

Particle spectrograph

Wave operator and propagator

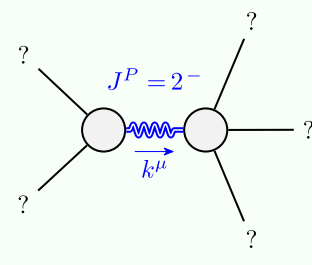
Source constraints		Fundamental fields	Multiplicities
SO(3) irreps			
$\tau_0^{\#2} == 0$		$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == 0$	1
$\tau_0^{\#1} - 2 i k \sigma_0^{\#1} == 0$		$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial_\alpha \tau^\alpha_\alpha + 2 \partial_\chi \partial^\chi \partial_\beta \sigma^{\alpha\beta}_\alpha$	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
$\tau_1^{\#1\alpha\beta} + i k \sigma_1^{\#2\alpha\beta} == 0$		$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^\alpha \chi + \partial_\chi \partial^\chi \tau^{\alpha\beta} +$ $2 \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 2 \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} ==$ $\partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} +$ $\partial_\chi \partial^\chi \tau^{\beta\alpha} + 2 \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\tau_2^{\#1\alpha\beta} - 2 i k \sigma_2^{\#1\alpha\beta} == 0$		$-i (4 \partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2 \partial_\delta \partial^\delta \partial^\beta \partial^\alpha \tau^\chi_\chi -$ $3 \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} - 3 \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $3 \partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} + 3 \partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\beta\alpha} +$ $4 i k^\chi \partial_\epsilon \partial_\chi \partial^\beta \partial^\alpha \sigma^{\delta\epsilon}_\delta -$ $6 i k^\chi \partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon} -$ $6 i k^\chi \partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $2 \eta^{\alpha\beta} \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6 i k^\chi \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} +$ $6 i k^\chi \partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} -$ $2 \eta^{\alpha\beta} \partial_\epsilon \partial^\epsilon \partial_\delta \partial^\chi \tau^\chi_\chi -$ $4 i \eta^{\alpha\beta} k^\chi \partial_\theta \partial^\theta \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}_\delta) == 0$	5
Total constraints/gauge generators:			16

