Particle spectrograph

Wave operator and propagator

	$\Delta_1^{\#1}{}_{\alpha\beta}$	$\Delta_1^{\#2}{}_{\alpha\beta}$	$\Delta_1^{\#3}{}_{\alpha\beta}$	$\Delta_1^{\#1}{}_{\alpha}$	$\Delta_1^{\#2}{}_{\alpha}$	$\Delta_1^{\#3}{}_{\alpha}$	$\Delta_1^{\#4}{}_{\alpha}$	$\Delta_1^{\#5}{}_{\alpha}$	$\Delta_1^{\#6}{}_{\alpha}$	$\mathcal{T}_1^{\#1}{}_{\alpha}$
$\Delta_1^{\#1}{}_{+}^{\alpha\beta}$	0	$-\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_1^{\#2}{}_{+}^{\alpha\beta}$	$-\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_1^{\#3}{}_{+}^{\alpha\beta}$	0	0	$\frac{4}{a_0}$	0	0	0	0	0	0	0
$\Delta_1^{\#1}{}_{-}^{\alpha}$	0	0	0	0	0	0	0	0	0	0
$\Delta_1^{\#2}{}_{-}^{\alpha}$	0	0	0	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	0	0	0	0	0	0
$\Delta_1^{\#3}{}_{-}^{\alpha}$	0	0	0	$\frac{(4+k^2)^2}{2\,a_0\,(2+k^2)^2}$	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	0	0	0	0	0
$\Delta_1^{\#4}{}_{-}^{\alpha}$	0	0	0	$-\frac{2k^2}{\sqrt{3}\,(2a_0+a_0k^2)}$	$\frac{k^2\,(-2+k^2)}{2\sqrt{6}\,a_0\,(2+k^2)^2}$	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	0	0	0	0
$\Delta_1^{\#5}{}_{-}^{\alpha}$	0	0	0	0	$-\frac{\sqrt{5}\,k^2}{6\,a_0+2\,a_0k^2}$	$\frac{k^2\,(5+2k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	0	0	0
$\Delta_1^{\#6}{}_{-}^{\alpha}$	0	0	0	$\frac{\sqrt{2}\,k^2}{2\,a_0+a_0k^2}$	0	$-\frac{2\,(-7+k^2)}{3\,a_0\,(2+k^2)^2}$	$\frac{5}{3\,a_0}$	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	0	0
$\mathcal{T}_1^{\#1}{}_{-}^{\alpha}$	0	0	0	$\frac{2\,i\,\sqrt{2}\,k}{2\,a_0+a_0k^2}$	0	$\frac{i\,(6+k^2)}{\sqrt{6}\,a_0\,(2+k^2)^2}$	$\frac{i\,\sqrt{3}\,k}{2\,a_0+a_0k^2}$	$\frac{2\,i\,(3+k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$	$\frac{i\,\sqrt{3}\,k}{2\,a_0+a_0k^2}$	$\frac{2\,i\,(3+k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$

$\mathcal{A}_{3^-}^{\#1}{}_{\alpha\beta\chi}$

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

$\Delta_{3^-}^{\#1}{}_{\alpha\beta\chi}$

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

Quadratic (free) action

$$\mathcal{S} == \int\int\int\int \left(\tfrac{1}{4}\,(2\,a_0\,\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta}\,\mathcal{A}^{\chi}{}_{\beta\chi} + 4\,h^{\alpha\beta}\,\mathcal{T}_{\alpha\beta} + \mathcal{A}^{\alpha\beta\chi}\,(-2\,a_0\,\mathcal{A}_{\beta\chi\alpha} + 4\,\Delta_{\alpha\beta\chi}) - a_0\,h^{\chi}{}_{\chi}\,\partial_{\beta}\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta} + a_0\,h^{\chi}{}_{\chi}\,\partial_{\beta}\mathcal{A}^{\alpha\beta}{}_{\alpha} - 2\,a_0\,h_{\alpha\chi}\,\partial_{\beta}\mathcal{A}^{\alpha\beta\chi} + 2\,a_0\,h_{\beta\chi}\,\partial^{\chi}\mathcal{A}^{\alpha}{}_{\alpha}{}^{\beta})\right)[t, x, y, z]\,dz\,dy\,dx\,dt$$

