Particle spectrograph

Wave operator and propagator

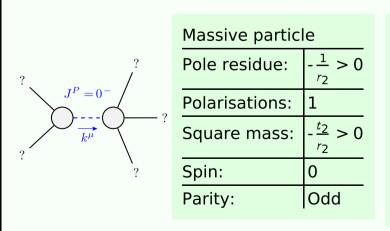
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_0^{\#1} - 2 \bar{l} k \sigma_0^{\#1} == 0$	$\partial_{\beta}\partial_{\alpha}\tau^{\alpha\beta} == \partial_{\beta}\partial^{\beta}\tau^{\alpha}_{\alpha} + 2 \partial_{\chi}\partial^{\chi}\partial_{\beta}\sigma^{\alpha\beta}_{\alpha} $ 1	
$\tau_{1}^{\#2\alpha} - ik \ \sigma_{1}^{\#1\alpha} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} + \partial_{\delta}\partial^{\delta}\partial_{\chi}\partial_{\beta}\sigma^{\alpha\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau^{\alpha\beta} + 3$	
	$\partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\alpha}\sigma^{\beta\chi}_{\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	
$\tau_{1}^{\#1}{}^{\alpha} == 0$	$\partial_{\chi}\partial_{\beta}\partial^{\alpha}\tau^{\beta\chi} == \partial_{\chi}\partial^{\chi}\partial_{\beta}\tau^{\beta\alpha} $ 3	
$\sigma_{1}^{\#1}{}^{\alpha} + 2 \ \sigma_{1}^{\#2}{}^{\alpha} = 0$	$\partial_{\chi}\partial^{\alpha}\sigma^{\beta\chi}_{\beta} + \partial_{\chi}\partial^{\chi}\sigma^{\alpha\beta}_{\beta} = 3 \partial_{\chi}\partial_{\beta}\sigma^{\alpha\beta\chi}$ 3	
$\tau_1^{\#1}\alpha\beta + ik \ \sigma_1^{\#1}\alpha\beta == 0$	$\partial_{\chi}\partial^{\alpha}t^{\beta\chi} + \partial_{\chi}\partial^{\beta}t^{\chi\alpha} + \partial_{\chi}\partial^{\chi}t^{\alpha\beta} +$ 3	
	$\partial_{\delta}\partial_{\chi}\partial^{\beta}\sigma^{\alpha\chi\delta} + \partial_{\delta}\partial^{\delta}\partial_{\chi}\sigma^{\beta\chi\alpha} = =$	
	$\partial_{\chi}\partial^{\alpha}\tau^{\chi\beta} + \partial_{\chi}\partial^{\beta}\tau^{\alpha\chi} + \partial_{\chi}\partial^{\chi}\tau^{\beta\alpha} +$	
	$\partial_{\delta}\partial_{\chi}\partial^{\alpha}\sigma^{\beta\chi\delta} + \partial_{\delta}\partial^{\delta}\partial_{\chi}\sigma^{\alpha\chi\beta}$	
$\sigma_{1}^{\#1}\alpha\beta == \sigma_{1}^{\#2}\alpha\beta$	$3 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} +$ 3	
	$2 \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \beta \chi} + \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\alpha \chi \beta} = =$	
	$3 \partial_{\delta} \partial_{\chi} \partial^{\beta} \sigma^{\alpha \chi \delta} + \partial_{\delta} \partial^{\delta} \partial_{\chi} \sigma^{\beta \chi \alpha}$	
$\sigma_2^{\#1}\alpha\beta\chi == 0$	$3 \partial_{\epsilon} \partial_{\delta} \partial^{\chi} \partial^{\alpha} \sigma^{\beta \delta \epsilon} + 3 \partial_{\epsilon} \partial^{\epsilon} \partial^{\chi} \partial^{\alpha} \sigma^{\beta \delta}_{\delta} + $ 5	
-	$2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\beta} \sigma^{\alpha \chi \delta} + 4 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\beta} \sigma^{\alpha \delta \chi} +$	
	$2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\beta} \sigma^{\chi \delta \alpha} + 4 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\chi} \sigma^{\alpha \beta \delta} +$	
	$2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\chi} \sigma^{\alpha \delta \beta} + 2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\delta} \sigma^{\beta \chi \alpha} +$	
	$3 \eta^{\beta\chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial^{\alpha} \sigma^{\delta\epsilon}{}_{\delta} +$	
	$3 \eta^{\alpha\chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial_{\delta} \sigma^{\beta \delta \epsilon} +$	
	$3 \eta^{\beta \chi} \partial_{\phi} \partial^{\phi} \partial_{\epsilon} \partial^{\epsilon} \sigma^{\alpha \delta}{}_{\delta} ==$	
	$3 \partial_{\epsilon} \partial_{\delta} \partial^{\chi} \partial^{\beta} \sigma^{\alpha \delta \epsilon} + 3 \partial_{\epsilon} \partial^{\epsilon} \partial^{\chi} \partial^{\beta} \sigma^{\alpha \delta}{}_{\delta} +$	
	$2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\alpha} \sigma^{\beta X \delta} + 4 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\alpha} \sigma^{\beta \delta X} +$	
	$2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\alpha} \sigma^{\chi \delta \beta} + 2 \partial_{\epsilon} \partial^{\epsilon} \partial_{\delta} \partial^{\chi} \sigma^{\beta \delta \alpha} +$	
	$4\partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial^{\delta}\sigma^{lphaeta\chi} + 2\partial_{\epsilon}\partial^{\epsilon}\partial_{\delta}\partial^{\delta}\sigma^{lpha\chieta} +$	
	$3 \eta^{\alpha\chi} \partial_{\phi} \partial^{\phi} \partial_{\varepsilon} \partial^{\beta} \sigma^{\delta \varepsilon}{}_{\delta} +$	
	$3 \eta^{\beta\chi} \partial_{\phi} \partial^{\phi} \partial_{\varepsilon} \partial_{\delta} \sigma^{\alpha\delta\varepsilon} +$	
	$3 \eta^{\alpha\chi} \partial_{\phi} \partial_{\phi} \partial_{\epsilon} \partial^{\epsilon} \sigma^{\beta\delta}$	
$\tau_2^{\#1}\alpha\beta == 0$	$4 \partial_{\delta} \partial_{\chi} \partial^{\beta} \partial^{\alpha} \tau^{\chi \delta} + 2 \partial_{\delta} \partial^{\delta} \partial^{\beta} \partial^{\alpha} \tau^{\chi} + 5 \partial_{\delta} \partial^{\beta} \partial^{\alpha} \tau^{\chi} + 5 \partial_{\delta} \partial^{\beta} \partial^{\alpha} \tau^{\chi} + 6 \partial_{\delta} \partial^{\alpha} \partial^$	
	$3\partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\chi}\tau^{\alpha\beta} + 3\partial_{\delta}\partial^{\delta}\partial_{\chi}\partial^{\chi}\tau^{\beta\alpha} +$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial_{\delta} \partial_{\chi} \tau^{\chi\delta} ==$	
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} t^{\beta \chi} + 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\alpha} t^{\chi \beta} +$	
	$3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\beta} \tau^{\alpha \chi} + 3 \partial_{\delta} \partial^{\delta} \partial_{\chi} \partial^{\beta} \tau^{\chi \alpha} +$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial_{\delta} \partial_{\delta} \partial^{\lambda}_{X}$	
$\sigma_2^{\#1}\alpha\beta==0$	$3 \partial_{\delta} \partial_{\chi} \partial^{\alpha} \sigma^{\beta \chi \delta} + 3 \partial_{\delta} \partial_{\chi} \partial^{\beta} \sigma^{\alpha \chi \delta} + 5$	
	$2 \eta^{\alpha\beta} \partial_{\epsilon} \partial_{\delta} \partial_{\delta} \sigma^{\chi\delta}_{\chi} == 2 \partial_{\delta} \partial^{\beta} \partial^{\alpha} \sigma^{\chi\delta}_{\chi} +$	
	$x^{\beta} + \partial_{\delta}\partial^{\delta}\partial_{\chi}\sigma^{\beta\chi\alpha}$	
Total constraints/gauge generators:	ge generators:	7

