}^{\ \ \prime}+r_5\partial_{lpha}\omega_{\lambda}^{\ lpha}\partial^{\lambda}\omega^{eta\kappa}_{\ \ \ \ \ }-r_5\partial_{eta}\omega_{\lambda}^{\ lpha}\partial^{\lambda}\omega^{eta\kappa}_{\ \ \ \ \ \ \ }$	

	$\sigma_{2}^{\#1}{}_{lphaeta}$	$ au_2^{\#1}{}_{lphaeta}$	$\sigma_{2}^{\#1}{}_{\alpha\beta\chi}$
$\sigma_{2}^{\sharp 1} \dagger^{lphaeta}$	$\frac{2}{(1+2k^2)^2t_1}$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	0
$\tau_{2}^{\#1} \dagger^{\alpha\beta}$	$\frac{2 i \sqrt{2} k}{(1+2 k^2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2t_1}$	0
$\sigma_2^{\#1} \dagger^{lphaeta\chi}$	0	0	$\frac{2}{t_1}$

	$\omega_{2^{+}\alpha\beta}^{\#1}$	$f_{2}^{\#1}{}_{\alpha\beta}$	$\omega_{2-\alpha\beta\chi}^{\#1}$
$\omega_{2}^{\sharp 1} \dagger^{lphaeta}$	<u>t</u> 1 2	$-\frac{ikt_1}{\sqrt{2}}$	0
$f_{2^+}^{\#1}\dagger^{\alpha\beta}$	$\frac{i k t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_2^{#1}$ † $^{\alpha\beta\chi}$	0	0	<u>t</u> 1 2

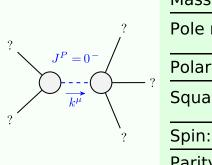
$f_{1^{ ext{-}}lpha}^{\#2}$	0	0	0	<i>ikt</i> 1 3	$i\sqrt{2} kt_1$	0	$\frac{2k^2t_1}{3}$
$f_{1^-}^{\#1} lpha$	0	0	0	0	$0 \frac{1}{3}$	0	0
$\omega_{1}^{\#2}{}_{\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	<u>£1</u> 3	0	$-\frac{1}{3}i\sqrt{2}kt_1$
$\omega_{1^{-}}^{\#1}{}_{\alpha}$	0	0	0	$k^2 r_5 + \frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$-\frac{1}{3}ikt_1$
$f_{1}^{\#1}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1}^{\#2}{}_{\alphaeta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1}^{\#1}{}_{\alpha\beta}$	$k^2 r_5 - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0
·	$\omega_{1}^{\#1} + \alpha^{eta}$	$\omega_1^{\#2} +^{\alpha\beta}$	$f_1^{\#1} + \alpha \beta$	$\omega_{1}^{\#1} +^{lpha}$	$\omega_1^{\#2} +^{lpha}$	$f_{1^{\bar{-}}}^{\#1} +^{\alpha}$	$f_1^{\#2} +^{lpha}$

	$\sigma_{0}^{\#1}$	$ au_0^{\#1}$	$ au_{0}^{\#2}$	$\sigma_0^{\#1}$
$\sigma_{0}^{\sharp 1}$ †	0	0	0	0
$\tau_{0}^{\#1}$ †	0	0	0	0
$\tau_{0^{+}}^{\#2} \dagger$	0	0	0	0
$\sigma_{0}^{\#1}$ †	0	0	0	$\frac{1}{k^2 r_2 - t_1}$

$\omega_{0}^{\#1}$	0	0	0	$k^2 r_2 - t_1$
$f_{0}^{\#2}$	0	0	0	0
$f_{0}^{\#1}$	0	0	0	0
$\omega_{0}^{\#1}$	0	0	0	0
,	$\omega_{0}^{\#1}$ \dagger	$f_{0}^{\#1}$ †	$f_0^{\#2} \uparrow$	$\omega_{0}^{\#1}$ \dagger

uge generators	Multiplicities	1	1	1	3	3	3	5	17
Source constraints/gauge generators	SO(3) irreps	$\tau_{0+}^{\#2} == 0$	$\tau_{0+}^{\#1} == 0$	$\sigma_{0+}^{\#1} == 0$	$t_1^{\#2}{}^{\alpha} + 2ik \sigma_1^{\#2}{}^{\alpha} = 0$	$\tau_{1}^{\#1}{}^{\alpha} == 0$	$\tau_{1+}^{\#1}{}^{\alpha\beta}+i\!\!\!/ k\;\sigma_{1+}^{\#2}{}^{\alpha\beta}==0$	$\tau_{2+}^{\#1}\alpha\beta - 2ik \sigma_{2+}^{\#1}\alpha\beta == 0$	Total constraints:

Massive and massless spectra



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

?	, /
	?
?	7

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

Unitarity conditions

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