## Particle spectrograph

Wave operator and propagator

<u> </u>	$\Delta_{1}^{\#1}{}_{lphaeta}$	$\Delta_{1}^{\#2}{}_{\alpha\beta}$	$\Delta_{1}^{\#3}{}_{lphaeta}$	$\Delta_{1}^{\#1}{}_{lpha}$	$\Delta_{1-lpha}^{\#2}$	$\Delta_{1^{-}\alpha}^{\#3}$	$\Delta_{1}^{\#4}{}_{lpha}$	$\Delta_{1-lpha}^{\#5}$	$\Delta_{1^{-} \ lpha}^{\#6}$	${\mathcal T}_{1^-lpha}^{\sharp 1}$
$\Delta_1^{\#1} \dagger^{lphaeta}$	0	$-\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_{1}^{#2} \dagger^{\alpha\beta}$	$-\frac{2\sqrt{2}}{a_0}$	$\frac{2(a_0^2 - 14a_0a_1k^2 - 35a_1^2k^4)}{a_0^2(a_0 - 29a_1k^2)}$	$\frac{40\sqrt{2} a_1 k^2}{a_0^2 - 29 a_0 a_1 k^2}$	0	0	0	0	0	0	0
$\Delta_{1}^{#3} \dagger^{\alpha\beta}$	0	$\frac{40\sqrt{2}a_1k^2}{a_0^2 - 29a_0a_1k^2}$	$\frac{4}{a_0-29a_1k^2}$	0	0	0	0	0	0	0
$\Delta_1^{#1} \dagger^{lpha}$	0	0	0	0	$\frac{\sqrt{2} (4+k^2)}{a_0 (2+k^2)}$	$-\frac{2 k^2}{\sqrt{3} a_0 (2+k^2)}$	0	$\frac{\sqrt{\frac{2}{3}} k^2}{a_0 (2+k^2)}$	0	$-\frac{2i\sqrt{2}k}{a_0(2+k^2)}$
$\Delta_1^{\#2} \uparrow^{\alpha}$	0	0	0	$\frac{\sqrt{2} (4+k^2)}{a_0 (2+k^2)}$	$\frac{a_0^2 (4+k^2)^2 - 30 a_0 a_1 k^2 (4+k^2) (4+3 k^2) + a_1^2 k^4 (6416 + 7928 k^2 + 1901 k^4)}{2 a_0^2 (2+k^2)^2 (a_0 - 33 a_1 k^2)}$	$\frac{k^2 (a_0^2 (-2+k^2) + a_0 a_1 (560 + 302 k^2 + 71 k^4) - 2 a_1^2 k^2 (9440 + 1901 k^2 (4+k^2)))}{2 \sqrt{6} a_0^2 (2+k^2)^2 (a_0 - 33 a_1 k^2)}$	$-\frac{\sqrt{\frac{5}{6}} k^2 (a_0 + a_1 (40 - 31 k^2))}{2 a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$\frac{k^2 (2 a_0^2 (5 + 2 k^2) - a_0 a_1 (880 + 778 k^2 + 199 k^4) + a_1^2 k^2 (9440 + 1901 k^2 (4 + k^2)))}{2 \sqrt{3} a_0^2 (2 + k^2)^2 (a_0 - 33 a_1 k^2)}$	$\frac{k^2 \left(-a_0 + a_1 \left(200 + 43  k^2\right)\right)}{\sqrt{6}  a_0 \left(2 + k^2\right) \left(a_0 - 33  a_1  k^2\right)}$	$-\frac{i k (-30 a_0 a_1 k^4 + a_0^2 (4 + k^2) + 27 a_1^2 k^4 (-28 + 3 k^2))}{a_0^2 (2 + k^2)^2 (a_0 - 33 a_1 k^2)}$
$\Delta_{1}^{#3} \dagger^{\alpha}$	0	0	0	$-\frac{2 k^2}{\sqrt{3} (2 a_0 + a_0 k^2)}$	$\frac{k^2 (a_0^2 (-2+k^2) + a_0 a_1 (560 + 302 k^2 + 71 k^4) - 2 a_1^2 k^2 (9440 + 1901 k^2 (4+k^2)))}{2 \sqrt{6} a_0^2 (2+k^2)^2 (a_0-33 a_1 k^2)}$	$\frac{-a_0^2 (76+52 k^2+3 k^4)+4 a_0 a_1 k^2 (472+214 k^2+19 k^4)+4 a_1^2 k^4 (5120+7280 k^2+1901 k^4)}{12 a_0^2 (2+k^2)^2 (a_0-33 a_1 k^2)}$	$\frac{\sqrt{5} (10 a_0 + (3 a_0 - 328 a_1) k^2 - 62 a_1 k^4)}{12 a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$\frac{2{a_0}^2(-2+k^2) + a_0a_1k^2(472 + 934k^2 + 289k^4) - 2a_1^2k^4(5120 + 7280k^2 + 1901k^4)}{6\sqrt{2}{a_0}^2(2+k^2)^2(a_0 - 33a_1k^2)}$	$-\frac{2 a_0 + (3 a_0 - 56 a_1) k^2 + 86 a_1 k^4}{6 a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$\frac{i k (54 a_1^2 k^4 (40 + 3 k^2) + a_0^2 (6 + 5 k^2) - 3 a_0 a_1 k^2 (86 + 23 k^2))}{\sqrt{6} a_0^2 (2 + k^2)^2 (a_0 - 33 a_1 k^2)}$
