Particle spectrograph

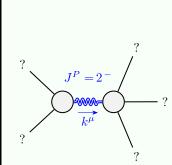
Wave operator and propagator

SO(3) irreps	Fundamental fields	Multiplicities
$\sigma_0^{\#1} == 0$	$\epsilon \eta_{\alpha\beta\chi\delta} \partial^{\delta} \sigma^{\alpha\beta\chi} == 0$	1
$\tau_{0^{+}}^{\#2} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == 0$	1
$\tau_{0^{+}}^{\#1} - 2 \bar{\imath} k \sigma_{0^{+}}^{\#1} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} = \partial_{\beta}\partial^{\beta}\tau^{\alpha}_{\alpha} + 2\partial_{\chi}\partial^{\chi}\partial_{\beta}\sigma^{\alpha\beta}_{\alpha}$	1
$\tau_1^{\#2\alpha} + 2ik \sigma_1^{\#2\alpha} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau^{\alpha\beta} + 2\partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\sigma^{\alpha\beta\chi}$	3
$\tau_1^{\#1\alpha} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau^{\beta\alpha}$	3
$\tau_{1+}^{\#1}{}^{\alpha\beta} + ik \sigma_{1+}^{\#2}{}^{\alpha\beta} == 0$	$\partial_{\chi}\partial^{\alpha}\tau^{\beta\chi} + \partial_{\chi}\partial^{\beta}\tau^{\chi\alpha} + \partial_{\chi}\partial^{\chi}\tau^{\alpha\beta} +$	3
	$2 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \beta \chi} = =$	
	$\partial_{\chi}\partial^{\alpha}\tau^{\chi\beta} + \partial_{\chi}\partial^{\beta}\tau^{\alpha\chi} +$	
	$\partial_{\chi}\partial^{\chi}\tau^{\beta\alpha} + 2\partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\alpha\chi\delta}$	
$\tau_{2+}^{\#1\alpha\beta} - 2ik \sigma_{2+}^{\#1\alpha\beta} == 0$	$-i \left(4 \partial_{\delta} \partial_{\chi} \partial^{\beta} \partial^{\alpha} \tau^{\chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial^{\beta} \partial^{\alpha} \tau^{\chi}_{\ \ \gamma} - \right)$	5
	$3 \partial_{\delta} \partial^{\delta} \partial_{x} \partial^{\alpha} \tau^{\beta \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{x} \partial^{\alpha} \tau^{\chi \beta} -$	
	$3 \partial_{\delta} \partial^{\delta} \partial_{\nu} \partial^{\beta} \tau^{\alpha \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\nu} \partial^{\beta} \tau^{\chi \alpha} +$	
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\alpha\beta} + 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\beta\alpha} +$	
	$4 i k^{\chi} \partial_{\epsilon} \partial_{\chi} \partial^{\beta} \partial^{\alpha} \sigma^{\delta \epsilon} \partial_{\delta} -$	
	$6 i k^{X} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \delta \epsilon} -$	
	$6 i k^{\chi} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \partial^{\beta} \sigma^{\alpha \delta \epsilon} +$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \tau^{\chi\delta} +$	
	$6 i k^{X} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{x} \sigma^{\alpha \delta \beta} +$	
	$6 i k^{\chi} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \sigma^{\beta \delta \alpha} -$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\delta} \tau^{\chi}_{\gamma} -$	
	$4 i \eta^{\alpha\beta} k^{X} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial_{X} \sigma^{\delta\epsilon} \partial_{\delta} = 0$	

