Particle spectrograph

Wave operator and propagator

	$\Delta_{1^+}^{\#1}{}_{\alpha\beta}$	$\Delta_{1^+}^{\#2}{}_{\alpha\beta}$	$\Delta_{1^+}^{\#3}{}_{\alpha\beta}$	$\Delta_{1^-}^{\#1}{}_{\alpha}$	$\Delta_{1^-}^{\#2}{}_{\alpha}$	$\Delta_{1^-}^{\#3}{}_{\alpha}$	$\Delta_{1^-}^{\#4}{}_{\alpha}$	$\Delta_{1^-}^{\#5}{}_{\alpha}$	$\Delta_{1^-}^{\#6}{}_{\alpha}$	$\mathcal{T}_{1^-}^{\#1}{}_{\alpha}$
$\Delta_{1^+}^{\#1}{}^{\dagger\alpha\beta}$	0	$-\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_{1^+}^{\#2}{}^{\dagger\alpha\beta}$	$-\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_{1^+}^{\#3}{}^{\dagger\alpha\beta}$	0	0	$\frac{4}{a_0}$	0	0	0	0	0	0	0
$\Delta_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	$\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0
$\Delta_{1^-}^{\#2}{}^{\dagger\alpha}$	0	0	0	$\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0	0	0
$\Delta_{1^-}^{\#3}{}^{\dagger\alpha}$	0	0	0	0	0	$-\frac{19}{12\,a_0}$	$\frac{5\sqrt{5}}{12\,a_0}$	$-\frac{1}{6\sqrt{2}\,a_0}$	$-\frac{1}{6\,a_0}$	0
$\Delta_{1^-}^{\#4}{}^{\dagger\alpha}$	0	0	0	0	0	$\frac{5\sqrt{5}}{12\,a_0}$	$\frac{1}{12\,a_0}$	$-\frac{\sqrt{\frac{5}{2}}}{6\,a_0}$	$-\frac{\sqrt{5}}{6\,a_0}$	0
$\Delta_{1^-}^{\#5}{}^{\dagger\alpha}$	0	0	0	0	0	$-\frac{1}{6\sqrt{2}\,a_0}$	$-\frac{\sqrt{\frac{5}{2}}}{6\,a_0}$	$\frac{17}{6\,a_0}$	$-\frac{7}{3\sqrt{2}\,a_0}$	0
$\Delta_{1^-}^{\#6}{}^{\dagger\alpha}$	0	0	0	0	0	$-\frac{1}{6\,a_0}$	$-\frac{\sqrt{5}}{6\,a_0}$	$-\frac{7}{3\sqrt{2}\,a_0}$	$\frac{5}{3\,a_0}$	0
$\mathcal{T}_{1^-}^{\#1}{}^{\dagger\alpha}$	0	0	0	0	0	0	0	0	0	0

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

Quadratic (free) action

$$\mathcal{S} == \iiiint\Big(\tfrac{1}{8}\,(8\,h^{\alpha\beta}\,\mathcal{T}_{\alpha\beta} - 4\,\Gamma^{\alpha\beta\chi}\,(a_0\,\Gamma_{\beta\chi\alpha} - 2\,\Delta_{\alpha\beta\chi} + a_0\,\partial_\beta h_{\alpha\chi}) + 2\,a_0\,\Gamma^{\alpha\beta}{}_{\alpha}\,\partial_\beta h^{\chi}{}_{\chi} - 2\,a_0\,h^{\chi}{}_{\chi}\,\partial_\beta \Gamma^{\alpha}{}_{\alpha}{}^{\beta} + 2\,a_0\,h^{\chi}{}_{\chi}\,\partial_\beta \Gamma^{\alpha\beta}{}_{\alpha} - 4\,a_0\,h_{\alpha\chi}\,\partial_\beta \Gamma^{\alpha\beta\chi} + 4\,a_0\,h^{\alpha\beta}\,\partial_\beta \partial_\alpha h^{\chi}{}_{\chi} - a_0\,\partial_\beta h^{\chi}{}_{\chi}\,\partial^\beta h^{\alpha}{}_{\alpha} - 4\,a_0\,\partial_\alpha h^{\alpha\beta}\,\partial_\chi h_\beta{}^{\chi} + 4\,a_0\,\partial^\beta h^{\alpha}{}_{\alpha}\,\partial_\chi h_\beta{}^{\chi} + 2\,a_0\,\Gamma^{\alpha}{}_{\alpha}{}^{\beta}\,(2\,\Gamma^{\chi}{}_{\beta\chi} - \partial_\beta h^{\chi}{}_{\chi} + 2\,\partial_\chi h_\beta{}^{\chi}) - 8\,a_0\,h^{\alpha\beta}\,\partial_\chi \partial_\beta h_\alpha{}^{\chi} + 2\,a_0\,h^{\alpha}{}_{\alpha}\,\partial_\chi \partial_\beta h^{\beta\chi} + 4\,a_0\,h^{\alpha\beta}\,\partial_\chi \partial^\chi h_{\alpha\beta} - 2\,a_0\,h^{\alpha}{}_{\alpha}\,\partial_\chi \partial^\chi h^{\beta}{}_{\beta} - 2\,a_0\,\partial_\beta h_{\alpha\chi}\,\partial^\chi h^{\alpha\beta} + 3\,a_0\,\partial_\chi h_{\alpha\beta}\,\partial^\chi h^{\alpha\beta} + 4\,a_0\,h_{\beta\chi}\,\partial^\chi \Gamma^{\alpha}{}_{\alpha}{}^{\beta})\Big)[t, x, y, z]\,dz\,dy\,dx\,dt$$