$\Delta_{1}^{\#4} \uparrow^{\alpha}$	0	0	0	0	$-\frac{\sqrt{\frac{5}{6}} k^2 (a_0+a_1 (40-31 k^2))}{2 a_0 (2+k^2) (a_0-33 a_1 k^2)}$	$\frac{\sqrt{5} (10 a_0 + k^2 (3 a_0 - 2 a_1 (164 + 31 k^2)))}{12 a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$\frac{1}{12 a_0 - 396 a_1 k^2}$	$\frac{\sqrt{\frac{5}{2}} \left(-2 a_0 + a_1 k^2 \left(164 + 31 k^2\right)\right)}{6 a_0 \left(2 + k^2\right) \left(a_0 - 33 a_1 k^2\right)}$	$-\frac{\sqrt{5}}{6(a_0-33a_1k^2)}$	$-\frac{i\sqrt{\frac{5}{6}}k(a_0-51a_1k^2)}{a_0(2+k^2)(a_0-33a_1k^2)}$
$\Delta_1^{\#5} \uparrow^{lpha}$	0	0	0	$\frac{\sqrt{\frac{2}{3}} k^2}{2 a_0 + a_0 k^2}$	$\frac{k^2 \left(2  a_0^2  (5 + 2  k^2) - a_0  a_1  (880 + 778  k^2 + 199  k^4) + a_1^2  k^2  (9440 + 1901  k^2  (4 + k^2))\right)}{2  \sqrt{3}  a_0^2  (2 + k^2)^2  (a_0 - 33  a_1  k^2)}$	$\frac{2 a_0^2 (-2+k^2) + a_0 a_1 k^2 (472 + 934 k^2 + 289 k^4) - 2 a_1^2 k^4 (5120 + 7280 k^2 + 1901 k^4)}{6 \sqrt{2} a_0^2 (2+k^2)^2 (a_0 - 33 a_1 k^2)}$	$\frac{\sqrt{\frac{5}{2}} \left(-2 a_0 + a_1 k^2 \left(164 + 31 k^2\right)\right)}{6 a_0 \left(2 + k^2\right) \left(a_0 - 33 a_1 k^2\right)}$	$\frac{4 a_0^2 (17 + 14 k^2 + 3 k^4) - 4 a_0 a_1 k^2 (236 + 287 k^2 + 77 k^4) + a_1^2 k^4 (5120 + 7280 k^2 + 1901 k^4)}{6 a_0^2 (2 + k^2)^2 (a_0 - 33 a_1 k^2)}$	$\frac{1}{3\sqrt{2}} - \frac{a_1 k^2 (28-43 k^2) + 2 a_0 (7+3 k^2)}{3\sqrt{2} a_0 (2+k^2) (a_0-33 a_1 k^2)}$	$\frac{i k (2 a_0^2 (3+k^2)-27 a_1^2 k^4 (40+3 k^2)+3 a_0 a_1 k^2 (34+7 k^2))}{\sqrt{3} a_0^2 (2+k^2)^2 (a_0-33 a_1 k^2)}$
$\Delta_1^{\#6}$ † $^{lpha}$	0	0	0	0	$\frac{k^2 (-a_0 + a_1 (200 + 43 k^2))}{\sqrt{6} a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$-\frac{2 a_0 + (3 a_0 - 56 a_1) k^2 + 86 a_1 k^4}{6 a_0 (2 + k^2) (a_0 - 33 a_1 k^2)}$	$-\frac{\sqrt{5}}{6(a_0-33a_1k^2)}$	$-\frac{a_1 k^2 (28-43 k^2)+2 a_0 (7+3 k^2)}{3 \sqrt{2} a_0 (2+k^2) (a_0-33 a_1 k^2)}$	$\frac{5}{3(a_0-33a_1k^2)}$	$-\frac{i\sqrt{\frac{2}{3}}k(a_0+57a_1k^2)}{a_0(2+k^2)(a_0-33a_1k^2)}$
${\mathcal T}_1^{\sharp 1}  {\dagger}^{lpha}$	0	0	0	$\frac{2i\sqrt{2}k}{2a_0+a_0k^2}$	$\frac{i(-30a_0a_1k^5 + a_0^2k(4+k^2) + 27a_1^2k^5(-28+3k^2))}{a_0^2(2+k^2)^2(a_0-33a_1k^2)}$	$-\frac{i\left(54a_{1}^{2}k^{5}(40+3k^{2})+a_{0}^{2}k(6+5k^{2})-3a_{0}a_{1}k^{3}(86+23k^{2})\right)}{\sqrt{6}a_{0}^{2}(2+k^{2})^{2}(a_{0}-33a_{1}k^{2})}$	$\frac{i\sqrt{\frac{5}{6}} k(a_0-51a_1k^2)}{a_0(2+k^2)(a_0-33a_1k^2)}$	$-\frac{i\left(2{a_{0}}^{2}k(3+k^{2})\text{-}27{a_{1}}^{2}k^{5}(40+3k^{2})+3a_{0}a_{1}k^{3}(34+7k^{2})\right)}{\sqrt{3}{a_{0}}^{2}(2+k^{2})^{2}(a_{0}\text{-}33a_{1}k^{2})}$	$\frac{i\sqrt{\frac{2}{3}}k(a_0+57a_1k^2)}{a_0(2+k^2)(a_0-33a_1k^2)}$	$\frac{2k^2(a_0^2+30a_0a_1k^2-459a_1^2k^4)}{a_0^2(2+k^2)^2(a_0-33a_1k^2)}$

uadratic (free) action	-#1 .αR	$\Gamma_{1}^{\#1}{}_{\alpha\beta}$	$\Gamma_{1}^{\#2}\alpha\beta$		Γ <sub>1</sub> -1 <sub>α</sub>	Γ <sub>1</sub> -α	Γ <sub>1</sub> -3 <sub>α</sub>	Γ <sub>1</sub> -4	<u>α</u>	Γ <sub>1</sub> -α		Γ <sub>1</sub> -α	$h_{1}^{\#1}\alpha$
