Particle spectrograph

Wave operator and propagator

	$\Delta_{1^-}^{\#3}{}_{\alpha}$	$\Delta_{1^-}^{\#4}{}_{\alpha}$	$\Delta_{1^-}^{\#5}{}_{\alpha}$	$\Delta_{1^-}^{\#6}{}_{\alpha}$	$\mathcal{T}_{1^-}^{\#1}{}_{\alpha}$
$\Delta_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\Delta_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\Delta_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\Delta_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$-\frac{2}{\sqrt{3}\,(3a_0+4a_1k^2)}$	$-\frac{2\sqrt{5}}{3a_0+4a_1k^2}$	$\frac{1}{12}\sqrt{5}\,(\frac{4}{a_0}+\frac{1}{-3a_0-4a_1k^2})$	$\frac{64a_1k^2}{9a_0^2+12a_0a_1k^2}$	$\frac{2}{3}\sqrt{2}\,(-\frac{1}{a_0}+\frac{12}{3a_0+4a_1k^2})$
$\Delta_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{\sqrt{2}}{3a_0+4a_1k^2}$	$\frac{\sqrt{10}}{3a_0+4a_1k^2}$	$-\frac{5}{3a_0}+\frac{1}{-36a_0-48a_1k^2}$	$\frac{2}{\sqrt{3}\,(3a_0+4a_1k^2)}$	$\frac{14}{3a_0}-\frac{8}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	$-\frac{1}{-18a_0-24a_1k^2}$	$\frac{1}{-18a_0-24a_1k^2}$	$-\frac{1}{\sqrt{2}\,(18a_0+24a_1k^2)}$	$-\frac{1}{\sqrt{3}\,(3a_0+4a_1k^2)}$	$\frac{\sqrt{2}}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	$-\frac{\sqrt{5}}{6\,(3a_0+4a_1k^2)}$	$-\frac{\sqrt{5}}{3a_0+4a_1k^2}$	$-\frac{\sqrt{5}}{6\,(3a_0+4a_1k^2)}$	$-\frac{2\sqrt{5}}{3a_0+4a_1k^2}$	$\frac{\sqrt{10}}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	$-\frac{8}{a_0}+\frac{1}{3\sqrt{2}}$	$\frac{8}{3a_0}+\frac{1}{-18a_0-24a_1k^2}$	$\frac{8}{3a_0}+\frac{1}{-18a_0-24a_1k^2}$	$-\frac{2\sqrt{2}}{3a_0+4a_1k^2}$	$\frac{2}{\sqrt{3}\,(3a_0+4a_1k^2)}$
$\Delta_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	$\frac{4}{3a_0}+\frac{1}{-9a_0-12a_1k^2}$	$\frac{8}{a_0}+\frac{1}{3\sqrt{2}}$	$\frac{8}{a_0}+\frac{1}{3\sqrt{2}}$	$\frac{2\sqrt{2}}{3a_0+4a_1k^2}$	$\frac{2\sqrt{2}}{3a_0+4a_1k^2}$
$\mathcal{T}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0

	$\Delta_{1^+}^{\#1}{}_{\alpha\beta}$	$\Delta_{1^+}^{\#2}{}_{\alpha\beta}$	$\Delta_{1^+}^{\#3}{}_{\alpha\beta}$	$\Delta_{1^-}^{\#1}{}_{\alpha}$	$\Delta_{1^-}^{\#2}{}_{\alpha}$
$\Delta_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	$-\frac{2\sqrt{2}}{a_0}$	0	0	0
$\Delta_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0
$\Delta_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{4}{a_0}$	0	0
$\Delta_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{64a_1k^2}{9a_0^2+12a_0a_1k^2}$	$\frac{2}{3}\sqrt{2}\,(-\frac{1}{a_0}+\frac{12}{3a_0+4a_1k^2})$
$\Delta_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{2}{3}\sqrt{2}\,(-\frac{1}{a_0}+\frac{12}{3a_0+4a_1k^2})$	$\frac{14}{3a_0}-\frac{8}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{2}{\sqrt{3}\,(3a_0+4a_1k^2)}$	$\frac{\sqrt{2}}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{\sqrt{5}}{6\,(3a_0+4a_1k^2)}$	$\frac{\sqrt{10}}{3a_0+4a_1k^2}$
$\Delta_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{\sqrt{5}}{6\,(3a_0+4a_1k^2)}$	$\frac{2}{\sqrt{3}\,(3a_0+4a_1k^2)}$
$\Delta_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{\sqrt{5}}{6\,(3a_0+4a_1k^2)}$	$\frac{2\sqrt{2}}{3a_0+4a_1k^2}$
$\mathcal{T}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0

