Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_{0+}^{\#2} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == 0$	1
$\tau_0^{\#1} - 2 i k \sigma_0^{\#1} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == \partial_{\beta}\partial^{\beta}\tau^{\alpha}_{\alpha} + 2 \partial_{\chi}\partial^{\chi}\partial_{\beta}\sigma^{\alpha\beta}_{\alpha}$	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
$\tau_{1+}^{\#1}\alpha\beta + ik \ \sigma_{1+}^{\#2}\alpha\beta == 0$	$\partial_{\chi}\partial^{\alpha}\tau^{\beta\chi} + \partial_{\chi}\partial^{\beta}\tau^{\chi\alpha} + \partial_{\chi}\partial^{\chi}\tau^{\alpha\beta} +$	8
	$2 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \beta \chi} = =$	
	$\partial_{\chi}\partial^{\alpha}\tau^{\chi\beta} + \partial_{\chi}\partial^{\beta}\tau^{\alpha\chi} +$	
	$\partial_{\chi}\partial^{\chi} \tau^{\beta\alpha} + 2 \partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\alpha\chi\delta}$	
$\tau_2^{\#1}\alpha\beta - 2ik \sigma_2^{\#1}\alpha\beta == 0$	$t_{2+}^{\#1}\alpha\beta - 2\bar{i}k \ \sigma_{2+}^{\#1}\alpha\beta == 0 \ -\bar{i}(4\partial_{\delta}\partial_{\chi}\partial^{\beta}\partial^{\alpha}\tau^{\chi\delta} + 2\partial_{\delta}\partial^{\delta}\partial^{\alpha}\tau^{\chi})$	5
	$3 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \tau^{\beta \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} \tau^{\chi \beta} -$	
	$3 \partial_{\delta} \partial_{\chi} \partial^{\beta} \tau^{\alpha \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\beta} \tau^{\chi \alpha} +$	
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\alpha\beta} + 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\beta\alpha} +$	
	$4\ ^{ec{l}}\ k^{\chi}\ \partial_{\epsilon}\partial_{\chi}\partial^{eta}\partial^{lpha}\sigma^{\delta\epsilon}_{\ \ \delta}$ -	
	$6 i k^{\chi} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \delta \epsilon}$ -	
	$6 i k^{\chi} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \partial^{\beta} \sigma^{\alpha \delta \epsilon} +$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \tau^{\chi\delta} +$	
	$6 i k^{\chi} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \sigma^{\alpha \delta \beta} +$	
	$6 \ i \ k^{\chi} \ \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \sigma^{eta \delta lpha}$ -	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\delta} t_{\chi}^{\chi}$ -	
	$4 i \eta^{\alpha\beta} k^{\chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial_{\chi} \sigma^{\delta\epsilon}_{\delta}) == 0$	
Total constraints/gauge generators:	ge generators:	16

