Particle spectrograph

Wave operator and propagator

Quadratic (free) Lagrangian density

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

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

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

$\Gamma_{3^-}^{\#1\,\alpha\beta\chi}$ ↦ $\Gamma_{3^-}^{\#1\,\dagger\,\alpha\beta\chi}$: $-\frac{a_0}{2}$

$\Gamma_{0^+}^{\#1}$ ↦ $\Gamma_{0^+}^{\#1\,\dagger}$: $-\frac{a_0}{2}$

$h_{0^+}^{\#1}$ ↦ $h_{0^+}^{\#1\,\dagger}$: $-\frac{a_0}{2}$

$h_{0^+}^{\#2}$ ↦ $h_{0^+}^{\#2\,\dagger}$: $-\frac{a_0}{2}$

$\Gamma_{0^+}^{\#4}$ ↦ $\Gamma_{0^+}^{\#4\,\dagger}$: $-\frac{a_0}{2}$

$\Gamma_{0^+}^{\#3}$ ↦ $\Gamma_{0^+}^{\#3\,\dagger}$: $-\frac{a_0}{2}$

$\Gamma_{0^+}^{\#2}$ ↦ $\Gamma_{0^+}^{\#2\,\dagger}$: $-\frac{a_0}{2}$

$\Gamma_{0^+}^{\#1}$ ↦ $\Gamma_{0^+}^{\#1\,\dagger}$: $-\frac{a_0}{2}$

$\Delta_{2^+}^{\#1\,\alpha\beta}$ ↦ $\Delta_{2^+}^{\#1\,\dagger\,\alpha\beta}$: 0

$\Delta_{2^+}^{\#2\,\alpha\beta}$ ↦ $\Delta_{2^+}^{\#2\,\dagger\,\alpha\beta}$: $2\,\frac{\sqrt{2}}{a_0}$

$\Delta_{2^+}^{\#3\,\alpha\beta}$ ↦ $\Delta_{2^+}^{\#3\,\dagger\,\alpha\beta}$: $\frac{4}{\sqrt{3}\,a_0}$

$\mathcal{T}_{2^+}^{\#1\,\alpha\beta}$ ↦ $\mathcal{T}_{2^+}^{\#1\,\dagger\,\alpha\beta}$: $\frac{4\,i\,\sqrt{2}}{a_0\,k}$

$\Delta_{2^-}^{\#1\,\alpha\beta\chi}$ ↦ $\Delta_{2^-}^{\#1\,\dagger\,\alpha\beta\chi}$: 0

$\Delta_{2^-}^{\#2\,\alpha\beta\chi}$ ↦ $\Delta_{2^-}^{\#2\,\dagger\,\alpha\beta\chi}$: 0

$\Gamma_{2^-}^{\#1\,\alpha\beta\chi}$ ↦ $\Gamma_{2^-}^{\#1\,\dagger\,\alpha\beta\chi}$: 0

$\Gamma_{2^-}^{\#2\,\alpha\beta\chi}$ ↦ $\Gamma_{2^-}^{\#2\,\dagger\,\alpha\beta\chi}$: 0

$h_{2^+}^{\#1\,\alpha\beta}$ ↦ $h_{2^+}^{\#1\,\dagger\,\alpha\beta}$: 0

$\Gamma_{2^+}^{\#1\,\alpha\beta}$ ↦ $\Gamma_{2^+}^{\#1\,\dagger\,\alpha\beta}$: $\frac{a_0}{4}$

$\Gamma_{2^+}^{\#2\,\alpha\beta}$ ↦ $\Gamma_{2^+}^{\#2\,\dagger\,\alpha\beta}$: 0

$\Gamma_{2^+}^{\#3\,\alpha\beta}$ ↦ $\Gamma_{2^+}^{\#3\,\dagger\,\alpha\beta}$: $-\frac{a_0}{2}$

$h_{2^+}^{\#1\,\alpha\beta}$ ↦ $h_{2^+}^{\#1\,\dagger\,\alpha\beta}$: $-\frac{i\,a_0\,k}{4\,\sqrt{2}}$

$\Gamma_{2^-}^{\#1\,\alpha\beta\chi}$ ↦ $\Gamma_{2^-}^{\#1\,\dagger\,\alpha\beta\chi}$: 0

$\Gamma_{2^-}^{\#2\,\alpha\beta\chi}$ ↦ $\Gamma_{2^-}^{\#2\,\dagger\,\alpha\beta\chi}$: $\frac{a_0}{4}$

$\Delta_{1^+}^{\#1\,\alpha\beta}$ ↦ $\Delta_{1^+}^{\#1\,\dagger\,\alpha\beta}$: 0

$\Delta_{1^+}^{\#2\,\alpha\beta}$ ↦ $\Delta_{1^+}^{\#2\,\dagger\,\alpha\beta}$: $-\frac{2\,\sqrt{2}}{a_0}$

$\Delta_{1^+}^{\#3\,\alpha\beta}$ ↦ $\Delta_{1^+}^{\#3\,\dagger\,\alpha\beta}$: $\frac{4}{a_0}$

