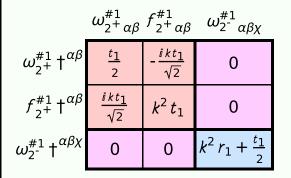
## Particle spectrograph

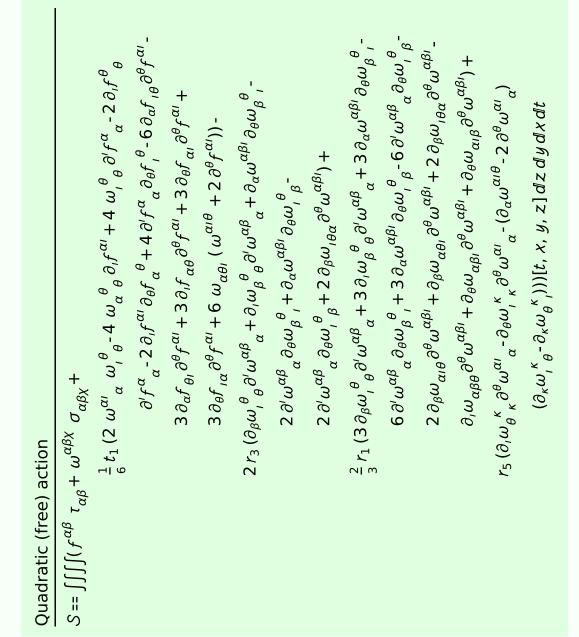
## Wave operator and propagator



SO(3) irreps	Fundamental fields	Multiplicities		
$\tau_{0^{+}}^{\#2} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == 0$	1		
$\tau_{0}^{\#1} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == \partial_{\beta}\partial^{\beta}\tau^{\alpha}_{\ \alpha}$	1		
$\tau_{1}^{\#2\alpha} + 2 i k \sigma_{1}^{\#2\alpha} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} = \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau^{\alpha\beta} + 2\partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\sigma^{\alpha\beta\chi}$	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		
$\frac{\tau_{1+}^{\#1}\alpha\beta + ik \sigma_{1+}^{\#2}\alpha\beta}{==0}$	$\partial_{\chi}\partial^{\alpha}\tau^{\beta\chi} + \partial_{\chi}\partial^{\beta}\tau^{\chi\alpha} + \partial_{\chi}\partial^{\chi}\tau^{\alpha\beta} +$	3		
	$2 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \beta \chi} = =$			
	$\partial_{\chi}\partial^{\alpha}\tau^{\chi\beta} + \partial_{\chi}\partial^{\beta}\tau^{\alpha\chi} +$			
	$\partial_{\chi}\partial^{\chi}\tau^{\beta\alpha} + 2\partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\alpha\chi\delta}$			
$\tau_{2+}^{\#1\alpha\beta}$ - 2 <i>i k</i> $\sigma_{2+}^{\#1\alpha\beta}$ ==	$0 - i (4 \partial_{\delta} \partial_{\chi} \partial^{\beta} \partial^{\alpha} \tau^{\chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial^{\beta} \partial^{\alpha} \tau^{\chi}_{\chi} -$	5		
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} \tau^{\beta \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} \tau^{\chi \beta} -$			
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\beta} \tau^{\alpha \chi} - 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\beta} \tau^{\chi \alpha} +$			
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\alpha\beta} + 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\chi} \tau^{\beta\alpha} +$			
	$4  i  k^{X}  \partial_{\epsilon} \partial_{\chi} \partial^{\beta} \partial^{\alpha} \sigma^{\delta \epsilon}_{ \delta} -$			
	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 $i k^X \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial_{\chi} \sigma^{\beta \delta \alpha}$ -			
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\delta} \tau^{\chi}_{\chi}$			
	$4 i \eta^{\alpha\beta} k^{\chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial_{\chi} \sigma^{\delta\epsilon} \delta = 0$			
Total constraints/gauge generators: 16				