$= \iiint (\frac{1}{4} (2 a_0 \Gamma_{\alpha}^{\alpha\beta} \Gamma_{\beta\chi}^{\chi} + 4 h^{\alpha\beta} \mathcal{T}_{\alpha\beta} + \Gamma^{\alpha\beta\chi} (-2 a_0 \Gamma_{\beta\chi\alpha} + 4 \Delta_{\alpha\beta\chi}) -$		$\frac{1}{4} (-a_0 - 15 a_1 k^2)$			0	0	0	0		0		0	0
$a_0 h_{\chi}^{\chi} \partial_{\beta} \Gamma_{\alpha}^{\alpha\beta} + a_0 h_{\chi}^{\chi} \partial_{\beta} \Gamma_{\alpha}^{\alpha\beta} - 2 a_0 h_{\alpha\chi} \partial_{\beta} \Gamma^{\alpha\beta\chi} +$	$\Gamma_{1+}^{\#2} + \alpha \beta$	•	0	0	0	0	0	0		0		0	0
$22a_1\partial^\alpha\Gamma^{\chi\delta}_{\delta}\partial_\beta\Gamma_{\chi\alpha}^{\beta} + 2a_1\partial^\alpha\Gamma_{\chi\alpha}^{\beta}\partial_\beta\Gamma^{\chi\delta}_{\delta} -$	$\Gamma_{1}^{#3} \dagger^{\alpha\beta}$	$5 a_1 k^2$	0	$\frac{1}{4}(a_0-29a_1k^2)$		0	0	0		0		0	0
$76 a_1 \partial^{\alpha} \Gamma^{\chi \delta}_{\chi} \partial_{\beta} \Gamma_{\delta \alpha}^{\beta} + 2 a_0 h_{\beta \chi} \partial^{\chi} \Gamma^{\alpha}_{\alpha}^{\beta} -$	$\Gamma_1^{#1} \uparrow^{\alpha}$	0	0	0	$\frac{1}{4} \left( -a_0 - 3 a_1 k^2 \right)$	$\frac{a_0}{2\sqrt{2}}$	$\frac{5}{2} \sqrt{3} a_1 k^2$	$-\frac{5}{2}\sqrt{\frac{5}{3}}$	$a_1 k^2$	$5\sqrt{\frac{3}{2}} a_1 k^2$	?	$-\frac{5a_1k^2}{\sqrt{3}}$	$-\frac{i a_0 k}{4 \sqrt{2}}$
$2 a_1 \partial_{\beta} \Gamma_{\chi \delta}^{\delta} \partial^{\chi} \Gamma_{\alpha}^{\alpha \beta} - 2 a_1 \partial_{\beta} \Gamma_{\delta \chi}^{\delta} \partial^{\chi} \Gamma_{\alpha}^{\alpha \beta} +$	$\Gamma_{1}^{#2} \uparrow^{\alpha}$	0	0	0	$\frac{a_0}{2\sqrt{2}}$	0	0	0		0		0	0
$2a_1\partial_\chi \Gamma_{\beta}^{\delta}\partial^\chi \Gamma^{\alpha}_{\alpha}{}^{\beta} - 2a_1\partial_\chi \Gamma^{\delta}_{\beta\delta}\partial^\chi \Gamma^{\alpha}_{\alpha}{}^{\beta} -$	Γ <sub>1</sub> -3 † <sup>α</sup>	0	0	0	$\frac{5}{2} \sqrt{3} a_1 k^2$	0	$-\frac{a_0}{3}$	$\frac{1}{6}\sqrt{5}(a_0-$	$8a_1k^2$ )	$-\frac{a_0}{6\sqrt{2}}$	$\frac{1}{6}$ (-a	$_0 + 20 a_1 k^2$	$\frac{i a_0 k}{4 \sqrt{6}}$
$2 a_1 \partial_{\chi} \Gamma^{\delta}_{\delta\beta} \partial^{\chi} \Gamma^{\alpha}_{\beta} - 22 a_1 \partial_{\beta} \Gamma^{\delta}_{\delta} \partial^{\chi} \Gamma^{\alpha\beta}_{\alpha} +$	$\Gamma_{1}^{#4} \uparrow^{\alpha}$		0	0	$-\frac{5}{2}\sqrt{\frac{5}{3}}a_1k^2$	$0 \frac{1}{6}$	$\sqrt{5} (a_0 - 8 a_1 k^2)$	$\frac{1}{2}(a_0+7)$	$(a_1 k^2)$ $-\frac{1}{2}$		$(a_1 k^2) - \frac{1}{2} \sqrt{5}$	$(a_0 - 5 a_1 k^2)$	
$38 a_1 \partial_{\beta} \Gamma^{\delta}_{\chi \delta} \partial^{\chi} \Gamma^{\alpha \beta}_{\alpha} + 22 a_1 \partial_{\chi} \Gamma^{\delta}_{\beta \delta} \partial^{\chi} \Gamma^{\alpha \beta}_{\alpha} -$				Ŭ	'	6		3					
