## Particle spectrograph

## Wave operator and propagator

$ au_1^{\#2}$	0	0	0	$\frac{2i}{k(1+2k^2)(r_1+r_5)}$	$\frac{i\sqrt{2} (3k^2 (r_1 + r_5) + 2t_3)}{k(1 + 2k^2)^2 (r_1 + r_5)t_3}$	0	$\frac{6k^2(r_1+r_5)+4t_3}{(1+2k^2)^2(r_1+r_5)t_3}$	
$\tau_{1}^{\#1}{}_{\alpha}$	0	0	0	0	0	0	0	
$\sigma_{1}^{\#2}$	0	0	0	$\frac{\sqrt{2}}{k^2 (1+2k^2) (r_1+r_5)}$	$\frac{3k^2(r_1+r_5)+2t_3}{(k+2k^3)^2(r_1+r_5)t_3}$	0	$-\frac{i\sqrt{2}(3k^2(r_1+r_5)+2t_3)}{k(1+2k^2)^2(r_1+r_5)t_3}$	
$\sigma_{1^{+}\alpha}^{\#1}$	0	0	0	$\frac{1}{k^2 \left( r_1 + r_5 \right)}$	$\frac{\sqrt{2}}{k^2 (1+2 k^2) (r_1 + r_5)}$	0	$-\frac{2i}{k(1+2k^2)(r_1+r_5)}$	
$\tau_{1}^{\#1}\!$	0	0	0	0	0	0	0	
$\sigma_{1}^{\#2}{}_{\alpha\beta} \tau_{1}^{\#1}{}_{\alpha\beta}$	0	0	0	0	0	0	0	
$\sigma_{1}^{\#1}{}_{\alpha\beta}$	$\frac{1}{k^2\left(2r_1+r_5\right)}$	0	0	0	0	0	0	
	$\sigma_{1+}^{\#1} + \alpha \beta$	$\sigma_{1}^{\#2} + \alpha \beta$	$\tau_1^{\#1} + \alpha \beta$	$\sigma_{1}^{\#_1} +^{\alpha}$	$\sigma_1^{\#2} + ^{lpha}$	$\tau_{1}^{\#1} +^{\alpha}$	$\tau_1^{\#2} + ^{\alpha}$	

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$f_{1^{-}}^{\#2}\alpha$	0	0	0	$-\frac{2}{3}ikt_3$	$\tfrac{1}{3}\bar{l}\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$
$f_{1^{}}^{\#1}\alpha$	0	0	0	0	0	0	0
$\omega_{1}^{\#2}{}_{\alpha}$	0	0	0	$-\frac{\sqrt{2}t_3}{3}$	<u>t3</u> 3	0	$-\frac{1}{3}$ i $\sqrt{2}$ $kt_3$
$\omega_{1}^{\#1}{}_{\alpha}$	0	0	0	$k^2 (r_1 + r_5) + \frac{2t_3}{3}$	$-\frac{\sqrt{2}t_3}{3}$	0	<u>2 i k t 3</u> 3
$f_{1}^{\#1}{}_{\!$	0	0	0	0	0	0	0
$\omega_{1}^{\#2}{}_{+}\alpha_{eta}$ f	0	0	0	0	0	0	0
$\omega_1^{\#1}{}_+\alpha\beta$	$k^2 (2 r_1 + r_5)$	0	0	0	0	0	0
	$\omega_1^{\#1} + \alpha^{\beta}$	$\omega_1^{\#2} + \alpha^{\beta}$	$_{1}^{++}$ $\dagger^{\alpha\beta}$	$\lambda_{1}^{\#1} + \alpha$	$\int_{1}^{\#2} +^{\alpha}$	$\frac{1}{1} + \alpha$	$f_{1}^{#2} +^{\alpha}$

$\omega_{2^{+}\alpha\beta}^{\#1} f_{2^{+}\alpha\beta}^{\#1} \omega_{2^{-}\alpha\beta\chi}^{\#1}$							
$\omega_{2}^{\#1} \dagger^{lphaeta}$	0	0	0				
$f_{2^{+}}^{#1}\dagger^{\alpha\beta}$	0	0	0				
$\omega_2^{\#1}$ † $^{lphaeta\chi}$	0	0	$k^2 r_1$				

 $\tau_{0+}^{\#1} - 2\, \bar{l}\, k\, \sigma_{0+}^{\#1} == 0$ 

 $\sigma_{0}^{\#1} == 0$ 

 $\tau_{0}^{\#2} == 0$ 

 $\tau_{1}^{\#2}{}^{\alpha}+2\,\overline{\imath}\,k\,\sigma_{1}^{\#2}{}^{\alpha}$ 

 $\sigma_1^{\#2}\alpha\beta==0$ 

 $\tau_{2}^{\#1}\alpha\beta=0$ 

 $\tau_{1}^{\#1}\alpha\beta == 0$ 

 $\tau_{1}^{\#1\alpha} == 0$ 

0	0	0					
${\dagger}^{\alpha eta}$	$\dagger^{\alpha \beta}$	$\alpha \beta \chi$					
7#1 . 2+	$\tau_{2}^{\#1}$	r <sub>2</sub> -1 +					
		Р					
				$\omega_{0}^{\#1}$	$f_{0^{+}}^{#1}$	$f_{0^{+}}^{#2}$	, ,#1
				$\omega_{0}^{+}$	<sup>7</sup> 0 <sup>+</sup>	70+	$\omega_0$ -
			$\omega_{0^{+}}^{\#1}$ †	$t_3$	$-i \sqrt{2} kt_3$	0	0
			$f_{0}^{#1}\dagger$	$i\sqrt{2}kt_3$	$2k^2t_3$	0	0
			c#2 .				

0

0

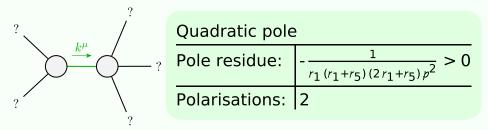
Total constraints:

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

$\sigma_{0+}^{\#1} + \left  \frac{1}{(1+2k^2)^2 t_3} \right  - \frac{i\sqrt{2}k}{(1+2k^2)^2 t_3} = 0$	-1
$O_0^+ + (1+2k^2)^2 t_3 - (1+2k^2)^2 t_3 = 0$	
$\tau_{0^{+}}^{\#1} + \left  \frac{i\sqrt{2}k}{(1+2k^{2})^{2}t_{3}} \right  \frac{2k^{2}}{(1+2k^{2})^{2}t_{3}} \right  0  0$	ı
$\tau_{0^{+}}^{\#2} + \boxed{0} \qquad \boxed{0} \qquad \boxed{0} \qquad \boxed{0}$	
$\sigma_{0^{-}}^{\#1} \dagger 0 0 0 0$	ļ

0 0

## Massive and massless spectra



(No massive particles)

## Unitarity conditions

$$r_1 < 0 \&\& (r_5 < -r_1 || r_5 > -2 r_1) || r_1 > 0 \&\& -2 r_1 < r_5 < -r_1$$