Particle spectrograph

Wave operator and propagator

${\mathcal T}_{1^-}^{\#1}{}_{lpha}$	0	0	0	0	0	0	0	0	0	0	$h_{1^-}^{\#1} \alpha$	0	0	0	0	0	0	0	0	0	
$\Delta_{1}^{\#6}{}_{lpha}$	0	0	0	0	0	$-\frac{1}{6a_0}$	√ <u>5</u> 6 <i>a</i> 0	$\frac{7}{3\sqrt{2}a_0}$	340	0	$\Gamma_{1}^{\#6}$	0	0	0	0	0	$-\frac{a_0}{6}$	$-\frac{\sqrt{5} a_0}{6}$	$\frac{a_0}{6\sqrt{2}}$	$\frac{5a_0}{12}$	
$\Delta_{1}^{\#5}{}_{lpha}$,	0	0	0	0	0	$\frac{1}{6\sqrt{2}a_0}$	$\frac{\sqrt{5}}{6a_0}$	$\frac{17}{6a_0}$	$\frac{7}{3\sqrt{2}a_0}$	0	$\Gamma_{1}^{\#5}$	0	0	0	0	0	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{1}{6}\sqrt{\frac{5}{2}}a_0$	<u>a0</u> 3	$\frac{a_0}{6\sqrt{2}}$	
$\Delta_{1^-}^{\#4}{}_{\alpha}$	0	0	0	0	0	$\frac{5\sqrt{5}}{12a_0}$	1 12 a ₀	- \(\sqrt{\frac{5}{2}}\)	- √5 6 a 0	0	$\Gamma_{1}^{\#4}$	0	0	0	0	0	$\frac{\sqrt{5} a_0}{6}$	<u>a0</u> 3	$\sqrt{\frac{5}{2}} a_0$	$\frac{\sqrt{5} a_0}{6}$	
$\Delta_{1}^{\#3}{}_{\alpha}$	0	0	0	0	0	$\frac{19}{12 a_0}$	$\frac{5\sqrt{5}}{12a_0}$	$\frac{1}{6\sqrt{2}a_0}$	$\frac{1}{6a_0}$	0	α						·	O]	- <u>1</u> 6	1	
χ				121		ı		10			Γ ₁ -3	0	0	0	0	0	$-\frac{a_0}{3}$	$\sqrt{5} a_0$	$-\frac{a_0}{6\sqrt{2}}$	- a 0	
$\Delta_{1}^{\#2}$	0	0	0	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\frac{2}{a_0}$	0	0	0	0	0	$\Gamma_{1}^{\#2}$	0	0	0	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0	
$\Delta_{1^{-}}^{\#1}{}_{\alpha}$	0	0	0	0	$\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	$\Gamma_{1}^{\#1}$ Γ	0	0	0	$-\frac{a_0}{4}$	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	
$\Delta_1^{\#3}$	0	0	4 a ₀	0	0	0	0	0	0	0	$\Gamma_{1}^{\#3}{}_{\alpha\beta}$ Γ	0	0	4	0	0	0	0	0	0	
$\Delta_{1}^{\#_{2}^{2}}$	$-\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0	0	0	0	0	0	$\Gamma_{1}^{\#2}$	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0	0	0	0	
$\Delta_1^{\#1}{}_+\alpha\beta$	0	$-\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	0	0	0	$\lceil \Gamma_1^{\#1} \rceil$	- <u>a</u> 0	$-\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0	0	0	
	$\Delta_1^{\#1} + ^{\alpha\beta}$	$\Delta_{1}^{\#2} \dagger^{\alpha\beta}$	$\Delta_{1}^{\#3} +^{\alpha\beta}$	$\Delta_{1}^{\#1} \uparrow^{\alpha}$	$\Delta_{1}^{\#2} {\dagger}^{\alpha}$	$\Delta_{1}^{\#3} +^{\alpha}$	$\Delta_{1}^{\#4} +^{\alpha}$	$\Delta_{1}^{\#5} +^{\alpha}$	$\Delta_{1}^{\#6} +^{\alpha}$	${\mathcal T}_{1^{\bar{-}}}^{\#1} {\dagger}^{\alpha}$		$\Gamma_1^{\#1} + \alpha \beta$	$\Gamma_1^{\#2} + \alpha \beta$	$\Gamma_1^{#3} + \alpha \beta$	$\Gamma_{1}^{\#1} +^{\alpha}$	$\Gamma_{1}^{#2} + \alpha$	$\Gamma_1^{\#3} +^{\alpha}$	$\Gamma_1^{\#4} + ^{lpha}$	$\Gamma_{1}^{\#5}+^{\alpha}$	$\Gamma_1^{\#6} +^{lpha}$	

