Particle spectrograph

Wave operator and propagator

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_0^{\#2} == 0$	$\partial_\beta \alpha_\tau{}^{\alpha\beta} == 0$	1
$\tau_0^{\#1} - 2\,i\,k\,\sigma_0^{\#1} == 0$	$\partial_\beta \alpha_\tau{}^{\alpha\beta} == \partial_\beta \alpha^{\beta\tau}{}_\alpha + 2\,\partial_\chi \alpha^{\chi\beta}{}_{\beta\alpha}$	1
$\tau_1^{\#2\,\alpha} + 2\,i\,k\,\sigma_1^{\#2\,\alpha} == 0$	$\partial_\chi \alpha^{\beta\alpha}{}_{\beta\tau} == \partial_\chi \alpha^{\chi\beta}{}_{\beta\tau} + 2\,\partial_\delta \alpha^{\delta\chi}{}_{\beta\alpha} + 2\,\partial_\alpha \alpha^{\beta\delta}{}_{\beta\chi}{}^{\alpha\beta\chi}$	3
$\tau_1^{\#1\,\alpha} == 0$	$\partial_\chi \alpha^{\beta\alpha}{}_{\beta\tau} == \partial_\chi \alpha^{\chi\beta}{}_{\beta\tau}{}^{\beta\alpha}$	3
$\tau_1^{\#1\,\alpha\beta} + i\,k\,\sigma_1^{\#2\,\alpha\beta} == 0$	$\partial_\chi \alpha^{\alpha}{}_{\beta\tau} + \partial_\chi \alpha^{\beta}{}_{\chi\tau}{}^{\alpha\beta} + \partial_\chi \alpha^{\chi}{}_{\tau}{}^{\alpha\beta}$ $2\,\partial_\delta \alpha_\chi{}^{\alpha}{}_{\sigma}{}^{\beta\chi\delta} + 2\,\partial_\delta \alpha^{\beta}{}_{\chi}{}^{\alpha\beta\chi\delta} == \partial_\chi \alpha^{\alpha}{}_{\tau}{}^{\chi\beta} + \partial_\chi \alpha^{\beta}{}_{\tau}{}^{\alpha\chi} +$ $\partial_\chi \alpha^{\chi}{}_{\tau}{}^{\beta\alpha} + 2\,\partial_\delta \alpha^{\beta}{}_{\chi}{}^{\alpha\chi\delta}$	3
$\sigma_2^{\#1\,\alpha\beta\chi} == 0$	$3\,\partial_\delta \alpha^{\beta\chi}{}_{\sigma}{}^{\beta\delta\varepsilon} + 3\,\partial_\varepsilon \alpha^{\delta\chi\beta}{}_{\sigma}{}^{\alpha\delta\varepsilon} + 3\,\partial_\varepsilon \alpha^{\beta\chi\delta}{}_{\sigma}{}^{\alpha\beta\varepsilon} +$ $2\,\partial_\varepsilon \alpha^{\varepsilon\chi}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\alpha\chi\delta} + 4\,\partial_\varepsilon \alpha^{\varepsilon\beta}{}_{\delta}{}^{\alpha\chi}{}_{\sigma}{}^{\alpha\beta\delta} + 4\,\partial_\varepsilon \alpha^{\varepsilon\chi}{}_{\delta}{}^{\beta\alpha}{}_{\sigma}{}^{\alpha\delta}{}_{\beta\chi} +$ $2\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\alpha\chi}{}_{\sigma}{}^{\alpha\beta\delta} + 2\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\beta\alpha}{}_{\sigma}{}^{\alpha\chi}{}_{\beta\chi} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \alpha^{\phi\varepsilon}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\beta\delta}{}_{\varepsilon} + 3\,\eta^{\alpha\chi}\,\partial_\phi \alpha^{\phi\beta}{}_{\varepsilon}{}^{\alpha\delta}{}_{\sigma}{}^{\beta\delta}{}_{\varepsilon} +$ $3\,\eta^{\beta\chi}\,\partial_\phi \alpha^{\phi\varepsilon}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\alpha\delta}{}_{\varepsilon} == 3\,\partial_\varepsilon \alpha^{\varepsilon\chi\beta}{}_{\delta}{}^{\alpha\delta\varepsilon} + 3\,\partial_\varepsilon \alpha^{\varepsilon\beta\chi}{}_{\delta}{}^{\alpha\delta}{}_{\sigma}{}^{\alpha\chi\delta} +$ $2\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\alpha\chi}{}_{\sigma}{}^{\alpha\beta\chi\delta} + 4\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\beta\chi}{}_{\sigma}{}^{\alpha\beta\delta}{}_{\chi} + 2\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\beta\alpha}{}_{\sigma}{}^{\beta\delta}{}_{\varepsilon}{}^{\alpha\chi\beta} +$ $4\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\alpha\chi}{}_{\sigma}{}^{\alpha\beta\chi} + 2\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\alpha\chi\delta}{}_{\chi} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \alpha^{\phi\varepsilon}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\alpha\delta}{}_{\varepsilon} + 3\,\eta^{\beta\chi}\,\partial_\phi \alpha^{\phi\varepsilon}{}_{\delta}{}^{\alpha\beta}{}_{\sigma}{}^{\alpha\delta}{}_{\varepsilon} +$ $3\,\eta^{\alpha\chi}\,\partial_\phi \alpha^{\phi\varepsilon}{}_{\delta}{}^{\beta\delta}{}_{\sigma}{}^{\alpha\beta}{}_{\varepsilon}{}^{\alpha\chi\delta}$	5