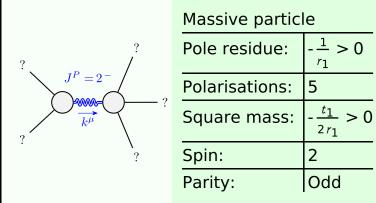
		c C	∠ σ _α τ _{ιθ} 'ƒ ^{αι} +		$^{}_{}^{}^{}_{}^{}$		$\partial^{\theta}\omega^{lphaeta\prime}$ +	ω ^{αβι} -	$\tau_{1}^{\#2}{}_{\alpha}$	0	O
		ςα _ α _	$g_{\theta f} = \frac{1}{2} \frac{1}{2} \frac{1}{2}$	-	$\omega^{\alpha \beta \prime}$ ∂		$\omega_{lpha heta}$	$_{lphaeta_{l}}^{\prime}\partial^{ heta}$	$\tau_{1}^{\#1}{}_{\alpha}$	0	U
		$rac{1}{2}t_1(2\ \omega^{lpha'}_{lpha}\ \omega_{I}^{ heta}_{eta}$ - $4\ \omega_{lpha}^{ heta}\ \partial_{I}f^{lpha'}$ + $4\ \omega_{I}^{ heta}\ \partial^{I}f^{lpha}_{lpha}$	$2 \partial_i f^{\alpha}_{\ \ \theta} \partial^i f^{\alpha}_{\ \ \alpha} - 2 \partial_i f^{\alpha}_{\ \ \theta} \partial^{\theta} f^{\alpha}_{\ \ \alpha} + 4 \partial^i f^{\alpha}_{\ \ \alpha} \partial^{\theta} f^{i}_{\ \ \beta} - 2 \partial_{\alpha} f_{i\theta}$ $\partial^{\theta} f^{\alpha i} - \partial_{\alpha} f_{\theta i} \partial^{\theta} f^{\alpha i} + \partial_i f_{\alpha \theta} \partial^{\theta} f^{\alpha i} + \partial_{\theta} f_{\alpha i} \partial^{\theta} f^{\alpha i} +$	$\partial_{\theta}f_{\prime\alpha}\partial^{\theta}f^{\alpha\prime} + 2\omega_{\alpha\theta\prime}(\omega^{\alpha\prime\theta} + 2\partial^{\theta}f^{\alpha\prime})) -$	$\frac{2}{3}r_{1}\left(3\partial_{\beta}\omega_{,\theta}^{\theta}\partial'\omega^{\alpha\beta}_{\alpha}-3\partial_{i}\omega_{\beta}^{\theta}\partial'\omega^{\alpha\beta}_{\alpha}-3\partial_{\alpha}\omega^{\alpha\beta i}\partial_{\theta}\omega_{\beta}^{\theta}\right.+$	$6 \partial' \omega^{\alpha \beta}_{\ \ \alpha} \partial_{\theta} \omega^{\ \ \theta}_{\ \ \ \ } + 3 \partial_{\alpha} \omega^{\alpha \beta i} \partial_{\theta} \omega^{\ \ \theta}_{\ \ \ \beta} -$	$6\partial'\omega^{\alpha\beta}_{\alpha}\partial_{\theta}\omega^{}_{\beta} + 2\partial_{\beta}\omega_{\alpha\beta}\partial^{\theta}\omega^{\alpha\beta} - \partial_{\beta}\omega_{\alpha\beta}\partial^{\theta}\omega^{\alpha\beta} +$	$\begin{split} &4\partial_{\beta}\omega_{_{\beta}\theta_{_{\alpha}}}\partial^{\theta}\omega^{\alpha\beta_{!}}+\partial_{,}\omega_{_{\alpha\beta\theta}}\partial^{\theta}\omega^{\alpha\beta_{!}}-\partial_{\theta}\omega_{_{\alpha\beta_{!}}}\partial^{\theta}\omega^{\alpha\beta_{!}}-\\ &\partial_{\theta}\omega_{_{\alpha_{!}\beta}}\partial^{\theta}\omega^{\alpha\beta_{!}}))[t,x,y,z]dzdydxdt \end{split}$	$\sigma_{1}^{\#2}{}_{\alpha}$	0	O
		θ - 4 ω_{α}^{θ} $\dot{\theta}$	$\alpha - 20, t$ $\alpha f_{\theta_1} \partial^{\theta} f^{\alpha_1}$	" + 2 $\omega_{\alpha\theta_I}$	$u^{\alpha\beta}_{\alpha}$ -3 ∂_{μ}	$\theta_{\theta}\omega_{\beta}^{\theta}+3\dot{\theta}$	$_{\theta}\omega_{,\beta}^{\theta}+2\delta$	$(\partial_t \omega^{\alpha\beta\prime} + \partial_{,c} \omega^{\alpha\beta\prime}))[t, x, t]$	$\sigma_{1^{\bar{-}}\alpha}^{\#1}$	0	C
	$\sigma_{\alpha\beta\chi}$ +	$\omega^{\alpha\prime}_{\alpha} \omega^{\theta}_{\alpha}$	$2 a_1 t^{\alpha} \theta^{\alpha} t$ $\partial^{\theta} f^{\alpha \prime} - \partial^{\alpha} \theta^{\alpha}$	$\partial_{\theta}f_{\prime\alpha}\partial_{\theta}f^{\alpha}$	$\partial_{eta}\omega_{eta}^{}$	$6 \partial' \omega^{\alpha \beta}_{\alpha} \partial$	$6 \partial' \omega^{\alpha \beta}_{\alpha} \hat{c}$	$4 \partial_{eta} \omega_{Ieta lpha} \partial_{eta} \omega_{Ieta eta} \partial_{eta} \omega_{Ieta eta} \partial_{eta} \omega_{Ieta} \partial_{eta}$	$\tau_{1}^{\#1}{}_{\alpha\beta}$	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	īk
:	Quadratic (free) action $S == \iiint (f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} +$	$\frac{1}{2}t_{1}$ (2			$\frac{2}{3}r_1$ (3				$\sigma_{1}^{\#2}{}_{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	1
3	Quadratic (free) action $S == \iiint (f^{\alpha\beta} t_{\alpha\beta} + \omega^{\alpha\beta})$								$\sigma_{1}^{\#1}{}_{\alpha\beta}$	0	$\tau^{\#_2} + \alpha \beta$ - $\sqrt{2}$
-	Quadr $S == \iint$									$\sigma_1^{#1} + \alpha \beta$	$\tau^{\#2} + \alpha\beta$