	$\mathcal{A}_{1^+}^{\#1}{}_{\alpha\beta}$	$\mathcal{A}_{1^+}^{\#2}{}_{\alpha\beta}$	$\mathcal{A}_{1^+}^{\#3}{}_{\alpha\beta}$	$\mathcal{A}_{1^-}^{\#1}{}_{\alpha}$	$\mathcal{A}_{1^-}^{\#2}{}_{\alpha}$
$\mathcal{A}_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{a_0}{4}$	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
$\mathcal{A}_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{a_0}{2\sqrt{2}}$	0	0	0	0
$\mathcal{A}_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{a_0}{4}$	0	0
$\mathcal{A}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{7a_0}{36}$	$\frac{a_0}{18\sqrt{2}}$
$\mathcal{A}_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{a_0}{18\sqrt{2}}$	$\frac{2a_0}{9}$
$\mathcal{A}_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{a_0}{3\sqrt{3}}$	$\frac{a_0}{3\sqrt{6}}$
$\mathcal{A}_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{1}{3}\sqrt{\frac{5}{3}}\,a_0$	$\frac{1}{6}\sqrt{\frac{5}{2}}\,(a_0-4a_1k^2)$
$\mathcal{A}_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{1}{3}\sqrt{\frac{2}{3}}\,a_0$	$\frac{a_0}{3\sqrt{3}}$
$\mathcal{A}_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{2a_0}{3\sqrt{3}}$	$\frac{1}{3}\sqrt{\frac{2}{3}}\,a_0$
$h_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0

	$\mathcal{A}_{1^-}^{\#3}{}_{\alpha}$	$\mathcal{A}_{1^-}^{\#4}{}_{\alpha}$	$\mathcal{A}_{1^-}^{\#5}{}_{\alpha}$	$\mathcal{A}_{1^-}^{\#6}{}_{\alpha}$	$h_{1^-}^{\#1}{}_{\alpha}$
$\mathcal{A}_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\mathcal{A}_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\mathcal{A}_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0
$\mathcal{A}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$-\frac{a_0}{3\sqrt{3}}$	$\frac{1}{3}(-a_0-a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{a_0{}^2-8a_1k^2}{6\sqrt{2}}$	0
$\mathcal{A}_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{a_0}{3\sqrt{6}}$	$\frac{1}{3}(-a_0-a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{a_0{}^2-4a_1k^2}{6\sqrt{2}}$	0
$\mathcal{A}_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	$\frac{1}{3}(-a_0-a_1k^2)$	$\frac{1}{3}(-a_0-a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{a_0{}^2-4a_1k^2}{6\sqrt{2}}$	0
$\mathcal{A}_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{1}{3}(a_0-5a_1k^2)$	$\frac{a_0{}^2-8a_1k^2}{6\sqrt{2}}$	0
$\mathcal{A}_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{1}{3}(a_0-2a_1k^2)$	$\frac{5a_0}{12}-\frac{4a_1k^2}{3}$	0
$\mathcal{A}_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	$\frac{1}{6}\sqrt{5}\,(a_0-2a_1k^2)$	$\frac{1}{6}\sqrt{5}\,(a_0-4a_1k^2)$	$\frac{1}{3}(a_0-4a_1k^2)$	0	0
$h_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0

	$\Delta_{0^+}^{\#1}$	$\Delta_{0^+}^{\#2}$	$\Delta_{0^+}^{\#3}$	$\Delta_{0^+}^{\#4}$	$\mathcal{T}_{0^+}^{\#1}$	$\mathcal{T}_{0^+}^{\#2}$	$\Delta_{0^-}^{\#1}$
$\Delta_{0^+}^{\#1}{}^{\dagger}$	$-\frac{2}{a_0}$	$\frac{\sqrt{\frac{2}{3}}}{a_0}$	$\frac{\sqrt{\frac{2}{3}}}{a_0}$	$\frac{2}{\sqrt{3}\,a_0}$	0	0	0
$\Delta_{0^+}^{\#2}{}^{\dagger}$	$\frac{\sqrt{\frac{2}{3}}}{a_0}$	$-\frac{13}{12a_0}$	$\frac{11}{12a_0}$	$-\frac{1}{6\sqrt{2}\,a_0}$	0	0	0
$\Delta_{0^+}^{\#3}{}^{\dagger}$	$\frac{\sqrt{\frac{2}{3}}}{a_0}$	$\frac{11}{12a_0}$	$-\frac{13}{12a_0}$	$-\frac{1}{6\sqrt{2}\,a_0}$	0	0	0
$\Delta_{0^+}^{\#4}{}^{\dagger}$	$\frac{2}{\sqrt{3}\,a_0}$	$-\frac{1}{6\sqrt{2}\,a_0}$	$-\frac{1}{6\sqrt{2}\,a_0}$	$-\frac{1}{6a_0}$	0	0	0
$\mathcal{T}_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0	$\frac{4}{a_0k^2}$	0	0
$\mathcal{T}_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0	0	0	0
$\Delta_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{2}{a_0+12a_1k^2}$