$2 a_1 \partial_{\chi} \Gamma^{\delta}_{\beta\delta} \partial^{\chi} \Gamma^{\alpha\beta}_{\alpha} + 4 a_1 \partial_{\alpha} \Gamma^{\delta}_{\chi\delta} \partial^{\chi} \Gamma^{\alpha\beta}_{\beta} -$	Γ <sub>1</sub> -5 † <sup>α</sup>	0	0	0	$5\sqrt{\frac{3}{2}}a_1k^2$	0	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{1}{6}\sqrt{\frac{5}{2}}(a_0+$	$-16 a_1 k^2)$	<u>a<sub>0</sub></u> 3	<u>a</u>	$\frac{0+40 a_1 k^2}{6 \sqrt{2}}$	$\frac{i a_0 k}{4 \sqrt{3}}$
$4 a_1 \partial_{\chi} \Gamma_{\alpha \delta}^{\delta} \partial^{\chi} \Gamma_{\beta}^{\alpha\beta} - 2 a_1 \partial_{\chi} \Gamma_{\alpha\beta}^{\alpha\beta\chi} \partial_{\delta} \Gamma_{\alpha\beta}^{\delta} -$	Γ <sub>1</sub> -6 † α	0	0	0	$-\frac{5 a_1 k^2}{\sqrt{3}}$	$0 \frac{1}{6}$	$(-a_0 + 20 a_1 k^2)$	$-\frac{1}{6}\sqrt{5}(a_0)$	$-5a_1k^2$	$\frac{a_0 + 40 a_1 k^2}{6 \sqrt{2}}$	$\frac{5}{12}$ (a	$a_0 - 17 a_1 k^2$	$\frac{i a_0 k}{4 \sqrt{6}}$
$2 a_1 \partial_{\beta} \Gamma^{\alpha\beta\chi} \partial_{\delta} \Gamma_{\alpha\chi}^{ \delta} - 2 a_1 \partial_{\beta} \Gamma^{\alpha\beta\chi} \partial_{\delta} \Gamma_{\alpha\chi}^{ \delta} +$	$h_1^{\#1} + ^{\alpha}$	0	0	0	$\frac{i a_0 k}{4 \sqrt{2}}$	0	$-\frac{i a_0 k}{4 \sqrt{6}}$	$\frac{1}{4} \bar{I} \sqrt{\frac{5}{6}}$	$a_0 k$	$-\frac{i a_0 k}{4 \sqrt{3}}$		$-\frac{i a_0 k}{4 \sqrt{6}}$	0
$38 a_1 \partial_{\chi} \Gamma^{\alpha\beta\chi} \partial_{\delta} \Gamma_{\beta\alpha}^{ \delta} + 4 a_1 \partial^{\chi} \Gamma^{\alpha}_{ \alpha}^{ \beta} \partial_{\delta} \Gamma_{\beta  \chi}^{ \delta} -$	-				4 γ2		4 γο	4 <b>V</b> 6		4 γ3		4 γ6	
$22 a_1 \partial^{\chi} \Gamma^{\alpha\beta}_{\beta} \partial_{\delta} \Gamma_{\chi\alpha}^{\delta} + 2 a_1 \partial^{\chi} \Gamma^{\alpha\beta}_{\alpha} \partial_{\delta} \Gamma_{\chi\beta}^{\delta} -$	_	$\Delta_0^{\#1}$		Δ <sub>0</sub> <sup>#2</sup>	$\Delta_{0}^{#3}$		$\Delta_0^{\#_4}$	4 +	${\cal T}_0^{\#1}$	_	$\mathcal{T}_{0}^{#2}$	$\Delta_0^{\#1}$	
$2 a_1 \partial_{\beta} \Gamma^{\alpha\beta\chi} \partial_{\delta} \Gamma_{\chi \alpha}^{\delta} - 2 a_1 \partial^{\chi} \Gamma^{\alpha\beta}_{\beta} \partial_{\delta} \Gamma_{\chi \alpha}^{\delta} +$	$\Delta_0^{#1}$ †	0	_ - 1	$\frac{4\sqrt{6}}{16a_0+3a_0k^2}$	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0}$	- 	$-\frac{8}{\sqrt{3} (16 a_0)}$	$+3a_0k^2$	$-\frac{2i\sqrt{2}}{a_0k}$		$\frac{2i\sqrt{6}k}{5a_0+3a_0k^2}$	0	$\Delta_{2}^{\#1}$
$2 a_1 \partial^{\chi} \Gamma_{\beta \alpha}^{\ \beta} \partial_{\delta} \Gamma_{\chi}^{\ \delta \alpha} + 4 a_1 \partial^{\chi} \Gamma_{\alpha}^{\alpha \beta} \partial_{\delta} \Gamma_{\chi \beta}^{\ \delta} -$	A #2 .	<u>4 √6</u>		$(3a_0+197a_1k^2)$	$   \begin{array}{c c}     & 16 a_0 + 3 a_0 \\     & 16 (19 a_0 + (3 a_0 + 3 a_0 +$				$8i\sqrt{3}(a_0-65a_1k^2)$		$\frac{3a_0+3a_0k}{3a_0+197a_1k^2}$		
