Particle spectrograph

Wave operator and propagator

in-parity form	Covariant form					Multiplicities	
#1 0- \sigma ==0	$\epsilon \eta_{lphaeta\chi\delta}$ $\partial^{\delta}\sigma^{lphaeta\chi}$	0 ==				1	
#2 0 ⁺ r ==0	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta}==0$					1	
$^{#1}_{0}$ $^{#1}_{r-2}$ $^{#1}_{l}$ $^{#1}_{l}$ ==0	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == \partial_{\beta}\partial^{\beta}\tau^{\alpha}$	$_{\alpha}^{x}$ +2 $\partial_{\chi}\partial^{\chi}\partial_{\beta}\sigma^{\alpha\beta}$				1	
$\int_{1^{-1}}^{\#2} d^{\alpha} + 2 i k_{1^{-1}}^{\#2} d^{\alpha} = 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} ==$	$\hat{q}^{\partial X}\partial_{\beta}\tau^{\alpha\beta} + 2 \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\sigma^{\alpha\beta\chi}$	$\beta_{eta}\sigma_{lphaeta\chi}$			е .	
$\frac{\#1}{1} \frac{\alpha}{r} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} == \partial_{\zeta}\partial_{\zeta}\partial_{\zeta}\partial_{\zeta}\partial_{\zeta}\partial_{\zeta}\partial_{\zeta}\partial_{\zeta}$	$==\dot{q}\partial^{\chi}\partial_{\beta}\tau^{\beta\alpha}$				e e	
$\prod_{j=1}^{\#1} \alpha^{j} + i k_{1}^{\#2} \alpha^{j} =$	$= 0 \partial_{\chi} \partial^{\alpha} t^{\beta \chi} + \partial_{\chi} \partial^{\beta} t^{\gamma}$ $= 0 \partial_{\chi} \partial^{\alpha} t^{\chi \beta} + \partial_{\chi} \partial^{\beta} t^{\gamma}$	$\begin{split} \partial_{\chi} \partial^{\alpha} t^{\beta \chi} &+ \partial_{\chi} \partial^{\beta} t^{\chi \alpha} + \partial_{\chi} \partial^{\chi} t^{\alpha \beta} + 2 \ \partial_{\sigma} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} + 2 \ \partial_{\sigma} \partial_{\gamma} \sigma^{\alpha \beta \chi} \\ \partial_{\chi} \partial^{\alpha} t^{\chi \beta} &+ \partial_{\chi} \partial^{\beta} t^{\alpha \chi} + \partial_{\chi} \partial^{\chi} t^{\beta \alpha} + 2 \ \partial_{\sigma} \partial_{\chi} \partial^{\beta} \sigma^{\alpha \chi \delta} \end{split}$	$_{\delta}\partial_{\chi}\partial^{\alpha}\sigma^{\beta\chi_{i}}$	$\delta + 2 \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \beta \chi}$ $\alpha \chi \delta$	#	м	
$\frac{\#1}{2^+ t} \alpha \beta - 2 \tilde{i} k_2^{\#1} \alpha \beta =$	$==0 \frac{-i \left(4 \partial_{\delta} \partial_{\chi} \partial^{\beta} \partial^{\alpha} t^{\chi \delta} \right. + 2 \partial_{\delta} \partial^{\beta} \partial^{\beta} \partial^{\alpha} t^{\chi}}{\chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} t^{\beta \chi} - 3 \partial_{\delta} \partial^{\beta} \partial_{\chi} \partial^{\alpha} t^{\chi \beta}}$	$+2 \partial_{\delta}\partial^{\delta}\partial^{\beta}\partial^{\alpha}t^{\chi}_{\chi}$.3 0 ₅ 0 ⁶ 0 _x	$\partial^{\alpha} t^{\beta \chi}$ -3 $\partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\epsilon}$	- _β χ ¹ _z	5	
	3 9 6 9 9	$3 \partial_6 \partial^6 \partial_\chi \partial^\beta \iota^{\alpha\chi}$ -3 $\partial_6 \partial^6 \partial_\chi \partial^\beta \iota^{\chi\alpha}$ +3 $\partial_6 \partial^6 \partial_\chi \partial^\chi \iota^{\alpha\beta}$ +	3 ₇ ^{xa} +3 6	$+ {}_{\partial^{Q}} \partial_{\chi} \partial_{\chi} \iota_{\alpha\beta} +$			
	30000	$3\partial_{\delta}\partial^{\delta}\partial_{\lambda}\partial^{\chi}t^{\beta\alpha} + 4i K^{\lambda} \partial_{\epsilon}\partial_{\lambda}\partial^{\beta}\partial^{\alpha}\sigma^{\delta\epsilon} - 6i$	$\partial_{\chi}\partial^{\beta}\partial^{\alpha}\sigma^{\delta\epsilon}$	$\int_{\delta} -6 i k^{\chi} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \delta \epsilon}$	$^{\beta a}\sigma^{eta\delta\epsilon}$		- 5 -
	0	or k ofosoxor o +2 ir ofo osox $^{(1)}$ 6 i k^{χ} 0 $_{arepsilon}$ 0 $_{arepsilon}$ 0 +6 i k^{χ} 0 $_{arepsilon}$ 0 $_{arepsilon}$ 0 $_{arepsilon}$	KX OEO U	$\delta \partial_{\chi} U + \delta \delta_{\chi} = \delta \delta_{\chi} \sigma^{\beta \delta \alpha}$			
	2 η ^{αβ} 6	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\delta} t^{X}_{X} - 4 i \eta^{\alpha\beta}$		$k^{\chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial_{\chi} \sigma^{\delta \epsilon}_{\ \delta}) == 0$			
Total expected gauge generators:	e generators:					17	