	$\mathcal{A}_{0^+}^{\#1}$	$\mathcal{A}_{0^+}^{\#2}$	$\mathcal{A}_{0^+}^{\#3}$	$\mathcal{A}_{0^+}^{\#4}$	$h_{0^+}^{\#1}$	$h_{0^+}^{\#2}$	$\mathcal{A}_{0^-}^{\#1}$
$\mathcal{A}_{0^+}^{\#1}{}^{\dagger}$	$\frac{a_0}{6}$	$\frac{a_0}{\sqrt{6}}$	$\frac{a_0}{\sqrt{6}}$	$\frac{a_0}{\sqrt{3}}$	0	0	0
$\mathcal{A}_{0^+}^{\#2}{}^{\dagger}$	$\frac{a_0}{\sqrt{6}}$	0	$\frac{a_0}{2}$	$\frac{a_0}{2\sqrt{2}}$	0	0	0
$\mathcal{A}_{0^+}^{\#3}{}^{\dagger}$	$\frac{a_0}{\sqrt{6}}$	$\frac{a_0}{2}$	0	$\frac{a_0}{2\sqrt{2}}$	0	0	0
$\mathcal{A}_{0^+}^{\#4}{}^{\dagger}$	$\frac{a_0}{\sqrt{3}}$	$\frac{a_0}{2\sqrt{2}}$	$\frac{a_0}{2\sqrt{2}}$	$\frac{a_0}{2}$	0	0	0
$h_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0	$\frac{a_0k^2}{4}$	0	0
$h_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0	0	0	0
$\mathcal{A}_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{a_0}{2}-6a_1k^2$

	$\Delta_{3^-}^{\#1}{}_{\alpha\beta\chi}$
$\mathcal{A}_{3^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	$-\frac{a_0}{2}$

	$\Delta_{3^-}^{\#1}{}_{\alpha\beta\chi}$
$\Delta_{3^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$	$-\frac{2}{a_0}$

Source constraints

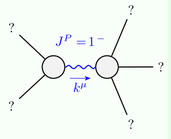
SO(3) irreps	Fundamental fields	Multiplicities
$\mathcal{T}_{0^+}^{\#2}==0$	$\partial_\beta\partial_\alpha\mathcal{T}^{\alpha\beta}==0$	1
$\Delta_{0^+}^{\#3}+3\,\Delta_{0^+}^{\#2}==2\,\Delta_{0^+}^{\#4}$	$\partial_\alpha\Delta^{\alpha\beta}{}_{\beta}==2\,(\partial_\beta\Delta^{\alpha}{}_{\alpha}{}^{\beta}+\partial_\beta\Delta^{\alpha\beta}{}_{\alpha})$	1
$\mathcal{T}_{1^-}^{\#1\alpha}==0$	$\partial_\chi\partial_\beta\partial^\alpha\mathcal{T}^{\beta\chi}==\partial_\chi\partial^\chi\partial_\beta\mathcal{T}^{\alpha\beta}$	3
$2\,(\Delta_{1^-}^{\#6\,\alpha}+\Delta_{1^-}^{\#5\,\alpha})==$ $\Delta_{1^-}^{\#4\,\alpha}+\Delta_{1^-}^{\#3\,\alpha}$	$\partial_\beta\partial^\alpha\Delta^{\beta\chi}{}_{\chi}+$ $2\,(\partial_\chi\partial^\chi\Delta^{\beta\alpha}{}_{\beta}+\partial_\chi\partial^\chi\Delta^{\beta}{}_{\beta}{}^{\alpha})==$ $2\,\partial_\chi\partial^\alpha\Delta^{\beta}{}_{\beta}{}^{\chi}+2\,\partial_\chi\partial^\alpha\Delta^{\beta\chi}{}_{\beta}+$ $\partial_\chi\partial^\chi\Delta^{\alpha\beta}{}_{\beta}$	3
Total constraints/gauge generators:		8