# T	$\sigma_{1}^{\#1}$	$\sigma_{1}^{#2} + \alpha \beta$	$\tau_{1}^{\#1}$	$\sigma_{1^{-}lpha}^{\#1}$	$\sigma_{1^{-}\alpha}^{#2}$	$ au_{1}^{\#1}$	$t_1^{#2}$
$(3+k^2)^2 t_2$	t ₂	$\frac{3.42}{(3+k^2)^2 t_2}$	$\frac{3 l \sqrt{2 k}}{(3+k^2)^2 t_2}$	0	0	0	0
$\frac{3\sqrt{2}}{(3+k^2)^2t_2}$	$\frac{1}{2}$	$\frac{3}{(3+k^2)^2 t_2}$	$\frac{3ik}{(3+k^2)^2t_2}$	0	0	0	0
$\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$	$\left \frac{z}{t_2}\right $	$-\frac{3ik}{(3+k^2)^2t_2}$	$\frac{3k^2}{(3+k^2)^2t_2}$	0	0	0	0
0		0	0	$\frac{6}{(3+2k^2)^2t_3}$	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	0	$-\frac{6ik}{(3+2k^2)^2t_3}$
0		0	0	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	$\frac{3}{(3+2k^2)^2t_3}$	0	$\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$
0		0	0	0	0	0	0
0		0	0	$\frac{6ik}{(3+2k^2)^2t_3}$	$-\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$	0	$\frac{6k^2}{(3+2k^2)^2t_3}$
c (1	free)	Quadratic (free) action					