$\overset{\#1}{1}^+\sigma_{\alpha\beta}$	$_{1}^{\#2}$	$1^{*1} \atop 1^+ \tau \alpha \beta$	$\frac{*1}{1}\sigma_{\alpha}$	$^{\#2}_{1}\sigma_{lpha}$	$_{1}^{\#1}$	$^{#2}_{1}$ $^{\tau}$	
$1 + \frac{\alpha\beta}{\sigma} \qquad \frac{1}{k^2 (2r_1 + r_5)}$	$\frac{1}{\sqrt{2} (k^2 + k^4)(2 \ r_1 + r_5)}$	$\frac{i}{\sqrt{2} (k+k^3)(2 \ r_1 + r_5)}$	0	0	0	0	
	$\frac{6k^2(2r_1+r_5)+t_1}{2(k+k^3)^2(2r_1+r_5)t_1}$	$\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0	
	$\frac{i(6k^2(2r_1+r_5)+t_1)}{2k(1+k^2)^2(2r_1+r_5)t_1}$	$\frac{6k^2(2r_1+r_5)+t_1}{2(1+k^2)^2(2r_1+r_5)t_1}$	0	0	0	0	
$\frac{\#1}{1}\sigma + 0$ 0	0	0 0		$\frac{\sqrt{2}}{t_1 + 2 k^2 t_1}$	0	$\frac{2i \ k}{t_1 + 2 k^2 t_1}$	
$\frac{#2}{1 \cdot \sigma + \alpha} = 0$	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	$\frac{i\sqrt{2}k(2k^2(r_1+r_5)\varepsilon_1)}{(t_1+2k^2t_1)^2}$	
$\frac{*1}{1}r^{\alpha}$ 0	0	0 0		0	0	0	
$\frac{^{*2}}{1^-\tau^+}$ 0	0	0	$\frac{2i k}{t_1 + 2k^2 t_1}$	$\frac{i\sqrt{2} k(2k^2(r_1+r_5)t_1)}{(t_1+2k^2t_1)^2}$	0	$\frac{-4 k^4 (r_1 + r_5) + 2 k^2 t_1}{(t_1 + 2 k^2 t_1)^2}$	
$S == \iiint \left(\frac{1}{3} \left(3 t_1 \mathcal{A}^{\alpha \prime} \mathcal{A}^{\beta \prime} \right) \mathcal{A}^{\beta} + 3 f^{\alpha \beta} \right)$		$\tau_{\alpha\beta} + 3 \mathcal{A}^{\alpha\beta\chi} \mathcal{O}_{\alpha\beta\chi}$	-6 t ₁ A	$\sigma_{lphaeta\chi}$ -6 t_1 $\mathcal{A}_{lpha}^{\; heta}$ $\partial_i f^{lpha}$ +6 t_1 $\mathcal{A}_{,\; heta}^{\; heta}$ $\partial_i f^{lpha}$	4 9 9'	f^{α} -	
	$3t_1\partial_i f^{\theta}_{\ \ \ }\partial^i f^{lpha}_{\ \ \ \ }$ -		$6 t_1 \partial' f^{\alpha}_{\alpha}$	$_{\alpha}^{'}\partial_{\theta}f_{,}^{\;\theta}+2t_{1}\mathcal{A}_{,\theta\alpha}\partial^{\theta}f^{\alpha\prime}$	$^{1}\partial^{\theta}f^{\alpha}$	_ *	
	$2t_1\partial_{\alpha}f_{i\theta}\partial^{\theta}f^{\alpha i}$	$2t_1\partial_{\alpha}f_{i\theta}\partial^{\beta}f^{\alpha i} - 2t_1\partial_{\alpha}f_{\theta i}\partial^{\beta}f^{\alpha i} + t_1\partial_{\beta}g_{\theta}\partial^{\beta}f^{\alpha i} + 2t_1\partial_{\beta}f_{\alpha i}\partial^{\beta}f^{\alpha i} + \dots$	$t_1 \partial_f f_{\alpha\theta} \partial^{\alpha}$	$^{\theta}f^{\alpha\prime} + 2 t_1 \partial_{\theta}f_{\alpha\prime}$ $\dot{\phi}$	$\theta^{f^{\alpha\prime}}$ +		
	$t_1 \delta_{ heta f} {}_{ ext{i}lpha} \delta^{ ext{i}eta} + t \ 4 r_1 \delta_{ heta} \mathcal{A}_{lpha heta} \delta^{ heta} \mathcal{A}^{lpha}$	$c_{1,0gf}_{l\alpha} \circ r_{1} + c_{1} \mathcal{H}_{\alpha l \theta} \left(\mathcal{H}^{} + 2 \circ r_{1} \right) + c_{1} \mathcal{H}_{\alpha \theta_{l}} \left(\mathcal{H}^{} + 4 \circ r_{1} \right) - 4 c_{1} \partial_{\rho} \mathcal{H}_{\alpha l \theta} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}_{\alpha \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}_{\alpha \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}_{\alpha l \theta} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} + 2 c_{1} \partial_{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l} \partial^{\rho} \mathcal{H}^{\alpha l \theta_{l}} \partial^{\rho} \mathcal{H}^{\alpha l} \partial^{\rho} $: σ*†)+ θ'Aαβ! -8	$egin{array}{l} t_1 \mathcal{A}_{lpha heta_l} \ (\mathcal{A}_{lpha heta_l} \ (\mathcal{A}_{lpha heta_l}) \end{array}$	+4 0°) -2 ₁₁ ($(1)^{-}$ $(1)^{\alpha}_{\alpha\beta\theta} \partial^{\theta} \mathcal{A}^{\alpha\beta\prime} +$	
	$2r_1\partial_ heta \mathcal{A}_{lphaeta_l}\partial^ heta \mathcal{A}^{'}$	$2r_1\partial_\theta\mathcal{R}_{lphaeta_1}\partial^{}_{artheta\mathcal{R}_{lpha}}\partial^{}_{artheta\mathcal{R}_{lphaeta}}+2\;r_5\partial_{,\mathcal{G}}\mathcal{R}^{\ \ \ \ \ }_{lpha}\partial^{}_{artheta}\mathcal{R}^{\ \ \ \ }_{lpha}\partial^{}_{artheta}\mathcal{R}^{\ \ \ \ }_{lpha}$	^θ A ^{αβι} +3	1	α -		
	$3r_5\partial_\theta \mathcal{A}_{IK}^K\partial^\theta \mathcal{A}^{\alpha_0}$	$-3 r_5 \partial_{\alpha} \mathcal{A}^{\alpha}$	β, + 6 β, β + 6	$r_5 \partial^{\theta} \mathcal{A}^{\alpha_{l}}{}_{\alpha} \partial_{\kappa} \mathcal{A}^{\kappa}{}_{l} +$	+ •		
	315009 069 1 -6 15099 0	, -6 r ₅ ∂ ⁶ A ^{α'} α ∂ _κ	$\mathcal{A}_{\theta^{'}}^{\ \ \prime}))[t,$	$_{lpha}{}^{\partial_{\kappa}}\!\mathcal{A}_{eta}^{\ \ \ \ })][t,x,y,z]dzdyd$	d x d t	7 t	