Quadratic (free) action

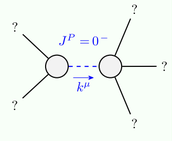
$S==$

$$\int\int\int(h^{\alpha\beta}\,\mathcal{T}_{\alpha\beta}+\mathcal{A}^{\alpha\beta\chi}\,\Delta_{\alpha\beta\chi}+\frac{1}{72}\,a_0\,(16\,\mathcal{A}_{\alpha}{}^{\chi}{}_{\chi}\,\mathcal{A}^{\alpha\beta}{}_{\beta}-16\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\,\mathcal{A}_{\beta}{}^{\chi}{}_{\chi}+32\,\mathcal{A}^{\alpha\beta}{}_{\alpha}\,\mathcal{A}_{\beta}{}^{\chi}{}_{\chi}+4\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\,\mathcal{A}^{\chi}{}_{\beta\chi}-36\,\mathcal{A}^{\alpha\beta\chi}\,(\mathcal{A}_{\beta\chi\alpha}+\partial_\beta h_{\alpha\chi})-18\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\,\partial_\beta h^{\chi}{}_{\chi}+36\,h^{\alpha\beta}{}_{\alpha}\,\partial_\beta h^{\chi}{}_{\chi}-18\,h^{\chi}{}_{\chi}\,\partial_\beta\mathcal{A}^{\alpha\beta}{}_{\alpha}+18\,\mathcal{A}^{\alpha\beta}{}_{\alpha}\,\partial_\beta h^{\chi}{}_{\chi}+18\,h^{\chi}{}_{\chi}\,\partial_\beta\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}-36\,h^{\alpha\beta}{}_{\alpha}\,\partial_\chi h^{\chi}{}_{\beta}+36\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\,\partial_\chi h^{\chi}{}_{\beta}-18\,h^{\alpha}{}_{\alpha}\,\partial_\chi h^{\chi\beta}+18\,h^{\alpha\beta}\,\partial_\chi\partial^\chi h_{\alpha\beta}-18\,h^{\alpha}{}_{\alpha}\,\partial_\chi\partial^\chi h^{\beta}{}_{\beta}+18\,\partial_\beta h^{\chi}{}_{\alpha}\,\partial^\chi h^{\alpha\beta}+9\,\partial_\chi h_{\alpha\beta}\,\partial^\chi h^{\alpha\beta}+36\,h_{\beta\chi}\,\partial^\chi\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta})+a_1\,(\partial_\alpha\mathcal{A}_{\chi}{}^{\mu}\,\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\mu}-\partial_\chi\mathcal{A}_{\alpha}{}^{\mu}\,\partial^\chi\mathcal{A}^{\alpha\beta}{}_{\beta}+2\,\partial_\alpha\mathcal{A}_{\beta\chi\mu}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-2\,\partial_\alpha\mathcal{A}_{\beta\mu\chi}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+2\,\partial_\alpha\mathcal{A}_{\chi\mu\beta}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-2\,\partial_\alpha\mathcal{A}_{\mu\beta\chi}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\alpha\mathcal{A}_{\mu\chi\beta}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-2\,\partial_\beta\mathcal{A}_{\alpha\chi\mu}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\beta\mathcal{A}_{\mu\alpha\chi}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-\partial_\beta\mathcal{A}_{\chi\mu\alpha}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\chi\mathcal{A}_{\alpha\beta\mu}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-\partial_\chi\mathcal{A}_{\beta\mu\alpha}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+2\,\partial_\chi\mathcal{A}_{\beta\mu\alpha}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-\partial_\mu\mathcal{A}_{\alpha\chi\beta}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\mu\mathcal{A}_{\beta\alpha\chi}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}-2\,\partial_\mu\mathcal{A}_{\beta\chi\alpha}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\mu\mathcal{A}_{\chi\beta\alpha}\,\partial^\mu\mathcal{A}^{\alpha\beta\chi}+\partial_\chi\partial_\beta h_{\alpha\mu}\,\partial^\chi h^{\alpha\beta}-\partial_\mu\partial_\beta h_{\alpha\chi}\,\partial^\mu\partial^\chi h^{\alpha\beta}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$$

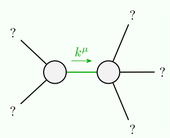
Massive and massless spectra



Massive particle	
Pole residue:	$\frac{25}{4a_1}>0$
Polarisations:	3
Square mass:	$-\frac{3a_0}{4a_1}>0$
Spin:	1
Parity:	Odd



Massive particle	
Pole residue:	$\frac{1}{6a_1}>0$
Polarisations:	1
Square mass:	$-\frac{a_0}{12a_1}>0$
Spin:	0
Parity:	Odd



Quadratic pole	
Pole residue:	$-\frac{1}{a_0}>0$
Polarisations:	2

Unitarity conditions

$a_0<0\;\&\&\;a_1>0$