								1 4
0	0	0	$-\frac{6ik}{(3+2k^2)^2t_3}$	$\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$	0	$\frac{6k^2}{(3+2k^2)^2t_3}$		$a_{1}f^{\alpha \prime} - a_{2}f^{\alpha \prime} + a_{3}f^{\alpha \prime} + a_{4}f^{\alpha \prime} + a_{5}f^{\alpha \prime} + a_{5$
0	0	0	0	0	0	0		ω_{α}^{κ} $\omega_{\beta\alpha}^{\alpha}$ $\omega_{\beta\beta}^{\alpha}$ $(\omega^{\alpha\prime})$ $\omega_{\alpha\beta}^{\beta}$ $\omega_{\alpha\beta}^{\beta}$ $\omega_{\alpha\beta}^{\beta}$
0	0	0	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	$\frac{3}{(3+2k^2)^2t_3}$	0	$\frac{3i\sqrt{2}k}{(3+2k^2)^2t_3}$		$ a \omega_{,\kappa}^{\kappa} + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} + 8 t_3 \omega_{,\kappa}^{\kappa} \partial_{i} f^{\alpha_{i}} - 8 t_3 \omega_{,\kappa}^{\kappa} \partial_{i} f^{\alpha_{i}} + 4 t_3 \partial_{i} f^{\kappa} \partial^{i} f^{\alpha} + 4 t_2 \omega_{i\beta\alpha} \partial^{\theta} f^{\alpha_{i}} + 2 t_2 \partial_{i} f_{\alpha\beta} \partial^{\theta} f^{\alpha_{i}} + 4 t_2 \partial_{i} f_{\alpha\beta} \partial^{\theta} f^{\alpha_{i}} + 4 t_2 \partial_{i} f_{\alpha\beta} \partial^{\theta} f^{\alpha_{i}} + 4 f_2 \partial_{i} f_{\alpha\beta} \partial^{\theta} f^{\alpha_{i}} + 4 f_2 \partial_{i} f_{\alpha\beta} \partial^{\theta} f^{\alpha_{i}} + 4 f_2 \partial_{i} f^{\alpha_{i}} \partial^{\theta} f^{\alpha_{i}} + 4 f_2 \partial_{i} f^{\alpha_{i}} \partial^{\theta} f^{\alpha_{i}} + 4 f_2 \partial_{i} \omega_{\alpha\beta} \partial^{\theta} \omega_{\alpha\beta} \partial^{\theta} \partial^{\alpha\beta} \partial^{\beta} \partial^{\beta} \partial^{\alpha\beta} \partial^{\beta} \partial^{\beta} \partial^{\alpha\beta} \partial^{\beta} \partial^{\alpha\beta} \partial^{\beta} \partial^{\beta} \partial^{\alpha\beta} \partial^{\beta} $
0	0	0	$\frac{6}{(3+2k^2)^2t_3}$	$-\frac{3\sqrt{2}}{(3+2k^2)^2t_3}$	0	$\frac{6ik}{(3+2k^2)^2t_3}$		$a_{\beta} + 6 \omega^{\alpha\beta\chi}$ $a + 4t_{3}\partial_{i}f^{k}$ $a + 4t_{3}\partial_{i}f^{k}$ $a + 4t_{3}\partial_{i}f^{k}$ $b + 2\partial_{\theta}f_{i\alpha}\partial_{\theta}f^{i}$ $a^{\beta\beta} + 4r_{2}\partial_{\mu}$
$\frac{3t}{(3+k^2)^2} \frac{\sqrt{2k}}{t_2}$	$\frac{3ik}{(3+k^2)^2t_2}$	$\frac{3k^2}{(3+k^2)^2t_2}$	0	0	0	0		$+6 f^{\alpha\beta} T$ $+6 f^{\alpha\beta} T$ $\omega_{i}^{k} \partial^{i} f^{\alpha}$ $\partial_{\alpha} f_{i\beta} \partial^{\beta} f^{\alpha i}$ $\omega_{\alpha i\beta} (\omega^{\alpha})$ $\partial_{\beta} \omega_{\alpha\beta i} \partial^{\beta} C$ $\partial_{\beta} \omega_{\alpha\beta i} \partial^{\beta} C$ $\partial_{\beta} \omega_{\alpha\beta i} \partial^{\beta} C$
$\frac{3 \sqrt{2}}{(3+k^2)^2 t_2}$	$\frac{3}{(3+k^2)^2 t_2}$	$-\frac{3ik}{(3+k^2)^2t_2}$	0	0	0	0	action	~
$\frac{3}{(3+k^2)^2 t_2}$	$\frac{3\sqrt{2}}{(3+k^2)^2t_2}$	$-\frac{3i\sqrt{2}k}{(3+k^2)^2t_2}$	0	0	0	0	Quadratic (free) action	$S == \iiint \left(\frac{1}{6} \left(-4 t_3 \ \omega^{\alpha'}\right)\right)$
$r_1^{#1} + \alpha \beta$	$r_1^{\#2} + \alpha \beta$	$\alpha_{1}^{*1} + \alpha \beta$	$\sigma_{1}^{\#1} +^{lpha}$	$\sigma_{1}^{\#2} +^{\alpha}$	$\tau_{1}^{\#1} + ^{\alpha}$	$\tau_{1}^{\#2} + ^{\alpha}$	Quadr	S == S