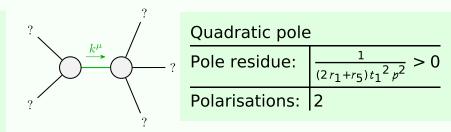
$t_1^{\#1}$ $t_1^{\#2}$	0 0	0 0	0 0	$0 \qquad \frac{2ik}{t_1 + 2k^2t_1}$	$0 \left -\frac{i\sqrt{2}k(2k^2(r_1+r_5)-t_1)}{(t_1+2k^2t_1)^2} \right $	0 0	$0 \left \frac{-4k^4(r_1+r_5)+2k^2t_1}{(t_1+2k^2t_1)^2} \right $	
$\sigma_{1^-}^{\#2}{}_{lpha}$ $ au_1^{\sharp}$	0	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2t_1}$	$\frac{-2 k^2 (r_1 + r_5) + t_1}{(t_1 + 2 k^2 t_1)^2}$	0	$\frac{i\sqrt{2}k(2k^2(r_1+r_5)\cdot t_1)}{(t_1+2k^2t_1)^2}$	
$\sigma_{1^{-}\alpha}^{\#1}$	0	0	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2t_1}$	0	$-\frac{2ik}{t_1+2k^2t_1}$	
${\mathfrak l}_{1}^{\#1}$	$\frac{i}{\sqrt{2} (k+k^3) (2 r_1 + r_5)}$	$\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	$\frac{6k^2(2r_1+r_5)+t_1}{2(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0	
$\sigma_{1}^{\#2}_{+}$	$\frac{1}{\sqrt{2} (k^2 + k^4) (2 r_1 + r_5)}$	$\frac{6k^2(2r_1+r_5)+t_1}{2(k+k^3)^2(2r_1+r_5)t_1}$	$-\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0	
$\sigma_{1}^{\#1}_{\alpha\beta}$	$\frac{1}{k^2 (2 r_1 + r_5)}$	$\frac{1}{\sqrt{2} \; (k^2 + k^4) \; (2 r_1 + r_5)}$	$-\frac{i}{\sqrt{2}\;(k\!+\!k^3)(2r_1\!+\!r_5)}$	0	0	0	0	
	$_{1}^{\#1}+^{\alpha\beta}$	$_{1}^{\#2}$ $+^{\alpha\beta}$	$\frac{1}{1} + \alpha \beta$	$\sigma_{1}^{\#1} +^{lpha}$	$\sigma_{1}^{\#2} +^{\alpha}$	$\tau_{1}^{\#1} +^{\alpha}$	$\tau_{1}^{\#2} + \alpha$	