Quadratic (free) action

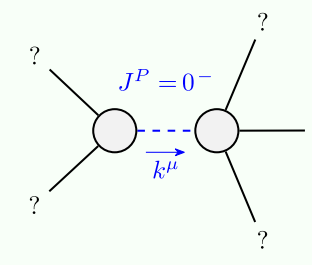
$S ==$

$$\iiint \iiint \frac{1}{6} (6 t_1 \omega^\alpha_\alpha \omega_{\theta}^\theta + 6 f^{\alpha\beta} \tau_{\alpha\beta} + 6 \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 12 t_1 \omega^\theta_\alpha \partial_{\theta} f^{\alpha\chi} + 12 t_1 \omega_{\theta}^\theta \partial_{\theta} f^\alpha_\alpha - 6 t_1 \partial_{\theta} f^\alpha_\alpha \partial_{\theta} f^\theta_\theta - 12 r_1 \partial_\beta \omega_{\theta}^\theta \partial_{\theta} \omega^{\alpha\beta}_\alpha + 12 r_1 \partial_{\theta} \omega_{\beta}^\theta \partial_{\theta} \omega^{\alpha\beta}_\alpha - 6 t_1 \partial_{\theta} f^{\alpha\chi} \partial_{\theta} f^\theta_\theta + 12 t_1 \partial_{\theta} f^\alpha_\alpha \partial_{\theta} f^\theta_\theta + 12 r_1 \partial_\alpha \omega^{\alpha\beta\chi} \partial_{\theta} \omega_{\beta}^\theta - 24 r_1 \partial_{\theta} \omega^{\alpha\beta}_\alpha \partial_{\theta} \omega_{\beta}^\theta - 12 r_1 \partial_\alpha \omega^{\alpha\beta\chi} \partial_{\theta} \omega_{\beta}^\theta + 24 r_1 \partial_{\theta} \omega^{\alpha\beta}_\alpha \partial_{\theta} \omega_{\beta}^\theta + 4 t_1 \omega_{\theta\alpha} \partial^\theta f^{\alpha\chi} + 4 t_2 \omega_{\theta\alpha} \partial^\theta f^{\alpha\chi} - 4 t_1 \partial_\alpha f_{\theta} \partial^\theta f^{\alpha\chi} + 2 t_2 \partial_\alpha f_{\theta} \partial^\theta f^{\alpha\chi} - 4 t_1 \partial_\alpha f_{\theta} \partial^\theta f^{\alpha\chi} - t_2 \partial_\alpha f_{\theta} \partial^\theta f^{\alpha\chi} + 2 t_1 \partial_{\theta} f_{\alpha\theta} \partial^\theta f^{\alpha\chi} - t_2 \partial_{\theta} f_{\alpha\theta} \partial^\theta f^{\alpha\chi} + 4 t_1 \partial_{\theta} f_{\alpha\chi} \partial^\theta f^{\alpha\chi} + t_2 \partial_{\theta} f_{\alpha\chi} \partial^\theta f^{\alpha\chi} + 2 t_1 \partial_{\theta} f_{\alpha\theta} \partial^\theta f^{\alpha\chi} - t_2 \partial_{\theta} f_{\alpha\theta} \partial^\theta f^{\alpha\chi} - 2 \omega_{\alpha\theta\chi} ((t_1 - 2 t_2) \omega^{\alpha\theta\chi} + 2 (2 t_1 - t_2) \partial^\theta f^{\alpha\chi}) - 8 r_1 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta\chi} + 8 r_2 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_\beta \omega_{\alpha\theta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_2 \partial_\beta \omega_{\alpha\theta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 16 r_1 \partial_\beta \omega_{\theta\alpha} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_2 \partial_\beta \omega_{\theta\alpha} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_1 \partial_{\theta} \omega_{\alpha\beta\theta} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_1 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 2 r_2 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 2 r_2 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} + 4 r_1 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi} - 4 r_2 \partial_{\theta} \omega_{\alpha\beta\chi} \partial^\theta \omega^{\alpha\beta\chi})) [t, \chi, y, z] dz dy dx dt$$

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



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

(No massless particles)

Unitarity conditions

$r_1 < 0 \ \&\& \ r_2 < 0 \ \&\& \ t_1 > 0 \ \&\& \ t_2 > 0$

$\sigma_1^{#1} + \alpha\beta$	$\sigma_1^{#2} + \alpha\beta$	$\tau_1^{#1} + \alpha\beta$	$\sigma_1^{#1} \alpha$	$\sigma_1^{#2} \alpha$	$\tau_1^{#1} \alpha$	$\tau_1^{#2} \alpha$
$\frac{2(t_1+t_2)}{3t_1t_2}$	$\frac{\sqrt{2}(t_1-2t_2)}{3(1+k^2)t_1t_2}$	$\frac{i\sqrt{2}k(t_1-2t_2)}{3(1+k^2)t_1t_2}$	0	0	0	0
$\frac{\sqrt{2}(t_1-2t_2)}{3(1+k^2)t_1t_2}$	$\frac{t_1+4t_2}{3(1+k^2)^2t_1t_2}$	$\frac{ik(t_1+4t_2)}{3(1+k^2)^2t_1t_2}$	0	0	0	0
$-\frac{i\sqrt{2}k(t_1-2t_2)}{3(1+k^2)t_1t_2}$	$-\frac{ik(t_1+4t_2)}{3(1+k^2)^2t_1t_2}$	$\frac{k^2(t_1+4t_2)}{3(1+k^2)^2t_1t_2}$	0	0	0	0
0	0	0	0	$\frac{\sqrt{2}}{t_1+2k^2t_1}$	0	$\frac{2ik}{t_1+2k^2t_1}$
0	0	0	$\frac{\sqrt{2}}{t_1+2k^2t_1}$	$\frac{2k^2r_1+t_1}{(t_1+2k^2t_1)^2}$	0	$\frac{i\sqrt{2}k(2k^2r_1+t_1)}{(t_1+2k^2t_1)^2}$
0	0	0	0	0	0	0
0	0	0	$-\frac{2ik}{t_1+2k^2t_1}$	$-\frac{i\sqrt{2}k(2k^2r_1+t_1)}{(t_1+2k^2t_1)^2}$	0	$\frac{2k^2(2k^2r_1+t_1)}{(t_1+2k^2t_1)^2}$

