Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_0^{\#2} == 0$	$\partial_\beta \sigma_\alpha{}^{\alpha\beta} == 0$	1
$\tau_0^{\#1} - 2\,i\,k\,\sigma_0^{\#1} == 0$	$\partial_\beta \sigma_\alpha{}^{\alpha\beta} == \partial_\beta \sigma^{\chi\alpha}{}_\chi{}^\beta + 2\,\partial_\chi \sigma_\beta{}^{\alpha\beta}$	1
$\tau_1^{\#2\,\alpha} + 2\,i\,k\,\sigma_1^{\#2\,\alpha} == 0$	$\partial_\chi \sigma_\beta{}^{\alpha\chi} == \partial_\chi \sigma^{\chi\alpha}{}_\beta + 2\,\partial_\delta \sigma_\beta{}^{\delta\alpha} + 2\,\partial_\chi \sigma_\beta{}^{\alpha\chi}$	3
$\tau_1^{\#1\,\alpha} == 0$	$\partial_\chi \sigma_\beta{}^{\alpha\chi} == \partial_\chi \sigma^{\chi\alpha}{}_\beta$	3
$\tau_1^{\#1\,\alpha\beta} + i\,k\,\sigma_1^{\#2\,\alpha\beta} == 0$	$\partial_\alpha \sigma_\chi{}^{\beta\chi} + \partial_\chi \sigma^{\chi\alpha}{}_\chi{}^\beta + \partial_\chi \sigma^{\chi\beta}{}_\chi{}^\alpha == 2\,\partial_\delta \sigma_\chi{}^{\alpha\chi}\,\eta^{\beta\delta} + 2\,\partial_\delta \sigma_\chi{}^{\beta\chi}\,\eta^{\alpha\delta} + 2\,\partial_\delta \sigma_\chi{}^{\alpha\beta}\,\eta^{\chi\delta}$	3
$\sigma_2^{\#1\,\alpha\beta\chi} == 0$	$3\,\partial_\delta \sigma^{\beta\chi}{}_\sigma{}^{\alpha\delta\varepsilon} + 3\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\sigma{}^{\alpha\beta\delta} + 2\,\partial_\varepsilon \sigma^{\varepsilon\alpha}{}_\sigma{}^{\beta\chi\delta} + 4\,\partial_\varepsilon \sigma^{\varepsilon\beta}{}_\sigma{}^{\alpha\chi\delta} + 4\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\sigma{}^{\alpha\beta\delta} + 2\,\partial_\varepsilon \sigma^{\varepsilon\delta}{}_\sigma{}^{\alpha\beta\chi} + 3\,\eta^{\beta\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\sigma{}^{\alpha\delta\varepsilon} + 3\,\eta^{\alpha\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\sigma{}^{\beta\delta\varepsilon} + 3\,\eta^{\beta\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\sigma{}^{\alpha\delta\varepsilon} == 3\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\phi{}^{\alpha\delta\varepsilon}\,\eta^{\beta\phi} + 3\,\partial_\varepsilon \sigma^{\varepsilon\beta}{}_\phi{}^{\alpha\delta\varepsilon}\,\eta^{\chi\phi} + 4\,\partial_\varepsilon \sigma^{\varepsilon\delta}{}_\phi{}^{\alpha\beta\chi}\,\eta^{\delta\phi} + 2\,\partial_\varepsilon \sigma^{\varepsilon\alpha}{}_\phi{}^{\beta\chi\delta}\,\eta^{\delta\phi} + 2\,\partial_\varepsilon \sigma^{\varepsilon\beta}{}_\phi{}^{\alpha\chi\delta}\,\eta^{\delta\phi} + 2\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\phi{}^{\alpha\beta\delta}\,\eta^{\delta\phi} + 4\,\partial_\varepsilon \sigma^{\varepsilon\delta}{}_\phi{}^{\alpha\beta\chi}\,\eta^{\delta\phi} + 3\,\eta^{\alpha\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\varepsilon{}^{\beta\delta\varepsilon} + 3\,\eta^{\beta\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\varepsilon{}^{\alpha\delta\varepsilon} + 3\,\eta^{\alpha\chi}\,\partial_\phi \sigma^{\phi\varepsilon}{}_\varepsilon{}^{\beta\delta\varepsilon}$	5
$\tau_2^{\#1\,\alpha\beta} == 0$	$4\,\partial_\delta \sigma_\chi{}^{\beta\delta\alpha\chi} + 2\,\partial_\delta \sigma^{\delta\beta\alpha\chi}{}_\chi + 3\,\partial_\delta \sigma^{\delta\alpha\chi}{}_\chi{}^\beta + 3\,\partial_\delta \sigma^{\delta\beta\chi}{}_\chi{}^\alpha + 2\,\eta^{\alpha\beta}\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\chi == 3\,\partial_\delta \sigma_\chi{}^{\alpha\chi}\,\eta^{\beta\delta} + 3\,\partial_\delta \sigma_\chi{}^{\beta\chi}\,\eta^{\alpha\delta} + 2\,\eta^{\alpha\beta}\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\chi$	5
$\sigma_2^{\#1\,\alpha\beta} == 0$	$3\,\partial_\delta \sigma_\chi{}^{\alpha\chi}\,\eta^{\beta\delta} + 3\,\partial_\delta \sigma_\chi{}^{\beta\chi}\,\eta^{\alpha\delta} + 2\,\eta^{\alpha\beta}\,\partial_\varepsilon \sigma^{\varepsilon\chi}{}_\chi == 2\,\partial_\delta \sigma^{\beta\alpha}{}_\chi{}^{\chi\delta} + 3\,(\partial_\delta \sigma^{\alpha\chi\beta}{}_\chi + \partial_\delta \sigma^{\beta\delta}{}_\chi{}^{\alpha\chi})$	5
Total constraints/gauge generators:		26