	$\Delta_{0^+}^{\#1}$	$\Delta_{0^+}^{\#2}$	$\Delta_{0^+}^{\#3}$	$\Delta_{0^+}^{\#4}$	$\mathcal{T}_{0^+}^{\#1}$	$\mathcal{T}_{0^+}^{\#2}$	$\Delta_{0^-}^{\#1}$
$\Delta_{0^+}^{\#1}{}^{\dagger}$	$-\frac{2}{a_0}$	0	0	0	0	0	0
$\Delta_{0^+}^{\#2}{}^{\dagger}$	0	$-\frac{3}{4\,a_0}$	$\frac{5}{4\,a_0}$	$-\frac{1}{2\sqrt{2}\,a_0}$	0	0	0
$\Delta_{0^+}^{\#3}{}^{\dagger}$	0	$\frac{5}{4\,a_0}$	$-\frac{3}{4\,a_0}$	$-\frac{1}{2\sqrt{2}\,a_0}$	0	0	0
$\Delta_{0^+}^{\#4}{}^{\dagger}$	0	$-\frac{1}{2\sqrt{2}\,a_0}$	$-\frac{1}{2\sqrt{2}\,a_0}$	$\frac{1}{2\,a_0}$	0	0	0
$\mathcal{T}_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0	$\frac{4}{a_0\,k^2}$	0	0
$\mathcal{T}_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0	0	0	0
$\Delta_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{2}{a_0}$

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

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

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

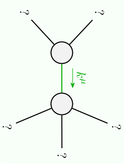
	$\Gamma_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#3}{}_{\alpha\beta}$	$h_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^-}^{\#1}{}_{\alpha\beta\chi}$	$\Gamma_{2^-}^{\#2}{}_{\alpha\beta\chi}$
$\Gamma_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	$\frac{a_0}{4}$	0	0	0	0	0
$\Gamma_{2^+}^{\#2}{}^{\dagger\alpha\beta}$	0	$-\frac{a_0}{2}$	0	0	0	0
$\Gamma_{2^+}^{\#3}{}^{\dagger\alpha\beta}$	0	0	$\frac{a_0}{4}$	0	0	0
$h_{2^+}^{\#1}{}^{\dagger\alpha\beta}$	0	0	0	$-\frac{a_0\,k^2}{8}$	0	0
$\Gamma_{2^-}^{\#1}{}^{\dagger\alpha\beta\chi}$	0	0	0	0	$\frac{a_0}{4}$	0
$\Gamma_{2^-}^{\#2}{}^{\dagger\alpha\beta\chi}$	0	0	0	0	0	$\frac{a_0}{4}$

	$\Gamma_{0^+}^{\#1}$	$\Gamma_{0^+}^{\#2}$	$\Gamma_{0^+}^{\#3}$	$\Gamma_{0^+}^{\#4}$	$h_{0^+}^{\#1}$	$h_{0^+}^{\#2}$	$\Gamma_{0^-}^{\#1}$
$\Gamma_{0^+}^{\#1}{}^{\dagger}$	$-\frac{a_0}{2}$	0	0	0	0	0	0
$\Gamma_{0^+}^{\#2}{}^{\dagger}$	0	0	$\frac{a_0}{2}$	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
$\Gamma_{0^+}^{\#3}{}^{\dagger}$	0	$\frac{a_0}{2}$	0	$-\frac{a_0}{2\sqrt{2}}$	0	0	0
$\Gamma_{0^+}^{\#4}{}^{\dagger}$	0	$-\frac{a_0}{2\sqrt{2}}$	$-\frac{a_0}{2\sqrt{2}}$	$\frac{a_0}{2}$	0	0	0
$h_{0^+}^{\#1}{}^{\dagger}$	0	0	0	0	$\frac{a_0\,k^2}{4}$	0	0
$h_{0^+}^{\#2}{}^{\dagger}$	0	0	0	0	0	0	0
$\Gamma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{a_0}{2}$

Source constraints/gauge generators	Multiplicities	Total constraints:
SO(3)⁻ irreps		
$\mathcal{T}_{0^-}^{\#2} == 0$	1	8
$\Delta_{0^+}^{\#3} + 2\,\Delta_{0^+}^{\#4} + 3\,\Delta_{0^+}^{\#2} == 0$	1	
$\mathcal{T}_{1^-}^{\#1\,\alpha} == 0$	3	
$2\,\Delta_{1^-}^{\#6\,\alpha} + \Delta_{1^-}^{\#4\,\alpha} + 2\,\Delta_{1^-}^{\#5\,\alpha} + \Delta_{1^-}^{\#3\,\alpha} == 0$	3	

Massive and massless spectra

$a_0 < 0$



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

(No massive particles)

Unitarity conditions