$\omega_1^{#1} + \alpha\beta$	$\omega_1^{#2} + \alpha\beta$	$f_1^{#1} + \alpha\beta$	$\omega_1^{#1} \alpha$	$\omega_1^{#2} \alpha$	$f_1^{#1} \alpha$	$f_1^{#2} \alpha$
$\frac{1}{6}(t_1+4t_2)$	$-\frac{t_1-2t_2}{3\sqrt{2}}$	$-\frac{ik(t_1-2t_2)}{3\sqrt{2}}$	0	0	0	0
$-\frac{t_1-2t_2}{3\sqrt{2}}$	$\frac{t_1+t_2}{3}$	$\frac{1}{3}ik(t_1+t_2)$	0	0	0	0
$\frac{ik(t_1-2t_2)}{3\sqrt{2}}$	$-\frac{1}{3}ik(t_1+t_2)$	$\frac{1}{3}k^2(t_1+t_2)$	0	0	0	0
0	0	0	$-k^2r_1-\frac{t_1}{2}$	$\frac{t_1}{\sqrt{2}}$	0	$iik t_1$
0	0	0	$\frac{t_1}{\sqrt{2}}$	0	0	0
0	0	0	0	0	0	0
0	0	0	$-ik t_1$	0	0	0

$\sigma_0^{#1} + \alpha\beta$	$\tau_0^{#1} + \alpha\beta$	$\tau_0^{#2} + \alpha\beta$	$\sigma_0^{#1} \alpha$
0	0	0	$\frac{1}{k^2r_2+t_2}$
$-\frac{1}{(1+2k^2)^2t_1}$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2t_1}$	$-\frac{2k^2}{(1+2k^2)^2t_1}$	0
$-\frac{i\sqrt{2}k}{(1+2k^2)^2t_1}$	$-\frac{2k^2}{(1+2k^2)^2t_1}$	0	0
0	0	0	0
0	0	0	0

$\omega_0^{#1} + \alpha\beta$	$f_0^{#1} + \alpha\beta$	$f_0^{#2} + \alpha\beta$	$\omega_0^{#1} \alpha$
0	0	0	$k^2r_2+t_2$
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

$\sigma_2^{#1} + \alpha\beta$	$\tau_2^{#1} + \alpha\beta$	$\tau_2^{#2} + \alpha\beta$	$\sigma_2^{#1} \alpha\beta\chi$
0	0	0	$\frac{2}{2k^2r_1+t_1}$
$\frac{2}{(1+2k^2)^2t_1}$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	$-\frac{4k^2}{(1+2k^2)^2t_1}$	0
$-\frac{2i\sqrt{2}k}{(1+2k^2)^2t_1}$	$-\frac{4k^2}{(1+2k^2)^2t_1}$	0	0
0	0	0	0
0	0	0	0

$\omega_2^{#1} + \alpha\beta$	$f_2^{#1} + \alpha\beta$	$f_2^{#2} + \alpha\beta$	$\omega_2^{#1} \alpha\beta\chi$
0	0	0	$k^2r_1+\frac{t_1}{2}$
$-\frac{ik t_1}{\sqrt{2}}$	$k^2 t_1$	0	0
0	0	0	0
0	0	0	0
0	0	0	0