 $0^{+1} f 0^{+2} f 0^{-1} \mathcal{F}$

0

0

0

 $\stackrel{\text{\#2}}{1^+}\mathcal{R}_{\alpha\beta} \stackrel{\text{\#1}}{1^+} f_{\alpha\beta}$

 $-\frac{t_1}{3\sqrt{2}}$

 $-\frac{1}{3}i k i$

0

0

 $\frac{i \ k \ t}{3 \sqrt{2}}$

0

0

0

 $2^{+1} \sigma_{\alpha\beta}$

 $(1+2k^2)^2t$

 $(1+2k^2)^2t$

0

1 k t

 $\overset{\#1}{2}\sigma_{\alpha\beta\chi}$

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

0 | i k t

0

0

0 0 0

 $^{*1}_{2}$

2 [7

 $2^{+} \tau \alpha \beta$ $2 i \sqrt{2} k$

 $(1+2k^2)^2t_1$

 $\frac{1}{(1+2k^2)^2t_1}$

 $\overset{\sharp 1}{1}\mathcal{F}\!\!/_{lpha}$

0

 $k^2 (r_1 + r_5) - \frac{t_1}{2}$

 $\frac{t_1}{\sqrt{2}}$

-i k **t**

i √2 k t₁

 $-2 k^2 t_1$

0

#1 0+ *3*(

-i √2 k t₁

#1 0⁺ *A* †

> #1 0⁺ f †

> #2 0⁺ f †

#1 0 *3*(†

 $\stackrel{\#1}{0}\sigma$

#2 0⁺ τ

 $_{0}^{\#1}_{\tau}$

 $1^{+2}\mathcal{A}^{\alpha\beta}$

#1 1 *F*(†

#2 1 *F*(†

 $\frac{^{#1}}{1}f + ^{a}$

Massive and massless spectra

Spin: Parity:

Odd

Pole residue: Square mass:

Massive particle

Polarisations: 2	Poleresidue:	Massless particle	k ^µ = (p, 0, 0, p)
2	$\frac{1}{(2r_1+r_5)t_1^2p^2} > 0$	particle	?

Unitarity conditions