Quadratic (free) action

$$S == \int\int\int\int (\tfrac{1}{6}(-4\,t_3\;\omega^{\alpha\prime}{}_\alpha\;\omega_\prime{}_\kappa{}^\kappa + 6\;f^{\alpha\beta}\;\tau_{\alpha\beta} + 6\;\omega^{\alpha\beta\chi}\;\sigma_{\alpha\beta\chi} + 8\,t_3\;\omega_\alpha{}^\kappa\;\partial_\prime f^{\alpha\prime}{}_\kappa - 8\,t_3\;\omega_\prime{}_\kappa{}^\kappa\;\partial^\prime f^\alpha{}_\alpha + 4\,t_3\,\partial_\prime f^\kappa{}_\kappa\;\partial^\prime f^\alpha{}_\alpha + 4\,t_2\;\omega_{\prime\theta\alpha}\;\partial^\theta f^{\alpha\prime} + 2\,t_2\,\partial_\alpha f_{\prime\theta}\,\partial^\theta f^{\alpha\prime} - 2\,t_2\,\partial_\prime f_{\alpha\theta}\,\partial^\theta f^{\alpha\prime} + t_2\,\partial_\theta f_{\alpha\prime}\,\partial^\theta f^{\alpha\prime} - 4\,t_2\;\omega_{\alpha\theta\prime}\;(\omega^{\alpha\prime\theta} + \partial^\theta f^{\alpha\prime}) + 2\,t_2\;\omega_{\alpha\prime\theta}\;(\omega^{\alpha\prime\theta} + 2\,\partial^\theta f^{\alpha\prime}) + 8\,r_2\,\partial_\beta \omega_{\alpha\prime\theta}\,\partial^\theta \omega^{\alpha\beta\prime} - 4\,r_2\,\partial_\beta \omega_{\alpha\theta\prime}\,\partial^\theta \omega^{\alpha\beta\prime} + 4\,r_2\,\partial_\prime \omega_{\alpha\theta}\,\partial^\theta \omega^{\alpha\beta\prime} + 2\,r_2\,\partial_\prime \omega_{\alpha\beta\theta}\,\partial^\theta \omega^{\alpha\beta\prime} - 4\,r_2\,\partial_\theta \omega_{\alpha\beta}\,\partial^\theta \omega^{\alpha\beta\prime} + 2\,r_2\,\partial_\theta \omega_{\alpha\beta\prime}\,\partial^\theta \omega^{\alpha\beta\prime} - 6\,r_5\,\partial_\theta \omega_\prime{}_\kappa{}^\kappa\,\partial^\theta \omega^{\alpha\prime}{}_\alpha + 6\,r_5\,\partial_\theta \omega_\prime{}_\kappa{}^\kappa\,\partial^\theta \omega^{\alpha\prime}{}_\alpha + 4\,t_3\,\partial_\prime f^{\alpha\prime}{}_\alpha\;f_\prime{}^\kappa{}_\kappa - 8\,t_3\,\partial^\prime f^\alpha{}_\alpha\;\partial_\kappa f_\prime{}^\kappa{}_\kappa - 6\,r_5\,\partial_\alpha \omega^{\alpha\theta}\,\partial_\kappa \omega_\prime{}_\theta{}^\kappa + 12\,r_5\,\partial^\theta \omega^{\alpha\prime}{}_\alpha\,\partial_\kappa \omega_\prime{}_\theta{}^\kappa + 6\,r_5\,\partial_\alpha \omega^{\alpha\theta}\,\partial_\chi \omega_\prime{}_\theta{}^\chi - 12\,r_5\,\partial^\theta \omega^{\alpha\prime}{}_\alpha\,\partial_\chi \omega_\prime{}_\theta{}^\chi))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