$2 a_1 \partial_{\beta} \Gamma^{\alpha}_{\alpha}{}^{\beta} \partial_{\delta} \Gamma^{\chi}_{\chi}{}^{\delta} + 4 a_1 \partial_{\beta} \Gamma^{\alpha}_{\alpha}{}^{\beta} \partial_{\delta} \Gamma^{\chi\delta}_{\chi} -$	Δ <sub>0</sub> <sup>#2</sup> †	$16a_0 + 3a_0 k^2$	- a	$u_0^2 (16+3k^2)^2$	$a_0^2 (16+3)$	$k^2$ ) <sup>2</sup>	$a_0^2$ (16+	$-3k^2)^2$	$a_0^2 k (16+3k^2)$	$a_0^2$	$(16+3k^2)^2$	0	$\Delta_2^{\#2}$
$2 a_1 \partial_{\beta} \Gamma^{\alpha\beta}_{ \alpha} \partial_{\delta} \Gamma^{\chi\delta}_{ \chi} + 2 a_1 \partial_{\alpha} \Gamma_{\beta\chi\delta} \partial^{\delta} \Gamma^{\alpha\beta\chi} + 4 a_1 \partial_{\alpha} \Gamma_{\beta\delta\chi} \partial^{\delta} \Gamma^{\alpha\beta\chi} + 4 a_1 \partial_{\alpha} \Gamma_{\chi\beta\delta} \partial^{\delta} \Gamma^{\alpha\beta\chi} +$	Δ <sub>0</sub> <sup>#3</sup> †	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0k^2}$	16 (19 a <sub>0</sub>	$\frac{0 + (3a_0 + 197a_1)k^2)}{0^2 (16 + 3k^2)^2}$	$-16(35a_0+(6a_0+6a_0+6a_0+6a_0+6a_0+6a_0+6a_0+6a_0+$	$+197a_1)k^2$ $3k^2)^2$	$-\frac{8\sqrt{2}(22a_0+(3a_0)^2)}{3a_0^2(16)}$		$\frac{8i(a_0-65a_1k^2)}{\sqrt{3}a_0^2k(16+3k^2)}$	$-\frac{8ik(19a_0)}{a_0}$	$a_0 + (3a_0 + 197a_1)$ $a_0 + (3a_0 + 197a_1)$	0	$\Delta_2^{\#3}$
$2 a_1 \partial_{\alpha} \Gamma_{\chi \delta \beta} \partial^{\delta} \Gamma^{\alpha \beta \chi} + 4 a_1 \partial_{\alpha} \Gamma_{\chi \beta \delta} \partial^{\delta} \Gamma^{\alpha \beta \chi} +$	A #4 .	8		0 a <sub>0</sub> + (3 a <sub>0</sub> -394 a <sub>1</sub> ) k <sup>2</sup> )					$8i\sqrt{\frac{2}{3}}(a_0-65a_1k^2)$			(k <sup>2</sup> )	2
$4 a_1 \partial_{\alpha} \Gamma_{\delta \chi \beta} \partial^{\delta} \Gamma^{\alpha \beta \chi} - 2 a_1 \partial_{\beta} \Gamma_{\alpha \chi \delta} \partial^{\delta} \Gamma^{\alpha \beta \chi} -$	$\Delta_{0}^{#4} + \frac{1}{2}$	$\sqrt{3} (16 a_0 + 3 a_0 k^2)$		$u_0^2 (16+3k^2)^2$	$3a_0^2$ (16+		$3a_0^2$ (16+	$+3k^2)^2$	$\frac{\sqrt{3}}{a_0^2 k (16+3 k^2)}$	$ a_0^2$	$(16+3k^2)^2$	0	${\mathcal T}_2^{\#_2}$
$2 a_1 \partial_{\beta} \Gamma_{\alpha\delta\chi} \partial^{\delta} \Gamma^{\alpha\beta\chi} - 2 a_1 \partial_{\beta} \Gamma_{\chi\delta\alpha} \partial^{\delta} \Gamma^{\alpha\beta\chi} -$	${\cal T}_{0}^{\#1}\dagger$	2 i √2 a <sub>0</sub> k	811	$\sqrt{3} (a_0 - 65 a_1 k^2)$ $0^2 k (16 + 3 k^2)$	$-\frac{8i(a_0-65a_0)^2}{\sqrt{3}a_0^2k(1)}$	$\frac{1}{6} \frac{k^2}{12k^2}$	$-\frac{8i\sqrt{\frac{2}{3}}}{2}(a_0$		$\frac{4(a_0-25a_1k^2)}{a_0^2k^2}$	$\frac{4\sqrt{3}}{3}$	$\frac{(a_0-65 a_1 k^2)}{(16+3 k^2)}$	0	$\Delta_2^{\#1}$
$2 a_1 \partial_{\chi} \Gamma_{\alpha\beta\delta} \partial^{\delta} \Gamma^{\alpha\beta\chi} - 2 a_1 \partial_{\chi} \Gamma_{\beta\alpha\delta} \partial^{\delta} \Gamma^{\alpha\beta\chi} +$		2 i √6 k		$\frac{k(3a_0+197a_1k^2)}{(3a_0+197a_1k^2)}$	$8ik(19a_0+(3a_0-6)a_0+(3a_0-$	_	$a_0^2 k (16)$ $4 i \sqrt{2} k (10 a_0 + 6)$		$\frac{a_0  k}{4 \sqrt{3} (a_0-65 a_1 k^2)}$		$(3a_0 + 197a_1k^2)$		$\Delta_2^{\#2}$