)	0	0	0	0	0	0	0]	
)	0	0	- <u>a0</u> -	$-\frac{\sqrt{5} a_0}{6}$	$\frac{a_0}{6\sqrt{2}}$	$\frac{5 a_0}{12}$	0		$\partial_{\beta}h^{X}$ - X - X - X - X + X + X + X - X
)	0	0	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{1}{6}\sqrt{\frac{5}{2}}a_0$	3	$\frac{a_0}{6\sqrt{2}}$	0		$S = \int \partial u du du du du du du du $
)	0	0	$\frac{\sqrt{5} a_0}{6}$	3	$-\frac{1}{6}\sqrt{\frac{5}{2}}a_0$	$-\frac{\sqrt{5} a_0}{6}$	0		$S == \begin{cases} \int \int \int_{\mathbb{R}}^{\frac{1}{2}} (8 h^{\alpha \beta} \mathcal{T}_{\alpha \beta} - 4 \Gamma^{\alpha \beta X} (a_0 \Gamma_{\beta \chi \alpha} - 2 \Delta_{\alpha \beta \chi} + a_0 \partial_{\beta} h_{\alpha \chi}) + 2 \\ 2 a_0 h^X_{\ X} \partial_{\beta} \Gamma^{\alpha}_{\ \alpha}^{\ \beta} + 2 a_0 h^X_{\ X} \partial_{\beta} \Gamma^{\alpha \beta}_{\ \alpha} - 4 a_0 h^{\alpha \beta} \partial_{\lambda} h_{\beta}^{\ X} + 4 a_0 \partial^{\beta} h^{\alpha}_{\ \alpha} \partial_{\lambda} h_{\beta}^{\ X} + \\ 2 a_0 \Gamma^{\alpha}_{\ \alpha}^{\ \beta} (2 \Gamma^X_{\ \beta \chi} - \partial_{\beta} h^X_{\ \chi} + 2 \partial_{\chi} h_{\beta}^{\ X}) - 8 a_0 h^{\alpha \beta} \partial_{\chi} \partial_{\beta} h_{\alpha}^{\ X} + \\ 2 a_0 h^{\alpha}_{\ \alpha} \partial_{\lambda} \partial_{\beta} h^{\beta X} + 4 a_0 h^{\alpha \beta} \partial_{\lambda} \partial_{\lambda} h_{\alpha \beta} - 2 a_0 h^{\alpha}_{\ \alpha} \partial_{\lambda} \partial_{\beta} h_{\alpha}^{\ X} + \\ 3 a_0 \partial_{\chi} h_{\alpha \beta} \partial^{\chi} h^{\alpha \beta} + 4 a_0 h^{\beta \chi} \partial^{\chi} \Gamma^{\alpha}_{\ \alpha}^{\ \beta}) [t, x, y, z] dz dy dx dt \end{cases}$
)	0	0	$-\frac{a_0}{3}$	$\sqrt{5} a_0$	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{a_0}{6}$	0		$\Delta_{\alpha\beta\chi}$ $0 h_{\alpha\chi}$ $0 \beta h_{\alpha}$ $a_0 h^{\alpha\beta}$ $2 a_0 h^{\alpha}$ x, y, y
)	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0	0		$\beta x\alpha^{-}2$ $\alpha^{-}4a$ $+ 4a_{C}$ $\beta^{x} - 8$ $\beta^{x} - 8$ $\beta^{x} - 8$ $\beta^{x} - 8$ $\beta^{x} - \beta$
)	- <u>a0</u> 4	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0		$(a_0 \Gamma \alpha)^{\alpha} = 0$ $(a_0$
4	0	0	0	0	0	0	0	tion	$4 \Gamma^{\alpha\beta\chi}$ $a_0 h^{\chi}$ $0 \partial_{\alpha} h^{\alpha\beta}$ $3 \beta h^{\chi} + 4$ $4 a_0 h^{\alpha}$ $1 a_0 h_{\beta\chi}$
)	0	0	0	0	0	0	0	Quadratic (free) action	$\begin{array}{c} 3 \mathcal{T}_{\alpha\beta}^{-} \\ \alpha \\ \alpha \\ \alpha \\ -4\alpha_{0} \\ \Gamma^{X} \\ \beta \chi^{-} \\ \beta h^{\beta \chi} + \\ h^{\alpha\beta} + 4 \end{array}$
)	0	0	0	0	0	0	0	atic (fi	$(8 h^{\alpha t})^{1/2} (8 h^{\alpha t}$
	$\Gamma_1^{\#1} \dotplus^\alpha$	$\Gamma_{1}^{#2} + ^{\alpha}$	$\Gamma_1^{\#3} + ^{\alpha}$	$\Gamma_1^{\#4} + ^{lpha}$	$\Gamma_1^{\#5} + ^{\alpha}$	$\Gamma_1^{\#6} +^{lpha}$	$h_{1}^{\#1} \dagger^{\alpha}$	Quadr	$S == \int \int \int \int \int \int \int \frac{1}{8} ds$ $2 a_0 h$ $2 a_0 \Gamma$ $2 a_0 \Gamma$ $2 a_0 \rho$ $3 a_0 \partial$