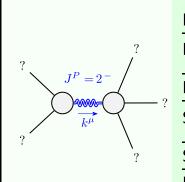
i							
$\tau_{1}^{\#2}_{\alpha}$	0	0	0	$\frac{i}{k(1+2k^2)(r_1-2r_3-r_5)}$	$\frac{i(6k^2(r_1-2r_3-r_5)-t_1)}{\sqrt{2}k(1+2k^2)^2(r_1-2r_3-r_5)t_1}$	0	$\frac{1}{\frac{-r_1+2r_3+r_5}{(1+2k^2)^2}} + \frac{6k^2}{t_1}$
$\tau_{1^{-}}^{\#1}\alpha$	0	0	0	0	0	0	0
$\sigma_{1^{-}\alpha}^{\#2}$	0	0	0	$\frac{1}{\sqrt{2} (k^2 + 2 k^4) (r_1 - 2 r_3 - r_5)}$	$\frac{1}{\frac{-r_1+2r_3+r_5}{2(k+2k^3)^2}}$	0	$-\frac{i(6k^2(r_1-2r_3-r_5)-t_1)}{\sqrt{2}k(1+2k^2)^2(r_1-2r_3-r_5)t_1}$
$\sigma_{1^{+}\alpha}^{\#1}$	0	0	0	$\frac{1}{k^2 (-r_1+2r_3+r_5)}$	$\frac{1}{\sqrt{2} (k^2 + 2k^4) (r_1 - 2r_3 - r_5)}$	0	$\frac{i}{k(1+2k^2)(-r_1+2r_3+r_5)}$
$\tau_{1}^{\#1}_{\alpha\beta}$	$-\frac{i\sqrt{2}k}{t_1+k^2t_1}$	$\frac{-2ik^3(2r_3+r_5)+ikt_1}{(1+k^2)^2t_1^2}$	$\frac{-2k^4(2r_3+r_5)+k^2t_1}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_{1}^{\#2}{}_{\alpha\beta}$	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{-2k^2(2r_3+r_5)+t_1}{(1+k^2)^2t_1^2}$	$\frac{i(2k^3(2r_3+r_5)-kt_1)}{(1+k^2)^2t_1^2}$	0	0	0	0
$\sigma_{1}^{\#1}{}_{+}\alpha\beta$	0	$-\frac{\sqrt{2}}{t_1+k^2t_1}$	$\frac{i\sqrt{2}k}{t_1+k^2t_1}$	0	0	0	0
	$\sigma_1^{\#1} + \alpha \beta$	$\sigma_{1}^{#2} + \alpha^{\beta}$	$t_1^{\#1} + \alpha \beta$	$\sigma_{1}^{\#1} +^{\alpha}$	$\sigma_{1}^{#2} + \alpha$	$\tau_{1}^{\#1} +^{\alpha}$	$\tau_{1}^{\#2} +^{\alpha}$

	$\omega_{1}^{\#1}{}_{lphaeta}$	$\omega_{1}^{\#2}{}_{\alpha\beta}$	$f_{1}^{\#1}{}_{\alpha\beta}$	$\omega_{1^{-}\alpha}^{\sharp 1}$	$\omega_{1-\alpha}^{\#2}$	$f_{1-\alpha}^{\#1}$	$f_{1-\alpha}^{#2}$
$\omega_1^{\sharp 1}$ † $^{lphaeta}$	$k^2 (2r_3 + r_5) - \frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ikt_1}{\sqrt{2}}$	0	0	0	0
$\omega_1^{\#2} \dagger^{lphaeta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1}^{\#1}\dagger^{\alpha\beta}$	$\frac{ikt_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_1^{\sharp 1} \dagger^{lpha}$	0	0	0	$k^2 \left( -r_1 + 2  r_3 + r_5 \right) + \frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	<u>i kt_1</u> 3
$\omega_{1}^{#2} \dagger^{\alpha}$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	<u>t</u> 1 3	0	$\frac{1}{3}\bar{l}\sqrt{2}kt_1$
$f_{1}^{#1} \dagger^{\alpha}$	0	0	0	0	0	0	0
$f_1^{#2} \dagger^{\alpha}$	0	0	0	$-rac{1}{3}ar{l}kt_1$	$-\frac{1}{3}\bar{l}\sqrt{2}kt_1$	0	$\frac{2k^2t_1}{3}$

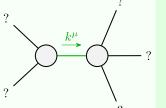


		$\sigma_{0}^{\#1}$	$\tau_{0}^{\#1}$	$\tau_{0}^{#2}$	$\sigma_0^{\sharp 1}$						
1 + †	$\frac{1}{6k^2}$	$\frac{1}{2(-r_1+r_3)}$	0	0	0						
<del>1</del> †		0	0	0	0		. 1				
<sup>2</sup> †		0	0	0	0		$\omega_{0}^{\#1}$	0	0	0	<i>-t</i> <sub>1</sub>
<sup>1</sup> †		0	0	0	$-\frac{1}{t_1}$		$f_{0}^{#2}$	0	0	0	0
		$\sigma_{2}^{\#1}$		<sub>τ</sub> #	1 + αβ	$\sigma_{2}^{\#1}{}_{lphaeta\chi}$	$f_{0}^{\#1}$	0	0	0	0
	† <sup>αβ</sup> • αβ	$\frac{2}{(1+2k^2)^2}$ $2i\sqrt{2}$	$\begin{bmatrix} \frac{2}{t_1} \\ k \end{bmatrix}$	2 ii	$\frac{\sqrt{2} k}{k^2)^2 t_1}$	0	$\omega_{0}^{\#1}$	$6 k^2 (-r_1 + r_3)$	0	0	0
2 <sup>+</sup>	$\dagger^{\alpha\beta}$	$(1+2k^2)^2$	$\frac{2}{t_1}$	(1+2	$(t^2)^2 t_1$	0		. e k			
<sup>-1</sup> †'	αβχ	0			0	$\frac{2}{2k^2r_1+t_1}$		$\omega_{0}^{\#1}$ $\dagger$	$f_{0}^{\#1}$ †	$f_0^{#2}$ †	$\omega_{0}^{\#1}\dagger$

## Massive and massless spectra



Massive particle					
Pole residue: $-\frac{1}{r_1} > 0$					
Polarisations: 5					
Square mass:	$-\frac{t_1}{2r_1} > 0$				
Spin:	2				
Parity:	Odd				



Quadratic pole					
Pole residue:	$\frac{1}{(r_1 - 2r_3 - r_5)t_1^2} > 0$				
Polarisations:	2				

## Unitarity conditions

 $r_1 < 0 \&\& r_5 < r_1 - 2 r_3 \&\& t_1 > 0$