$4a_1\partial_\chi \Gamma_{\beta\delta\alpha}\partial^\delta \Gamma^{\alpha\beta\chi} - 4a_1\partial_\delta \Gamma_{\alpha\beta\chi}\partial^\delta \Gamma^{\alpha\beta\chi} - 4a_1\partial_\delta \Gamma_{\alpha\chi\beta}$	T <sub>0</sub> <sup>#2</sup> †	$16a_0 + 3a_0 k^2$	<b>-</b> — а	$a_0^2 (16+3k^2)^2$	$a_0^2 (16+3)$	$k^2$ ) <sup>2</sup>	$a_0^2$ (16+		$a_0^2 (16+3k^2)$	- <u>a</u> 0	$(16+3k^2)^2$	0	<b>-</b> 2
$\partial^{\delta} \Gamma^{\alpha\beta\chi} - 2 a_1 \partial_{\delta} \Gamma_{\beta\alpha\chi} \partial^{\delta} \Gamma^{\alpha\beta\chi} - 2 a_1 \partial_{\delta} \Gamma_{\beta\chi\alpha} \partial^{\delta} \Gamma^{\alpha\beta\chi} -$	$\Delta_0^{\#1}$ †	0		0	0		0		0		0	$-\frac{2}{a_0-a_1k^2}$	
$2 a_1 \partial_{\delta} \Gamma_{\chi \beta \alpha} \partial^{\delta} \Gamma^{\alpha \beta \chi} + 2 a_1 \partial_{\beta} \Gamma_{\delta \alpha}^{\beta} \partial^{\delta} \Gamma^{\chi \alpha}_{\chi} +$		$\Gamma_{3}^{\#1}{}_{lphaeta\chi}$							Γ <sub>0</sub> <sup>#1</sup>	Γ <sub>0</sub> <sup>#2</sup>	Γ#3	Γ#4 0+	$h_0^{\#}$
$2a_1\partial_{\beta}\Gamma_{\delta\alpha}^{ \beta}\partial^{\delta}\Gamma_{\chi}^{\chi\alpha}))[t,x,y,z]dzdydxdt$	$\Gamma_{3}^{\#1} + \alpha\beta\chi \frac{1}{2}$	$(-a_0 - 7 a_1 k^2)$						Γ#1	$+\frac{1}{2}(-a_0+25a)$		$10 \sqrt{\frac{2}{3}} a_1 k$	-	
_#1 _#9 _#9 .#1 #3	_#2	Source cor	nstrainte						2		$\frac{a_0}{}$		
$\Gamma^{\#1}_{2^+  lphaeta} \qquad \Gamma^{\#2}_{2^+  lphaeta} \qquad \Gamma^{\#3}_{2^+  lphaeta} \qquad h^{\#1}_{2^+  lphaeta} \qquad \Gamma^{\#1}_{2^-  lphaeta\chi}$	$\Gamma_{2}^{\#2}_{\alpha\beta\chi}$	SO(3) irrep			ndamental fiel	de	Multiplicit	Γ <sub>0</sub> <sup>#2</sup>	† 0	0	2	$-\frac{a_0}{2\sqrt{2}}$	

<sup>5</sup> † <sup>α</sup>	0	0 0	$-\frac{5a_1k^2}{\sqrt{3}}$ 0 $\frac{1}{6}$ (-	$a_0 + 20 a_1 k^2$ $-\frac{1}{6} \sqrt{5} (a_0)$	$-5a_1k^2$	$\frac{a_0 + 40 a_1 k^2}{6 \sqrt{2}}$	$\frac{5}{12}$ $(a_0 - 17 a_1 k^2)$	$\frac{i a_0 k}{4 \sqrt{6}}$					
<sup>L</sup> † <sup>α</sup>	0	0 0	$\frac{i a_0 k}{4 \sqrt{2}} \qquad \qquad 0$	$-\frac{i a_0 k}{4 \sqrt{6}} \qquad \qquad \frac{1}{4} \bar{l} \sqrt{\frac{5}{6}}$	a <sub>0</sub> k	$-\frac{i a_0 k}{4 \sqrt{3}}$	$-\frac{ia_0k}{4\sqrt{6}}$	0					
	$\Delta_0^{\#1}$	Δ <sub>0</sub> <sup>#2</sup> +	Δ#3 0+	Δ <sub>0</sub> #4	${\mathcal T}_0^{\sharp 1}$	${\cal T}_{0}^{\#2}$	$\Delta_0^{\#.1}$		$\Delta_{2}^{\#1}{}_{lphaeta}$	$\Delta_{2}^{\#2}_{+ \ lphaeta}$	$\Delta^{\#3}_{2}^{+}{}_{lphaeta}$	${\cal T}^{\#1}_{2^+lphaeta}$	$\Delta_{2}^{\#1}{}_{\alpha\beta\chi}$
†	0	$\frac{4\sqrt{6}}{16a_0 + 3a_0 k^2}$	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0k^2}$	$-\frac{8}{\sqrt{3} (16 a_0 + 3 a_0 k^2)}$	$-\frac{2i\sqrt{2}}{a_0k}$	$-\frac{2i\sqrt{6}k}{16a_0+3a_0k^2}$	0	$\Delta_{2}^{\#1} \uparrow^{\alpha\beta}$	0	$\frac{2\sqrt{\frac{2}{3}}}{a_0}$	$\frac{4}{\sqrt{3} a_0}$	$\frac{4i\sqrt{2}}{a_0k}$	0