					1)		∼ J			$\sigma_0^{\sharp 1}$		$\tau_{0}^{\#1}$	$\tau_0^{\#}$	² + σ	#1 0 ⁻			
$ au_1^{\#2} lpha$	0	0	0	$\frac{2ik}{t_1 + 2k^2t_1}$	$i \sqrt{2} k (2k^2 r_1 + t_1) $ $ (t_1 + 2k^2 t_1)^2 $	0	$\frac{2 k^2 (2 k^2 r_1 + t_1)}{(t_1 + 2 k^2 t_1)^2}$	$\sigma_{0^{+}}^{#1}$		$\frac{1}{(2k^2)^2}$	_	i √2 k +2 k ²) ² t			0		$\sigma_{2}^{\#1}{}_{\alpha\beta}$	$\tau_{2}^{\#1}{}_{lphaeta}$
$ au_1^{\#}$				$\frac{2}{t_1+2}$	$\frac{\sqrt{2} \ k (2)}{(t_1 + 2)}$		$2k^2(2k)$	$ au_{0^{+}}^{#1}$		$\sqrt{2} k$		$\frac{2k^2}{+2k^2)^2}$			0	$\sigma_{2}^{\#1} \dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2t_1}$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$
$\tau_{1}^{\#_{1}}{}_{\alpha}$	0	0	0	0	0	0	0	$ au_{0^{+}}^{#2}$		0	1 (1	0	0)	0	$\tau_{2^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	$\frac{4k^2}{(1+2k^2)^2t_1}$
ı]2[$\frac{+t_1)}{2}$	$\sigma_0^{\#1}$	t 🔃	0		0	0	-	$\frac{1}{t_1}$	$\sigma_2^{\#1} \dagger^{\alpha\beta\chi}$	0	0
$\sigma_{1}^{\#2}{}_{lpha}$	0	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2t_1}$	$\frac{2 k^2 r_1 + t_1}{(t_1 + 2 k^2 t_1)^2}$	0	$-\frac{i\sqrt{2}k(2k^2r_1+t_1)}{(t_1+2k^2t_1)^2}$	α				<u>'</u> L				1		
0				t ₁ +	$\frac{2k^2}{(t_1+1)}$		$\sqrt{2} k$	$^{\alpha}f_{1}^{\#2}$	0	0	0	ikt_1	0	0	0			
					1.5			$f_{1}^{\#1}$	0	0	0	0	0	0	0			
$\sigma_{1}^{\#1}{}_{\alpha}$	0	0	0	0	$\frac{\sqrt{2}}{t_1 + 2k^2t_1}$	0	$\frac{2ik}{t_1 + 2k^2t_1}$	$\omega_{1}^{\#^2}{}_{lpha}$	0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0			
	. 1 년	LÆ	1.#		t ₁		1 2	α				- [‡] 1			*.			
$\tau_1^{\#1}\!$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$\frac{ik}{(1+k^2)^2 t_1}$	$\frac{k^2}{(1+k^2)^2t_1}$	0	0	0	0	$\omega_{1}^{\#_{1}}$	0	0	0	-k² r ₁ -	$\frac{t_1}{\sqrt{2}}$	0	- <i>ī</i> k t ₁			
	'							$f_1^{\#1}_{\alpha\beta}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0			
$\sigma_1^{\#_+^2} \alpha \beta$	$\frac{\sqrt{2}}{t_1 + k^2 t_1}$	$\frac{1}{(1+k^2)^2t_1}$	$\frac{ik}{(1+k^2)^2t_1}$	0	0	0	0	$^{\chieta}f_1^{\#}$										
	t		1					$\omega_1^{\#2}_{+lphaeta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0			
$\sigma_{1}^{\#1}\!$	0	$\frac{\sqrt{2}}{t_1 + k^2 t_1}$	$\frac{i\sqrt{2}k}{t_1 + k^2 t_1}$	0	0	0	0	$\omega_1^{\#1}\!$	$-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$\frac{i k t_1}{\sqrt{2}}$	0	0	0	0			
l	$+_{\alpha\beta}$	$+^{\alpha\beta}$	$+^{\alpha\beta}$	$\sigma_{1}^{\#1} + ^{lpha}$	$\sigma_{1}^{#2} + \alpha$	$\tau_{1}^{\#_1} + ^{\alpha}$	$\tau_1^{\#2} + \alpha$)	$-\alpha\beta$	$-\alpha\beta$	$-\alpha\beta$	$+^{\alpha}$	+α	$+^{\alpha}$	+α+			
	$\sigma_1^{\#1} + \alpha^{eta}$	$\sigma_1^{\#2} + \alpha^{\beta}$	$\tau_1^{\#1} + \alpha \beta$	$\sigma_{1^{-}}^{\#}$	$\sigma_{1}^{\#,j}$	$ au_1^\#$	$ au_1^{\#_2^2}$		$\omega_1^{\#_1} + \alpha^{\beta}$	$\omega_1^{\#_2^2} +^{\alpha\beta}$	$f_1^{#1} + \alpha^{\beta}$	$\omega_{1^{\bar{-}}}^{\#1} +^{\alpha}$	$\omega_1^{\#^2} +^{lpha}$	$f_{1}^{\#1} +^{\alpha}$	$f_1^{\#2} +^{\alpha}$	ł		

 $\sigma_{2}^{\#1}{}_{\alpha\beta\chi}$

 $\frac{2}{2 k^2 r_1 + t_1}$

Massive and massless spectra



(No massless particles)

Unitarity conditions

 $r_1 < 0 \&\& t_1 > 0$