$\lambda^{\mu} h^{\mu} p + 4 a_0 h_{\beta \chi} \partial^{\chi} \Gamma^{\alpha}_{\alpha} p) [t, \chi] h^{\mu} h^{\mu} + 4 a_0 h_{\beta \chi} \partial^{\chi} \Gamma^{\alpha}_{\alpha} p) [t, \chi] h^{\mu} h^$. ,	•																				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		Γ ₃ -1 †	αβχ	$-\frac{a_0}{2}$																5					Mul
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$				2													\mathcal{T}_{0}^{7}	#2) ⁺ ==	0						1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		$^{#1}_{3}^{}$	$\frac{a}{a}$ 0														$\Delta_0^{\#}$	+ + 2	$2 \Delta_{0}^{#4}$	+ 3 <u>/</u>	\(\frac{#2}{0^+} ==	0			1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			× ₈														$\overline{\mathcal{T}}$	#1α 1 =	= 0						3
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	dt		-̄1 +α/														2	Δ ₁ -6α	+ Δ ₁ [#]	±4α +	2 Δ ₁	5α+	$\Delta_1^{\#3\alpha}$	== 0	3
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	y a ス	_	Δ3						_								To	tal c	onsti	raint	5:				8
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	IZ G	$\Delta_{0^{\text{-}}}^{\#1}$	0	0	0	0	0	0	$-\frac{2}{a_0}$	$\frac{2}{\alpha\beta\chi}$	0	0	0	0	0	4 6	×								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$, 2](0	0	0	0	0	0	0							1 5	#2 2 ⁻ αβ	0	0	0	0	0	4		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	χ 2						⁴ / _{κ2}			$_{2}^{\#1}$	0	0	0	0	4 a 0	0								$\Gamma_{0}^{\#1}$	
$3a_0 \partial_{\chi} h_{\alpha\beta} \partial^{\chi} h^{, \omega_{\gamma}} + 4a_0 h_{\beta\chi} \partial^{\chi} h^{\alpha\beta} + A_0^{\alpha+1} + A_0^{\alpha} h_{\beta\chi} \partial^{\chi} h^{\alpha\beta} + A_0^{\alpha+1} + A_0^{$))[<i>t</i> ,	7)				a ₀							la.			$\lceil r_2^* \rceil$	0	0	0	0	$\frac{a_0}{4}$	0	7#2 10+	0
$3a_0 \partial_{\chi} h_{\alpha\beta} \partial^{\chi} h^{\omega p} + 4a_0 h_{\beta\chi}^{3}$ $\Delta_{0}^{\#+} + \frac{\Delta_{0}^{\#+}}{a_0} \qquad \Delta_{0}^{\#+}$ $\Delta_{0}^{\#+} + \frac{\Delta_{0}^{\#+}}{a_0} \qquad 0$ $\Delta_{0}^{$	$\partial^{\chi} \Gamma^{\alpha}_{\alpha}^{\ \ \mu}$	$\Delta_{0}^{\#4}^{}$	0	1 2	1 \	$\frac{1}{2a_0}$	0	0	0	${\mathcal T}_2^{\#1}$	0	0	0	$-\frac{8}{a_0 k^2}$	0	0	g_{χ}	0	0	0	$\frac{a_0 k^2}{8}$	0	0		
$3a_0 \partial_x h_{\alpha\beta} \partial^x h^{\alpha\nu} + 4a$ $\Delta_0^{\#+} + \frac{-2}{a_0} \qquad 0$ $\Delta_0^{\#+} + \frac{-2}{a_0} $	το h _{βχ}	**************************************	0	- 2 - a ₀	3 4 a 0	$\frac{1}{\sqrt{2} a_0}$	0	0	0	$\Delta_2^{\#3}$	0	0	4 a ₀	0	0	0	$\chi \beta$	0	0	<u>a</u> 0 4	0	0	0	7 4+0	0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	+ 4 <i>a</i>	◁		14	- '	1					0	2 a0	0	0	0	0								۳+ # 0	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	nap.	#5 0,+	0	3 1 a 0	5 a ₀	$\frac{1}{\sqrt{2}}a_0$	0	0	0			i						0	$-\frac{a(}{2}$	0	0	0	0	<u>_</u>	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\alpha \beta \frac{\partial^{\lambda}}{\partial \beta}$			- '	14	- 2,				$^{*1}_{2}^{#1}$	4 o ^a	0	0	0	0	0	$_{2}^{#1}$	<u>a</u> 0 4	0	0	0	0	0	Γ#2 0+2	0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\partial_{\chi}h$	$\Delta_0^{\#1}$	$-\frac{2}{a_0}$	0	0	0	0	0	0	4	$\alpha\beta$	$\alpha\beta$	$\alpha\beta$	$\alpha\beta$	χg	Xg:	<u> </u>		βλ	κβ	κβ	×	<u>×</u>	+ 0 +1	<u>a</u> 0
	3 4	•		#2 +	#3 + C	#4 0++	# ₁ +	#2 5+	# ₁ +		**1 2++	#2 2++	#3 2+	[#] 1 + 2	$^{\sharp_1}$ †	±2 +α		*1 + _c	*5 + c	*3 + _c	*1 + _c	1 $^{+}$ $^{\alpha\prime}$	² †α <i>μ</i>	_	
			Ĭ	۲	۲	۲		<u> </u>	Ď		◁	◁	◁	٢	∇_2^*	Δ_2^*		Ľ'`	Ľ'`	Ľ'	μ [‡]	L ₂ #	15#		# (c