†	$\frac{4\sqrt{6}}{16a_0 + 3a_0 k^2}$	$-\frac{48 (3 a_0 + 197 a_1 k^2)}{{a_0}^2 (16 + 3 k^2)^2}$	$\frac{16(19a_0 + (3a_0 + 197a_1)k^2)}{a_0^2(16 + 3k^2)^2}$	$-\frac{8\sqrt{2}(10a_0+(3a_0-394a_1)k^2)}{a_0^2(16+3k^2)^2}$	$-\frac{8i\sqrt{3}(a_0-65a_1k^2)}{a_0^2k(16+3k^2)}$	$\frac{24ik(3a_0+197a_0)}{a_0^2(16+3k^2)}$	0  0	$\Delta_{2}^{\#2} \dagger^{\alpha\beta}$	$\frac{2\sqrt{\frac{2}{3}}}{a_0}$	$-\frac{8(a_0+13a_1k^2)}{3a_0^2}$	$-\frac{2\sqrt{2}(a_0+52a_1k^2)}{3a_0^2}$	$-\frac{4i(a_0+31a_1k^2)}{\sqrt{3}a_0^2k}$	0
†	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0k^2}$	$\frac{16(19a_0 + (3a_0 + 197a_1)k^2)}{a_0^2(16 + 3k^2)^2}$	$-\frac{16(35a_0+(6a_0+197a_1)k^2)}{3a_0^2(16+3k^2)^2}$	$-\frac{8\sqrt{2}(22a_0+(3a_0+394a_1)k^2)}{3a_0^2(16+3k^2)^2}$	$\frac{8i(a_0-65a_1k^2)}{\sqrt{3}a_0^2k(16+3k^2)}$	$-8ik(19a_0+(3a_0+19a$	$07a_1)k^2$ 0	$\Delta_{2}^{#3}$ † $^{\alpha\beta}$	$\frac{4}{\sqrt{3} a_0}$	$-\frac{2\sqrt{2}(a_0+52a_1k^2)}{3a_0^2}$	$\frac{8(a_0-26a_1k^2)}{3a_0^2}$	$-\frac{4i\sqrt{\frac{2}{3}}(a_0+31a_1k^2)}{a_0^2k}$	0
+ -	$\frac{8}{\sqrt{3} (16 a_0 + 3 a_0 k^2)}$	$-\frac{8\sqrt{2}(10a_0+(3a_0-394a_1)k^2)}{a_0^2(16+3k^2)^2}$	$-\frac{8\sqrt{2}(22a_0+(3a_0+394a_1)k^2)}{3a_0^2(16+3k^2)^2}$	$\frac{32 (13 a_0 + (3 a_0 - 197 a_1) k^2)}{3 a_0^2 (16 + 3 k^2)^2}$	$\frac{8i\sqrt{\frac{2}{3}}(a_0-65a_1k^2)}{a_0^2k(16+3k^2)}$	$\frac{4i\sqrt{2}k(10a_0+(3a_0-3a_0-3a_0-3a_0-3a_0-3a_0-3a_0-3a_0-$	$0 \frac{94 a_1) k^2}{2}$	${\mathcal T}_{2}^{\#1}\dagger^{lphaeta}$	$-\frac{4i\sqrt{2}}{a_0k}$	$\frac{4i(a_0+31a_1k^2)}{\sqrt{3}a_0^2k}$	$\frac{4i\sqrt{\frac{2}{3}}(a_0+31a_1k^2)}{a_0^2k}$	$-\frac{8(a_0+11a_1k^2)}{a_0^2k^2}$	0
†	2 i √2 a <sub>0 k</sub>	$\frac{8 i \sqrt{3} (a_0-65 a_1 k^2)}{a_0^2 k (16+3 k^2)}$	$-\frac{8i(a_0-65a_1k^2)}{\sqrt{3}a_0^2k(16+3k^2)}$	$-\frac{8i\sqrt{\frac{2}{3}}(a_0-65a_1k^2)}{a_0^2k(16+3k^2)}$	$\frac{4(a_0-25a_1k^2)}{{a_0}^2k^2}$	$\frac{4\sqrt{3}(a_0-65a_1)}{a_0^2(16+3k^2)}$		$\Delta_2^{#1} \dagger^{lphaeta_\lambda}$	0	0	0	0	$\frac{4}{a_0-a_1 k^2}$
†	$\frac{2i\sqrt{6}k}{16a_0+3a_0k^2}$	$-\frac{24 i k (3 a_0 + 197 a_1 k^2)}{a_0^2 (16 + 3 k^2)^2}$	$\frac{8ik(19a_0 + (3a_0 + 197a_1)k^2)}{a_0^2(16 + 3k^2)^2}$	$-\frac{4i\sqrt{2}k(10a_0+(3a_0-394a_1)k^2)}{a_0^2(16+3k^2)^2}$	$\frac{4\sqrt{3}(a_0-65a_1k^2)}{a_0^2(16+3k^2)}$	$-\frac{12 k^2 (3 a_0 + 197 a_0)^2 (16 + 3 k^2)}{a_0^2 (16 + 3 k^2)}$	$\frac{(2+k^2)}{(2-k^2)}$ 0	$\Delta_2^{\#2} \dagger^{\alpha\beta\chi}$	0	0	0	0	0
_	0	0	0	0	0	0	2				$\Delta_3^*$		

	$\Gamma^{\#1}_{2^+  \alpha \beta}$	$\Gamma^{\#2}_{2}{}^{+}{}_{lphaeta}$	Γ <sub>2</sub> + <sub>αβ</sub>	$h_{2}^{\#1}{}_{lphaeta}$	$\Gamma_{2}^{\#1}_{\alpha\beta\chi}$	$\Gamma_{2}^{\#2}_{\alpha\beta\chi}$
$\Gamma_{2}^{#1} \dagger^{\alpha\beta}$	$\frac{1}{4} (a_0 + 11 a_1 k^2)$	$-5\sqrt{\frac{2}{3}}a_1k^2$	$\frac{5 a_1 k^2}{\sqrt{3}}$	$\frac{i a_0 k}{4 \sqrt{2}}$	0	0