												ω_{γ}^{\sharp}	#1 o+ ~?	$f_{2+\alpha\beta}^{\#1}$	
/Τ,		#1	#1	#2 "3						Ü	$\omega_{2}^{\#1}$ †		t ₁ 2	$-\frac{i k t_1}{\sqrt{2}}$	
v 7 . Ta	#1.	$\sigma_{0}^{#1}$	$\tau_{0}^{\#1}$ $i \sqrt{2} k$	$\tau_{0^{+}}^{#2} \sigma_{0^{-}}^{#1}$		$\sigma_{2^{+}\alpha\beta}^{\#1}$	$ au_{2}^{\#1}$	3 ($\sigma_{2}^{\#1}{}_{lphaeta_{2}}$	X	f ₂ ^{#1} †	αβ	$\frac{kt_1}{\sqrt{2}}$	$k^2 t_1$	
	$\sigma_{0+}^{#1}$ †	$\frac{1}{(1+2k^2)^2t_1}$	$\frac{i \sqrt{2} k}{(1+2k^2)^2 t_1}$	0 0	$\sigma_{2^{+}}^{\sharp 1} \dagger^{\alpha \beta}$		$-\frac{2i\sqrt{2}}{(1+2k^2)}$	k	0		ν ₂ -1 † ^α	βχ	0	0	k
	$\tau_{0}^{#1}$ †	$-\frac{i\sqrt{2} k}{(1+2k^2)^2 t_1}$	$-\frac{2k^2}{(1+2k^2)^2t_1}$	0 0	$\tau_{2}^{\#1} \dagger^{\alpha\beta}$		$\frac{4k^2}{(1+2k^2)^2}$	_	0		_	$\omega_0^{\#}$	±1 +	$f_{0}^{#1}$	
	$ au_{0^{+}}^{\#2} \dagger \\ \sigma_{0^{-}}^{\#1} \dagger$	0	0	0 0	$\sigma_2^{\#1} \dagger^{\alpha\beta\chi}$	· · ·	0		2	_	v ₀ ^{#1} †	-t:		į √2 ,	
Tawa	υ ₀ -	U	U	0 0	92 1	· ·		2	$k^2 r_1 + t$		_	- <i>i</i> √2		$-2k^2$	t_1
- Ta)											0 ^{#2} †	0		0	
7		_ + '	+				. I								
: T		$\frac{\partial}{\partial \theta} \partial_{i} f^{\alpha i} +$ $\frac{\partial}{\partial \theta} \partial_{i} f^{\alpha i} +$ $\frac{\partial}{\partial \theta} f^{\alpha i} -$	$\frac{1}{3}$	+			$f_{1}^{#2}$	0	0	0	$\vec{i} k t_1$	0	0	0	
		$ u_{\alpha}^{\ \theta}_{\beta} = 0 $ $ \int_{\beta} f^{\alpha l} \partial_{\alpha} f_{\beta} = 0 $	$\frac{\sigma a'}{\partial \theta f} \frac{\partial}{\partial a'} \left(\frac{\partial}{\partial a'} \right) + \frac{\partial}{\partial a'} \left(\frac{\partial}{$	$\partial^{ heta}\omega^{lphaeta}$ - $\delta^{lpha}\omega^{lphaeta}$	'υ +	'. alxalt	$f_{1^{ ext{-}}}^{\#1}$ $lpha$	0	0	0	0	0	0	0	
		$\sigma_{\alpha\beta\chi} - 6t_1 \omega_{\alpha}^{\ \theta} \partial_i f^{\alpha i} + \\ \partial^i f^{\alpha} - 3t_1 \partial_i f^{\alpha i} \partial_{\theta} f_{\alpha}^{\ \theta} + \\ \partial^{\theta} f^{\alpha i} - 2t_1 \partial_i f^{\alpha i} \partial_{\theta} f_{\alpha}^{\ \theta} - $	$+2t_1$ ($23\theta f$	$^{3}\omega_{\alpha l}\theta^{\prime l}$ $^{9}\omega^{\alpha \beta l}$ $^{3}\theta^{\prime l}\omega^{\alpha l}$	$+3r_5\partial_i\omega_{\theta}^{\ \ \kappa}\partial^\theta\omega^{lpha_i}$. $3r_5\partial_\alpha\omega^{lpha_i}\partial_\kappa\omega_{\kappa}^{\ \ \kappa}$.	$ {}_{\alpha}^{K} \partial_{\kappa} \omega_{\mu}^{K} + 3r_{5} \partial_{\alpha} \omega^{\alpha i \theta} \partial_{\kappa} \omega_{\theta', r}^{K} - \alpha^{\alpha i \theta} \partial_{\kappa} \omega_{\theta', r}^{K} - \alpha^{\alpha i \theta} \partial_{\kappa} \omega_{\theta', r}^{K}) $	$\omega_{1^{-}}^{\#2}{}_{lpha}$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0	
		$\sigma_{\alpha\beta\chi}^{-}$ $\partial'f^{\alpha}_{\alpha}$	$f^{(a)}$	$4 r_1 \partial_{\mu}$ $\omega_{\mu} \partial_{\alpha} \partial_{\alpha}$	ω_{θ}^{κ} ω_{α}^{κ}	$_{\alpha}\omega^{\alpha\prime\theta}$					$()-\frac{t_1}{2}$				
		$\omega^{\alpha\beta\chi}$ $\partial_{i}f^{\theta}$	$f_{\alpha\beta}^{\beta}(\omega)$	$f^{\alpha\prime}$) - $(r_1 \partial_{\beta} r_1 \partial_{\beta} r$	$3r_5\theta_{\alpha}$	3 75 0 t, x, y	$\omega_{1^{\bar{-}}}^{\#1}{}_{\alpha}$	0	0	0	(r_1+r_5)	$\frac{t_1}{\sqrt{2}}$	0	$-ikt_1$	
		$t_{\alpha\beta} + 3 \ \omega^{\alpha\beta\chi}$ $f^{\alpha}_{\ \alpha} - 3t_1 \partial_i f^{\theta}_{\ \theta}$ $f^{\theta} + 2t_1 \ \omega_{\alpha}$	$t_1 \omega_c$	$+40^{\theta}$ $\alpha\beta'-8$ $\alpha\beta'+$	α^{β_l} + α^{β_l} + α^{β_l} - 3	$\begin{pmatrix} \kappa \\ \theta \end{pmatrix} + \begin{pmatrix} \kappa \\ \theta \end{pmatrix}$	~				k^2 (r				
		$a\beta t^{\alpha\beta}$ $a\beta f^{\alpha}$ $a\beta f^{\alpha}$	$^{1}\partial^{\theta}f^{\alpha l}$	$\omega^{lpha i heta} - \omega^{lpha i heta} - \omega^{lpha i heta}$	$^{ ho G}_{lpha eta eta eta} \omega^{eta}_{lpha eta} \omega^{eta}_{lpha} \omega^$	$_{\alpha}^{\alpha}\partial_{\kappa}\omega$	$f_{1}^{\#1}$	$-\frac{ikt_1}{3\sqrt{2}}$	<i>ikt</i> 133	$\frac{k^2t_1}{3}$	0	0	0	0	