$\tau_2^{\#1\,\alpha\beta} == 0$	$4\,\partial_\delta \alpha^{\beta\delta\alpha\chi}{}_{\tau}{}^{\chi\delta} + 2\,\partial_\delta \alpha^{\beta\delta\alpha\tau}{}_{\chi}{}^{\chi\beta} +$ $3\,\partial_\delta \alpha^{\delta\chi}{}_{\tau}{}^{\alpha\beta} + 3\,\partial_\delta \alpha^{\delta\chi}{}_{\tau}{}^{\beta\alpha} +$ $2\,\eta^{\alpha\beta}\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\chi\delta}{}_{\chi} == 3\,\partial_\delta \alpha^{\delta\chi}{}_{\tau}{}^{\alpha\beta} + 3\,\partial_\delta \alpha^{\delta\alpha}{}_{\tau}{}^{\beta\chi} +$ $3\,\partial_\delta \alpha^{\delta\chi}{}_{\tau}{}^{\beta\alpha} + 3\,\partial_\delta \alpha^{\delta\beta}{}_{\chi}{}^{\alpha\tau}{}_{\chi} + 2\,\eta^{\alpha\beta}\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\tau\chi}$	5
$\sigma_2^{\#1\,\alpha\beta} == 0$	$3\,\partial_\delta \alpha_\chi{}^{\alpha}{}_{\sigma}{}^{\beta\chi\delta} + 3\,\partial_\delta \alpha^{\beta\chi}{}_{\chi}{}^{\alpha\delta} +$ $2\,\eta^{\alpha\beta}\,\partial_\varepsilon \alpha^{\varepsilon\delta}{}_{\delta}{}^{\alpha\chi\beta} == 2\,\partial_\delta \alpha^{\beta\delta}{}_{\chi}{}^{\alpha\chi\delta} +$ $3\,(\partial_\delta \alpha^{\delta}{}_{\chi}{}^{\alpha\chi\beta} + \partial_\delta \alpha^{\beta\delta}{}_{\chi}{}^{\alpha\chi\delta})$	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}{}_{\kappa}\,f^{\alpha\prime}{}_{\alpha} - 8\,t_3\;\omega_{\prime}{}_{\kappa}{}^{\kappa}\;\partial_{\prime}\,f^{\alpha}{}_{\alpha} + 4\,t_3\,\partial_{\prime}\,f^{\kappa}{}_{\alpha}\,\partial^{\beta}\,f^{\alpha\prime}{}_{\kappa} + 4\,t_2\;\omega_{\prime\theta\alpha}\,\partial^{\beta}\,f^{\alpha\prime} + 2\,t_2\,\partial_{\alpha}\,f_{\prime\theta}\,\partial^{\beta}\,f^{\alpha\prime} - 2\,t_2\,\partial_{\prime}\,f_{\alpha\theta}\,\partial^{\beta}\,f^{\alpha\prime} + t_2\,\partial_{\theta}\,f_{\alpha\prime}\,\partial^{\beta}\,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_{\beta}\omega_{\alpha\theta\prime}\,\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\prime}\,\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} + \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_{\alpha}\omega^{\alpha\theta}\,\partial_{\kappa}\omega_{\prime}{}_{\theta}{}^{\kappa} + 4\,t_3\,\partial_{\prime}\,f^{\alpha\prime}{}_{\alpha}\,\partial_{\prime}\,f^{\kappa}{}_{\kappa} - 8\,t_3\,\partial_{\prime}\,f^{\kappa}{}_{\alpha}\,\partial_{\kappa}\,f_{\prime}{}^{\alpha\prime} - 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_{\kappa}\omega_{\prime}{}_{\theta}{}^{\kappa} - 12\,r_5\,\partial^{\theta}\omega^{\alpha\prime}{}_{\alpha}\,\partial_{\kappa}\omega_{\prime}{}_{\theta}{}^{\kappa}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

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

	$\sigma_0^{\#1}$	$\tau_0^{\#1}$	$\tau_0^{\#2}$
$\sigma_0^{\#1\,\dagger}$	$\frac{1}{(1+2\,k^2)^2\,r_3}$	$-\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,r_3}$	0
$\tau_0^{\#1\,\dagger}$	$\frac{i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,r_3}$	$\frac{2\,k^2}{(1+2\,k^2)^2\,r_3}$	0
$\tau_0^{\#2\,\dagger}$	0	0	$\frac{1}{k^2\,r_2+t_2}$
$\sigma_0^{\#1\,\dagger}$	0	0	0

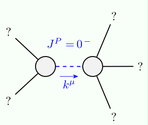
	$\omega_0^{\#1}$	$f_0^{\#2}$	$\omega_0^{\#1}$
$\omega_0^{\#1\,\dagger}$	t_3	$-i\,\sqrt{2}\,k\,t_3$	0
$f_0^{\#1\,\dagger}$	$i\,\sqrt{2}\,k\,t_3$	$2\,k^2\,t_3$	0
$f_0^{\#2\,\dagger}$	0	0	$k^2\,r_2+t_2$
$\omega_0^{\#1\,\dagger}$	0	0	0

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

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

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

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

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