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

Source constraints

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

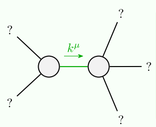
	$\Delta_{0^+}^{\#1}$	$\Delta_{0^+}^{\#2}$	$\Delta_{0^+}^{\#3}$	$\Delta_{0^+}^{\#4}$	$\mathcal{T}_{0^+}^{\#1}$	$\mathcal{T}_{0^+}^{\#2}$	$\Delta_{0^-}^{\#1}$
$\Delta_{0^+}^{\#1}\dagger$	0	$\frac{4\sqrt{6}}{16\,a_0+3\,a_0\,k^2}$	$-\frac{4\sqrt{\frac{2}{3}}}{16\,a_0+3\,a_0\,k^2}$	$-\frac{8}{\sqrt{3}\,(16\,a_0+3\,a_0\,k^2)}$	$-\frac{2\,i\,\sqrt{2}}{a_0\,k}$	$-\frac{2\,i\,\sqrt{6}\,k}{16\,a_0+3\,a_0\,k^2}$	0
$\Delta_{0^+}^{\#2}\dagger$	$\frac{4\sqrt{6}}{16\,a_0+3\,a_0\,k^2}$	$-\frac{144}{a_0\,(16+3\,k^2)^2}$	$\frac{16\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$-\frac{8\sqrt{2}\,(10+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$-\frac{8\,i\,\sqrt{3}}{16\,a_0\,k+3\,a_0\,k^3}$	$\frac{72\,i\,k}{a_0\,(16+3\,k^2)^2}$	0
$\Delta_{0^+}^{\#3}\dagger$	$-\frac{4\sqrt{\frac{2}{3}}}{16\,a_0+3\,a_0\,k^2}$	$\frac{16\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$-\frac{16\,(35+6\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$	$-\frac{8\sqrt{2}\,(22+3\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$	$\frac{8\,i}{\sqrt{3}\,(16\,a_0\,k+3\,a_0\,k^3)}$	$-\frac{8\,i\,k\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	0
$\Delta_{0^+}^{\#4}\dagger$	$-\frac{8}{\sqrt{3}\,(16\,a_0+3\,a_0\,k^2)}$	$-\frac{8\sqrt{2}\,(10+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$-\frac{8\sqrt{2}\,(22+3\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$	$\frac{32\,(13+3\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$	$\frac{8\,i\,\sqrt{\frac{2}{3}}}{16\,a_0\,k+3\,a_0\,k^3}$	$\frac{4\,i\,\sqrt{2}\,k\,(10+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	0
$\mathcal{T}_{0^+}^{\#1}\dagger$	$\frac{2\,i\,\sqrt{2}}{a_0\,k}$	$\frac{8\,i\,\sqrt{3}}{16\,a_0\,k+3\,a_0\,k^3}$	$-\frac{8\,i}{\sqrt{3}\,(16\,a_0\,k+3\,a_0\,k^3)}$	$-\frac{8\,i\,\sqrt{\frac{2}{3}}}{16\,a_0\,k+3\,a_0\,k^3}$	$\frac{4}{a_0\,k^2}$	$\frac{4\sqrt{3}}{16\,a_0+3\,a_0\,k^2}$	0
$\mathcal{T}_{0^+}^{\#2}\dagger$	$\frac{2\,i\,\sqrt{6}\,k}{16\,a_0+3\,a_0\,k^2}$	$-\frac{72\,i\,k}{a_0\,(16+3\,k^2)^2}$	$\frac{8\,i\,k\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$-\frac{4\,i\,\sqrt{2}\,k\,(10+3\,k^2)}{a_0\,(16+3\,k^2)^2}$	$\frac{4\sqrt{3}}{16\,a_0+3\,a_0\,k^2}$	$-\frac{36\,k^2}{a_0\,(16+3\,k^2)^2}$	0
$\Delta_{0^-}^{\#1}\dagger$	0	0	0	0	0	0	$-\frac{2}{a_0}$

