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	$\frac{2\sqrt{2}}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_1^{\#2}{}^\dagger{}^{\alpha}$	$\frac{2\sqrt{2}}{a_0}$	$\frac{2}{a_0}$	0	0	0	0	0	0	0	0
$\Delta_1^{\#3}{}^\dagger{}^{\alpha}$	0	0	0	0	0	$-\frac{19}{12a_0}$	$\frac{5\sqrt{5}}{12a_0}$	$-\frac{1}{6\sqrt{2}a_0}$	$-\frac{1}{6a_0}$	0
$\Delta_1^{\#4}{}^\dagger{}^{\alpha}$	0	0	0	0	0	$\frac{5\sqrt{5}}{12a_0}$	$\frac{1}{12a_0}$	$-\frac{\sqrt{5}}{6a_0}$	$-\frac{\sqrt{5}}{6a_0}$	0
$\Delta_1^{\#5}{}^\dagger{}^{\alpha}$	0	0	0	0	0	$-\frac{1}{6\sqrt{2}a_0}$	$-\frac{\sqrt{5}}{6a_0}$	$\frac{17}{6a_0}$	$-\frac{7}{3\sqrt{2}a_0}$	0
$\Delta_1^{\#6}{}^\dagger{}^{\alpha}$	0	0	0	0	0	$-\frac{1}{6a_0}$	$-\frac{\sqrt{5}}{6a_0}$	$-\frac{7}{3\sqrt{2}a_0}$	$\frac{5}{3a_0}$	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	$-\frac{a_0}{3}$	$\frac{\sqrt{5}\,a_0}{6}$	$\frac{a_0}{3}$	$\frac{a_0}{3}$	$-\frac{a_0}{6}$	0
$\Gamma_{1^-}^{\#4}{}^\dagger{}^{\alpha}$	0	0	0	$\frac{\sqrt{5}\,a_0}{6}$	0	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{1}{6}\sqrt{\frac{5}{2}}\,a_0$	$\frac{a_0}{3}$	$-\frac{\sqrt{5}\,a_0}{6}$	0
$\Gamma_{1^-}^{\#5}{}^\dagger{}^{\alpha}$	0	0	0	0	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{1}{6}\sqrt{\frac{5}{2}}\,a_0$	$\frac{a_0}{3}$	$\frac{a_0}{3}$	$\frac{a_0}{6\sqrt{2}}$	0
$\Gamma_{1^-}^{\#6}{}^\dagger{}^{\alpha}$	0	0	0	0	0	$-\frac{a_0}{6}$	$-\frac{\sqrt{5}\,a_0}{6}$	$\frac{a_0}{6\sqrt{2}}$	$\frac{5a_0}{12}$	0
$h_{1^-}^{\#1}{}^\dagger{}^{\alpha}$	0	0	0	0	0	0	0	0	0	0