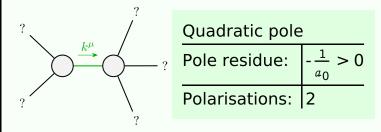
 $\Gamma_{3}^{\#1}_{\alpha\beta\chi}$

<i>a</i> 0	$\Gamma_{2}^{\#2} \alpha \beta \chi$	0	0	0	0	0	<u>a</u> 0 4								
,	$\alphaeta_X \; \Gamma^{\sharp}_2$							$\Gamma_{0}^{\#1}$	0	0	0	0	0	0	$-\frac{a_0}{2}$
	$\Gamma_{2}^{\#1}$	0	0	0	0	4	0	$h_0^{#2}$	0	0	0	0	0	0	0
)	$h_2^{\#1}$	0	0	0	$\frac{a_0 k^2}{8}$	0	0	$h_{0}^{\#1}$	0	0	0	0	$\frac{a_0 k^2}{4}$	0	0
	$\Gamma_{2}^{\#3}\alpha\beta$	0	0	<u>a</u> 0 4	- 0	0	0	Γ#4 0+	0	$-\frac{a_0}{2\sqrt{2}}$	$-\frac{a_0}{2\sqrt{2}}$	$\frac{a_0}{2}$	0	0	0
	$\Gamma_{2}^{\#2}_{+}$ Γ	0	- <u>a</u> 0	0	0	0	0	r#3	0	$\frac{a_0}{2}$	0	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
>	$\Gamma_2^{\#1}_{+}$ Γ	4 4	0	0	0	0	0	r #2	0	0	$\frac{a_0}{2}$	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
	L	$+\alpha\beta$	$+\alpha\beta$	$+^{\alpha\beta}$	αβ	ιβχ	$+^{\alpha \beta \chi}$	$\Gamma_{0}^{\#1}$	$-\frac{a_0}{2}$	0	0	0	0	0	0
- 7 1		$\Gamma_{2}^{#1}$ †	Γ*2 +	Γ ₂ ^{#3} †	$h_2^{#1} + \alpha \beta$	$\Gamma_{2}^{#1} + \alpha \beta \chi$	$\Gamma_{2}^{#2} + ^{a}$	•	$\Gamma_0^{\#1}$ †	Γ#2 †	Γ ₀ + +	Γ#4 0+	$h_{0}^{#1}$ †	$h_0^{#2} +$	$\Gamma_{0}^{#1}$ †

Source constraints/gauge generators

Multiplicities

Massive and massless spectra



(No massive particles)

Unitarity conditions