$\Gamma_{2+}^{#2} \dagger^{\alpha\beta}$	$-5\sqrt{\frac{2}{3}}a_1k^2$	$\frac{1}{6} \left( -3  a_0 + a_1  k^2 \right)$	$-\frac{a_1 k^2}{6 \sqrt{2}}$	$\frac{i a_0 k}{4 \sqrt{3}}$	0	0
$\Gamma_{2}^{#3} \dagger^{\alpha\beta}$	$\frac{5a_1k^2}{\sqrt{3}}$	$-\frac{a_1 k^2}{6 \sqrt{2}}$	$\frac{1}{12} \left( 3  a_0 + a_1  k^2 \right)$	$-\frac{i a_0 k}{4 \sqrt{6}}$	0	0
$h_{2}^{\#1} \dagger^{\alpha\beta}$	$-\frac{i a_0 k}{4 \sqrt{2}}$	$-\frac{i a_0 k}{4 \sqrt{3}}$	$\frac{i a_0 k}{4 \sqrt{6}}$	0	0	0
$\Gamma_2^{\#1} + \alpha\beta\chi$	0	0	0	0	$\frac{1}{4}(a_0-a_1k^2)$	0
$\Gamma_2^{\#2} + \alpha\beta\chi$	0	0	0	0	0	$\frac{1}{4}$ ( $a_0$ - 5 $a_1$ $k^2$

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicitie
$2\mathcal{T}_{0^{+}}^{\#2} - \bar{i} k \Delta_{0^{+}}^{\#2} == 0$	$2 \partial_{\beta} \partial_{\alpha} \mathcal{T}^{\alpha\beta} == \partial_{\chi} \partial_{\beta} \partial_{\alpha} \Delta^{\alpha\beta\chi}$	1
$\frac{\Delta_{0+}^{\#3} + 2\Delta_{0+}^{\#4} + 3\Delta_{0+}^{\#2} == 0}{\Delta_{0+}^{\#3} + 2\Delta_{0+}^{\#4} == 0}$	$\partial_{\alpha}\Delta^{\alpha\beta}_{\beta} == 0$	1
$\frac{1}{6  \mathcal{T}_{1}^{\#1}{}^{\alpha} - i  k  (3  \Delta_{1}^{\#2}{}^{\alpha} -$	$2\partial_{\chi}\partial_{\beta}\partial^{\alpha}\mathcal{T}^{\beta\chi} + \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\Delta^{\beta\alpha\chi} ==$	3
$\Delta_{1}^{\#5\alpha} + \Delta_{1}^{\#3\alpha}$ ) == 0	$2\partial_{\chi}\partial^{\chi}\partial_{\beta}\mathcal{T}^{\alpha\beta} + \partial_{\delta}\partial_{\chi}\partial_{\beta}\partial^{\alpha}\Delta^{\beta\chi\delta}$	
$2 \Delta_{1}^{\#6\alpha} + \Delta_{1}^{\#4\alpha} +$	$\partial_{\beta}\partial^{\alpha}\Delta^{\beta\chi}_{\chi} = \partial_{\chi}\partial^{\chi}\Delta^{\alpha\beta}_{\beta}$	3
$2 \Delta_{1}^{\#5\alpha} + \Delta_{1}^{\#3\alpha} == 0$		
Total constraints/gauge gener	rators:	8

_	1 0 <del>+</del>	0+	0+	0+	$n_0^{-1}$	$n_0^{-1}$	I #-1
	$\frac{1}{2} \left( -a_0 + 25  a_1  k^2 \right)$	0	$10\sqrt{\frac{2}{3}}a_1k^2$	$-\frac{10a_1k^2}{\sqrt{3}}$	$-\frac{i a_0 k}{2 \sqrt{2}}$	0	0
$\Gamma_{0}^{\#2}$ †	0	0	<u>a<sub>0</sub></u> 2	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
Γ <sub>0</sub> <sup>#3</sup> †	$10 \sqrt{\frac{2}{3}} a_1 k^2$	<u>a<sub>0</sub></u> 2	$\frac{23a_1k^2}{3}$	$-\frac{3a_0+46a_1k^2}{6\sqrt{2}}$	<u>ia₀k</u> 4√3	$-\frac{1}{4}\bar{l}a_0k$	0
Γ <sub>0</sub> <sup>#4</sup> †	$-\frac{10a_1k^2}{\sqrt{3}}$	$-\frac{a_0}{2\sqrt{2}}$	$-\frac{3a_0+46a_1k^2}{6\sqrt{2}}$	$\frac{1}{6} (3 a_0 + 23 a_1 k^2)$	$-\frac{i a_0 k}{4 \sqrt{6}}$	$\frac{i a_0 k}{4 \sqrt{2}}$	0
$h_0^{\#1}$ †	$\frac{i a_0 k}{2 \sqrt{2}}$	0	$-\frac{i a_0 k}{4 \sqrt{3}}$	$\frac{i a_0 k}{4 \sqrt{6}}$	0	0	0
$h_0^{\#2}$ †	0	0	<u>i a o k</u> 4	$-\frac{i a_0 k}{4 \sqrt{2}}$	0	0	0
$\Gamma_{0}^{#1}$ †	0	0	0	0	0	0	$\frac{1}{2}\left(-a_0+a_1k^2\right)$
_							

Massive and massless spectra

\*\* MassiveAnalysisOfSector...Null

Unitarity conditions