	$\Delta_{2^+}^{\#1}{}_{\alpha\beta}$	$\Delta_{2^+}^{\#2}{}_{\alpha\beta}$	$\Delta_{2^+}^{\#3}{}_{\alpha\beta}$	$\mathcal{T}_{2^+}^{\#1}{}_{\alpha\beta}$	$\Delta_{2^-}^{\#1}{}_{\alpha\beta\chi}$	$\Delta_{2^-}^{\#2}{}_{\alpha\beta\chi}$
$\Delta_{2^+}^{\#1}{}_{\alpha\beta}\dagger$	0	$\frac{2\sqrt{3}}{a_0}$	$\frac{4}{\sqrt{3}\,a_0}$	$\frac{4\,i\,\sqrt{2}}{a_0\,k}$	0	$\frac{4}{a_0}$
$\Delta_{2^+}^{\#2}{}_{\alpha\beta}\dagger$	$\frac{2\sqrt{3}}{a_0}$	$-\frac{8}{3\,a_0}$	$-\frac{2\sqrt{2}}{3\,a_0}$	$-\frac{4\,i}{\sqrt{3}\,a_0\,k}$	$\frac{4}{a_0}$	0
$\Delta_{2^+}^{\#3}{}_{\alpha\beta}\dagger$	$\frac{4}{\sqrt{3}\,a_0}$	$-\frac{2\sqrt{2}}{3\,a_0}$	$\frac{8}{3\,a_0}$	$\frac{4\,i\,\sqrt{3}}{a_0\,k}$	0	0
$\mathcal{T}_{2^+}^{\#1}{}_{\alpha\beta}\dagger$	$\frac{4\,i\,\sqrt{2}}{a_0\,k}$	$-\frac{4\,i}{\sqrt{3}\,a_0\,k}$	$\frac{4\,i\,\sqrt{3}}{a_0\,k}$	$-\frac{8}{a_0\,k^2}$	0	0
$\Delta_{2^-}^{\#1}{}_{\alpha\beta}\dagger$	0	$\frac{2\sqrt{3}}{a_0}$	$\frac{4}{\sqrt{3}\,a_0}$	$-\frac{4\,i\,\sqrt{2}}{a_0\,k}$	0	0
$\Delta_{2^-}^{\#1}{}_{\alpha\beta\chi}\dagger$	0	0	0	0	0	$\frac{4}{a_0}$
$\Delta_{2^-}^{\#2}{}_{\alpha\beta\chi}\dagger$	0	0	0	0	$\frac{4}{a_0}$	0

	$\mathcal{A}_{2^+}^{\#1}{}_{\alpha\beta}$	$\mathcal{A}_{2^+}^{\#2}{}_{\alpha\beta}$	$\mathcal{A}_{2^+}^{\#3}{}_{\alpha\beta}$	$h_{2^+}^{\#1}{}_{\alpha\beta}$	$\mathcal{A}_{2^-}^{\#1}{}_{\alpha\beta\chi}$	$\mathcal{A}_{2^-}^{\#2}{}_{\alpha\beta\chi}$
$\mathcal{A}_{2^+}^{\#1}\dagger^{\alpha\beta}$	$\frac{a_0}{4}$	0	0	$\frac{i\,a_0\,k}{4\sqrt{2}}$	0	0
$\mathcal{A}_{2^+}^{\#2}\dagger^{\alpha\beta}$	0	$-\frac{a_0}{2}$	0	$\frac{i\,a_0\,k}{4\sqrt{3}}$	0	0
$\mathcal{A}_{2^+}^{\#3}\dagger^{\alpha\beta}$	0	0	$\frac{a_0}{4}$	$-\frac{i\,a_0\,k}{4\sqrt{6}}$	0	0
$h_{2^+}^{\#1}\dagger^{\alpha\beta}$	$-\frac{i\,a_0\,k}{4\sqrt{2}}$	$-\frac{i\,a_0\,k}{4\sqrt{3}}$	$\frac{i\,a_0\,k}{4\sqrt{6}}$	0	0	0
$\mathcal{A}_{2^-}^{\#1}\dagger^{\alpha\beta\chi}$	0	0	0	0	$\frac{a_0}{4}$	0
$\mathcal{A}_{2^-}^{\#2}\dagger^{\alpha\beta\chi}$	0	0	0	0	0	$\frac{a_0}{4}$

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

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

$a_0 < 0$