$\sigma_1^{\#1\,\dagger\,\alpha\beta}$

$\sigma_1^{\#1\,\alpha\beta}$	$\frac{1}{k^2 r_5}$	$-\frac{\sqrt{2}}{k^2 r_5 + k^4 r_5}$	$-\frac{i\sqrt{2}}{k r_5 + k^3 r_5}$	0	0	0	0
$\sigma_1^{\#2\,\alpha\beta}$	$-\frac{\sqrt{2}}{k^2 r_5 + k^4 r_5}$	$\frac{3k^2 r_5 + 2t_2}{(k+k^3)^2 r_5 t_2}$	$\frac{i(3k^2 r_5 + 2t_2)}{k(1+k^2)^2 r_5 t_2}$	0	0	0	0
$\tau_1^{\#1\,\alpha\beta}$	$-\frac{i\sqrt{2}}{k r_5 + k^3 r_5}$	$\frac{i(3k^2 r_5 + 2t_2)}{k(1+k^2)^2 r_5 t_2}$	$\frac{3k^2 r_5 + 2t_2}{(1+k^2)^2 r_5 t_2}$	0	0	0	0
$\sigma_1^{\#1\,\dagger\,\alpha}$	0	0	0	$\frac{1}{k^2 r_5}$	$\frac{\sqrt{2}}{k^2 r_5 + 2k^4 r_5}$	0	$\frac{2i}{k r_5 + 2k^3 r_5}$
$\sigma_1^{\#2\,\dagger\,\alpha}$	0	0	0	$\frac{\sqrt{2}}{k^2 r_5 + 2k^4 r_5}$	$\frac{3k^2 r_5 + 2t_3}{(k+2k^3)^2 r_5 t_3}$	0	$\frac{i\sqrt{2}\,(3k^2 r_5 + 2t_3)}{k(1+2k^2)^2 r_5 t_3}$
$\tau_1^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$\tau_1^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{2i}{k r_5 + 2k^3 r_5}$	$-\frac{i\sqrt{2}\,(3k^2 r_5 + 2t_3)}{k(1+2k^2)^2 r_5 t_3}$	0	$\frac{6k^2 r_5 + 4t_3}{(1+2k^2)^2 r_5 t_3}$

$\sigma_0^{\#1\,\dagger}$

$\sigma_0^{\#1\,\dagger}$	$\frac{1}{(1+2k^2)^2 t_3}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0
$\tau_0^{\#1\,\dagger}$	$-\frac{i\sqrt{2}\,k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0
$\tau_0^{\#2\,\dagger}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0	$\frac{1}{k^2 r_2 + t_2}$
$\sigma_0^{\#1\,\dagger}$	0	0	$\frac{1}{k^2 r_2 + t_2}$	0

$\omega_0^{\#1\,\dagger}$

$\omega_0^{\#1\,\dagger}$	t_3	$2\,k^2 t_3$	0	0
$f_0^{\#1\,\dagger}$	$-i\sqrt{2}\,k t_3$	0	0	$k^2 r_2 + t_2$
$f_0^{\#2\,\dagger}$	0	0	0	0
$\omega_0^{\#1\,\dagger}$	0	0	0	0

$\sigma_2^{\#1\,\dagger\,\alpha\beta}$

$\sigma_2^{\#1\,\dagger\,\alpha\beta}$	0	0	0
$\tau_2^{\#1\,\dagger\,\alpha\beta}$	0	0	0
$\sigma_2^{\#1\,\dagger\,\alpha\beta\chi}$	0	0	0

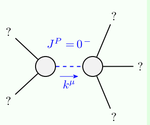
$\omega_{2^+}^{\#1\,\dagger\,\alpha\beta}$

$\omega_{2^+}^{\#1\,\dagger\,\alpha\beta}$	0	0	0
$f_{2^+}^{\#1\,\dagger\,\alpha\beta}$	0	0	0
$\omega_{2^+}^{\#1\,\dagger\,\alpha\beta\chi}$	0	0	0

$\omega_{1^+}^{\#1\,\dagger\,\alpha\beta}$ $\omega_{1^+}^{\#2\,\dagger\,\alpha\beta}$ $f_{1^+}^{\#1\,\dagger\,\alpha\beta}$ $\omega_{1^-}^{\#1\,\dagger\,\alpha}$ $\omega_{1^-}^{\#2\,\dagger\,\alpha}$ $f_{1^-}^{\#1\,\dagger\,\alpha}$ $f_{1^-}^{\#2\,\dagger\,\alpha}$

$\omega_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$k^2 r_5 + \frac{2t_2}{3}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{1}{3} i \sqrt{2}\, k t_2$	0	0	0	0
$\omega_{1^+}^{\#2\,\dagger\,\alpha\beta}$	$\frac{\sqrt{2}\,t_2}{3}$	$\frac{t_2}{3}$	$\frac{i k t_2}{3}$	0	0	0	0
$f_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{1}{3} i \sqrt{2}\, k t_2$	$-\frac{1}{3} i k t_2$	$\frac{k^2 t_2}{3}$	0	0	0	0
$\omega_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	$k^2 r_5 + \frac{2t_3}{3}$	$-\frac{\sqrt{2}\,t_3}{3}$	0	$-\frac{2}{3} i k t_3$
$\omega_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{\sqrt{2}\,t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3} i \sqrt{2}\, k t_3$
$f_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	$\frac{2 i k t_3}{3}$	$-\frac{1}{3} i \sqrt{2}\, k t_3$	0	$\frac{2k^2 t_3}{3}$

Massive and massless spectra



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

$r_2 < 0 \;\&\&\; t_2 > 0$