Quadratic (free) Lagrangian density

$$-\frac{1}{2}a_0\,\Gamma^{\alpha\beta\chi}\,\Gamma_{\beta\chi\alpha}+\frac{1}{2}a_0\,\Gamma^{\alpha}{}_{\alpha}{}^{\beta}\,\Gamma^{\chi}{}_{\beta\chi}+h^{\alpha\beta}\,\mathcal{T}_{\alpha\beta}+\Gamma^{\alpha\beta\chi}\,\Delta_{\alpha\beta\chi}-$$
$$\frac{1}{2}a_0\,\Gamma^{\alpha\beta\chi}\,\partial_\beta h_{\alpha\chi}-\frac{1}{4}a_0\,\Gamma^{\alpha}{}_{\alpha}{}^{\beta}\,\partial_\beta h^{\chi}{}_{\chi}+\frac{1}{4}a_0\,\Gamma^{\alpha\beta}{}_{\alpha}\,\partial_\beta h^{\chi}{}_{\chi}-\frac{1}{4}a_0\,h^{\chi}{}_{\chi}\,\partial^\beta h^{\alpha}{}_{\alpha}+$$
$$\frac{1}{4}a_0\,h^{\chi}{}_{\chi}\,\partial_\beta\Gamma^{\alpha\beta}{}_{\alpha}-\frac{1}{2}a_0\,h_{\alpha\chi}\,\partial_\beta\Gamma^{\alpha\beta\chi}+\frac{1}{2}a_0\,h^{\alpha\beta}\,\partial_\beta\partial_\alpha h^{\chi}{}_{\chi}-\frac{1}{8}a_0\,\partial_\beta h^{\chi}{}_{\chi}\,\partial^\beta h^{\alpha}{}_{\alpha}+$$
$$\frac{1}{2}a_0\,\Gamma^{\alpha}{}_{\alpha}{}^{\beta}\,\partial_\chi h_\beta{}^{\chi}-\frac{1}{2}a_0\,\partial_\alpha h^{\alpha\beta}\,\partial_\chi h_\beta{}^{\chi}+\frac{1}{2}a_0\,\partial^\beta h^{\alpha}{}_{\alpha}\,\partial_\chi h_\beta{}^{\chi}-a_0\,h^{\alpha\beta}\,\partial_\chi\partial_\beta h^{\chi}{}_{\alpha}+$$
$$\frac{1}{4}a_0\,h^{\alpha}{}_{\alpha}\,\partial_\chi\partial_\beta h^{\beta\chi}+\frac{1}{2}a_0\,h^{\alpha\beta}\,\partial_\chi\partial^\chi h_{\alpha\beta}-\frac{1}{4}a_0\,h^{\alpha}{}_{\alpha}\,\partial_\chi\partial^\chi h^{\beta}{}_{\beta}-$$
$$\frac{1}{4}a_0\,\partial_\beta h_{\alpha\chi}\,\partial^\chi h^{\alpha\beta}+\frac{3}{8}a_0\,\partial_\chi h_{\alpha\beta}\,\partial^\chi h^{\alpha\beta}+\frac{1}{2}a_0\,h_{\beta\chi}\,\partial^\chi\Gamma^{\alpha}{}_{\alpha}{}^{\beta}$$

	$\Delta_3^{\#1}{}_{\alpha\beta\chi}$
$\Delta_3^{\#1}{}^\dagger{}^{\alpha\beta\chi}$	$-\frac{2}{a_0}$

	$\Gamma_3^{\#1}{}_{\alpha\beta\chi}$
$\Gamma_3^{\#1}{}^\dagger{}^{\alpha\beta\chi}$	$-\frac{a_0}{2}$

	$\Delta_0^{\#1}{}_{}$	$\Delta_0^{\#2}{}_{}$	$\Delta_0^{\#3}{}_{}$	$\Delta_0^{\#4}{}_{}$	$\mathcal{T}_0^{\#1}{}_{}$	$\mathcal{T}_0^{\#2}{}_{}$	$\Delta_0^{\#1}{}_{}$
$\Delta_0^{\#1}{}^\dagger{}$	$-\frac{2}{a_0}$	0	0	0	0	0	$-\frac{2}{a_0}$
$\Delta_0^{\#2}{}^\dagger{}$	0	$-\frac{3}{4a_0}$	$\frac{5}{4a_0}$	$-\frac{1}{2\sqrt{2}a_0}$	0	0	0
$\Delta_0^{\#3}{}^\dagger{}$	0	$\frac{5}{4a_0}$	$-\frac{3}{4a_0}$	$-\frac{1}{2\sqrt{2}a_0}$	0	0	0
$\Delta_0^{\#4}{}^\dagger{}$	0	$-\frac{1}{2\sqrt{2}a_0}$	$-\frac{1}{2\sqrt{2}a_0}$	$\frac{1}{2a_0}$	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	$-\frac{2}{a_0}$

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

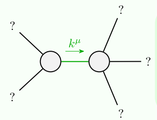
	$\Gamma_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#3}{}_{\alpha\beta}$	$h_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^-}^{\#1}{}_{\alpha\beta\chi}$	$\Gamma_{2^-}^{\#2}{}_{\alpha\beta\chi}$
$\Gamma_{2^+}^{\#1}{}^\dagger{}^{\alpha\beta}$	$\frac{a_0}{4}$	0	0	0	0	0
$\Gamma_{2^+}^{\#2}{}^\dagger{}^{\alpha\beta}$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

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

SO(3) irreps	Multiplicities
$\mathcal{T}_{0^+}^{\#2} == 0$	1
$\Delta_{0^+}^{\#3} + 2\,\Delta_{0^+}^{\#4} + 3\,\Delta_{0^+}^{\#2} == 0$	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
Total constraints:	8

Massive and massless spectra



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

(No massive particles)

Unitarity conditions

$a_0 < 0$