		$S == \iiint (\frac{1}{3} (3t_1 \ \omega^{\alpha_l} \ \omega_l^{\theta} + 3 f^{\alpha\beta} \ \tau_{\alpha\beta} + 3 \ \omega^{\alpha\beta\chi} \ \sigma_{\alpha\beta\chi} - 6t_1 \ \omega_{\alpha}^{\theta} \ \partial_l f^{\alpha_l} + 3 f^{\alpha\beta} \ \delta_l f^{\alpha} - 3t_1 \partial_l f^{\theta} \ \partial^l f^{\alpha} - 3t_1 \partial_l f^{\alpha} \partial_\theta f^{\alpha} - 3t_1 \partial_l f^{\alpha_l} \partial_\theta f^{\alpha_l} - 3t_1 \partial_l f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_1 \partial_l f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_1 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} - 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} - 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} - 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f^{\alpha_l} \partial_\theta f^{\alpha_l} + 2t_2 \partial_\mu f^{\alpha_l} \partial_\theta f$	$2t_1 \partial_{\beta} f_{\alpha} \partial_{\theta} f_{\alpha'} + t_1 \partial_{\beta} f_{\alpha\theta} \partial_{\theta} f_{\alpha'} + 2t_1 \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} + t_1 \partial_{\theta} f_{\alpha\theta} \partial_{\theta} f_{\alpha'} + 2t_1 \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} + t_1 \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} + t_1 \omega_{\alpha'} \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} \partial_{\theta} f_{\alpha'} + t_1 \omega_{\alpha'} \partial_{\theta} f_{\alpha'} \partial_{\theta} $	$t_1 \ \omega_{\alpha \theta_I} \left(\omega^{\alpha I \theta} + 4 \ \partial^{ heta} f^{lpha I} ight) - 4 \ r_1 \ \partial_{eta} \omega_{lpha I heta} \partial^{ heta} \omega^{lpha eta_I} + 2 \ r_1 \ \partial_{eta} \omega_{lpha eta_I} \partial^{ heta} \omega_{lpha eta_I} - 8 \ r_1 \ \partial_{eta} \omega_{lpha eta_I} \partial^{ heta} \omega^{lpha eta_I} - 2 \ r_1 \ \partial_{lpha} \omega_{lpha eta_I} \partial^{ heta} \omega_{lpha eta_I} \partial^{ heta} \omega^{lpha eta_I} + 2 \ r_1 \ \partial_{lpha} \omega_{lpha eta_I} \partial^{ heta} \omega_{lpha eta_I} \partial^{ heta} \omega^{lpha eta_I} + 2 \ r_1 \ \partial_{lpha} \omega_{lpha_I} \partial^{ heta} \omega_{lpha_I} \partial^{ heta} \omega^{lpha eta_I} \partial^{lpha eta_I} \partial^{ heta_I} \omega^{lpha eta_I} \partial^{ heta_I} \partial^{ heta_I} \omega^{lpha eta_I} \partial^{ heta_I} \partial^{ heta_$	$2r_1\partial_{ heta}\omega_{lphaeta}\partial^{ heta}\omega^{lphaetaeta}+3r_5\partial_{ert}\omega_{eta}^{ec{\kappa}}\partial^{ heta}\omega^{lphaert}$ $3r_5\partial_{ heta}\omega^{lphaert}\partial_{ heta}\omega^{lphae$	$6r_5 \partial^{\theta} \omega^{lpha\prime}$ $6r_5 \partial^{\theta} \omega^{lpha\prime}$	$\omega_{1}^{\#2}{}_{\alpha\beta} f_{1}^{\#1}{}_{\alpha\beta}$	$-\frac{t_1}{3\sqrt{2}}$	<u>1</u> 1	$-rac{1}{3}$	0	0	0	0	
	ction	α α α α	, (V +)	<i>t</i>) <i>(1</i>)	(1 (1)	w w		9 + [£] 1							
	ee) a	3t_1 $\omega^{}_{}$					$\omega_1^{\#1}{}_+^{lphaeta}$	$_1 + r_5$)	$-\frac{t_1}{3\sqrt{2}}$	$\frac{ikt_1}{3\sqrt{2}}$	0	0	0	0	
	Quadratic (free) action	$\int (\frac{1}{3})$					3	$\omega_{1}^{\#1} + \alpha^{\beta} k^{2} (2 r_{1} + r_{5}) +$							
	Jadra	<i>[[]</i>						$+\alpha\beta$	$\omega_{1}^{\#2} + ^{lphaeta}$	$f_{1}^{#1} + \alpha \beta$	$\omega_{1}^{\#_{1}} +^{\alpha}$	$\omega_1^{\#2} +^{lpha}$	$f_{1}^{#1} \dagger^{\alpha}$	$f_{1}^{\#2} +^{\alpha}$	
	9	ς						$\omega_1^{\#1}$	$\omega_1^{\#2}$	$f_1^{\#1}$	$\omega_{1^{-}}^{\#}$	$\omega_{1}^{\#}$	f_1^*	$f_{1}^{\#}$	

Massive and massless spectra



Massive particle					
Pole residue:	$-\frac{1}{r_1} > 0$				
Polarisations:	5				
Square mass:	$-\frac{t_1}{2r_1} > 0$				
Spin:	2				
Parity:	Odd				



Unitarity conditions

 $r_1 < 0 \&\& r_5 > -2 r_1 \&\& t_1 > 0$