$f_{1^-}^{\#2} \alpha$	0	0	0	$-\frac{2}{3}$ Ikt $_3$	$\frac{1}{3}\bar{l}\sqrt{2}kt_3$	0	$\frac{2k^2t_3}{3}$			
$f_{1^-}^{\#1}{}_{lpha}$	0	0	0	0	0	0	0			
$\omega_{1^{-}}^{\#2}{}_{\alpha}$	0	0	0	$-\frac{\sqrt{2}t_3}{3}$	<u>3</u> ع	0	$-\frac{1}{3}$ i $\sqrt{2}$ kt_3			
$\omega_{1^{\bar{-}}}^{\#1}{}_{\alpha}$	0	0	0	$\frac{2t_3}{3}$	$\frac{\sqrt{2}t_3}{3}$	0	2 i k t 3 3	ر #1 ـــ	$\omega_{0}^{#1}$	
$f_{1}^{\#1}$	$\frac{1}{3}\vec{l}\sqrt{2}kt_2$	<i>ikt</i> 2 3	$\frac{k^2 t_2}{3}$	0	0	0	0	$\omega_{0^{+}}^{\#1} \dagger$ $f_{0^{+}}^{\#1} \dagger$ $f_{0^{+}}^{\#2} \dagger$	$ \begin{array}{c} t_3 \\ \bar{i} \sqrt{2} kt_3 \\ 0 \end{array} $	-1
$\omega_{1}^{\#2}{}_{+}\alpha\beta$	$\frac{\sqrt{2} t_2}{3}$	3 3	$-\frac{1}{3}\bar{l}kt_2$	0	0	0	0	$\omega_0^{\sharp 1}$ †	$\sigma_{0^{+}}^{*1}$	
$\omega_{1}^{\#1}{}_{\alpha\beta}$	$\frac{2t_2}{3}$	$\frac{\sqrt{2}t_2}{3}$	$-\frac{1}{3}$ \bar{l} $\sqrt{2}$ kt_2	0	0	0	0	$\sigma_{0^{+}}^{#1}$ † $ au_{0^{+}}^{#1}$ †	$\frac{1}{(1+2k^2)^2 t_3}$ $\frac{i\sqrt{2}k}{(1+2k^2)^2 t_3}$	+
	$\omega_1^{\#1} + \tau^{lphaeta}$	$\omega_1^{\#2} + \alpha^{\beta}$	$f_1^{#1} + \alpha \beta$	$\omega_{1}^{\#1} +^{\alpha}$	$\omega_1^{\#2} +^{lpha}$	$f_{1}^{\#1} +^{lpha}$	$f_1^{\#2} +^{\alpha}$	$ au_{0^{+}}^{\#2} + \ \sigma_{0^{-}}^{\#1} + \ $	0	

Massive and massless spectra



Unitarity conditions