$\Delta_{1^-}^{\#1\,\alpha}$ ↦ $\Delta_{1^-}^{\#1\,\dagger\,\alpha}$: 0

$\Delta_{1^-}^{\#2\,\alpha}$ ↦ $\Delta_{1^-}^{\#2\,\dagger\,\alpha}$: 0

$\Delta_{1^-}^{\#3\,\alpha}$ ↦ $\Delta_{1^-}^{\#3\,\dagger\,\alpha}$: 0

$\Delta_{1^-}^{\#4\,\alpha}$ ↦ $\Delta_{1^-}^{\#4\,\dagger\,\alpha}$: 0

$\Delta_{1^-}^{\#5\,\alpha}$ ↦ $\Delta_{1^-}^{\#5\,\dagger\,\alpha}$: 0

$\Delta_{1^-}^{\#6\,\alpha}$ ↦ $\Delta_{1^-}^{\#6\,\dagger\,\alpha}$: 0

$\mathcal{T}_{1^-}^{\#1\,\alpha}$ ↦ $\mathcal{T}_{1^-}^{\#1\,\dagger\,\alpha}$: 0

$\Gamma_{1^+}^{\#1\,\alpha\beta}$ ↦ $\Gamma_{1^+}^{\#1\,\dagger\,\alpha\beta}$: $-\frac{a_0}{4}$

$\Gamma_{1^+}^{\#2\,\alpha\beta}$ ↦ $\Gamma_{1^+}^{\#2\,\dagger\,\alpha\beta}$: $-\frac{a_0}{2\,\sqrt{2}}$

$\Gamma_{1^+}^{\#3\,\alpha\beta}$ ↦ $\Gamma_{1^+}^{\#3\,\dagger\,\alpha\beta}$: 0

$\Gamma_{1^-}^{\#1\,\alpha}$ ↦ $\Gamma_{1^-}^{\#1\,\dagger\,\alpha}$: 0

$\Gamma_{1^-}^{\#2\,\alpha}$ ↦ $\Gamma_{1^-}^{\#2\,\dagger\,\alpha}$: 0

$\Gamma_{1^-}^{\#3\,\alpha}$ ↦ $\Gamma_{1^-}^{\#3\,\dagger\,\alpha}$: 0

$\Gamma_{1^-}^{\#4\,\alpha}$ ↦ $\Gamma_{1^-}^{\#4\,\dagger\,\alpha}$: 0

$\Gamma_{1^-}^{\#5\,\alpha}$ ↦ $\Gamma_{1^-}^{\#5\,\dagger\,\alpha}$: 0

$\Gamma_{1^-}^{\#6\,\alpha}$ ↦ $\Gamma_{1^-}^{\#6\,\dagger\,\alpha}$: 0

$h_{1^-}^{\#1\,\alpha}$ ↦ $h_{1^-}^{\#1\,\dagger\,\alpha}$: 0

$\Delta_{0^+}^{\#1}$ ↦ $\Delta_{0^+}^{\#1\,\dagger}$: $-\frac{2}{a_0}$

$\Delta_{0^+}^{\#2}$ ↦ $\Delta_{0^+}^{\#2\,\dagger}$: $\frac{4\,\sqrt{2}}{16\,a_0+3\,a_0\,k^2}$

$\Delta_{0^+}^{\#3}$ ↦ $\Delta_{0^+}^{\#3\,\dagger}$: $-\frac{144}{a_0\,(16+3\,k^2)^2}$

$\Delta_{0^+}^{\#4}$ ↦ $\Delta_{0^+}^{\#4\,\dagger}$: $\frac{16\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$

$\mathcal{T}_{0^+}^{\#1}$ ↦ $\mathcal{T}_{0^+}^{\#1\,\dagger}$: $-\frac{16\,(35+6\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$

$\mathcal{T}_{0^+}^{\#2}$ ↦ $\mathcal{T}_{0^+}^{\#2\,\dagger}$: $-\frac{8\,\sqrt{2}\,(22+3\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$

$\Delta_{0^-}^{\#1}$ ↦ $\Delta_{0^-}^{\#1\,\dagger}$: $-\frac{2}{a_0}$

$\Gamma_{0^+}^{\#1\,\alpha\beta}$ ↦ $\Gamma_{0^+}^{\#1\,\dagger\,\alpha\beta}$: $-\frac{a_0}{4}$

$\Gamma_{0^+}^{\#2\,\alpha\beta}$ ↦ $\Gamma_{0^+}^{\#2\,\dagger\,\alpha\beta}$: $-\frac{a_0}{2\,\sqrt{2}}$

$\Gamma_{0^+}^{\#3\,\alpha\beta}$ ↦ $\Gamma_{0^+}^{\#3\,\dagger\,\alpha\beta}$: $\frac{a_0}{4}$

$\Gamma_{0^-}^{\#1\,\alpha\beta\chi}$ ↦ $\Gamma_{0^-}^{\#1\,\dagger\,\alpha\beta\chi}$: $-\frac{2}{a_0}$

$\Delta_{0^+}^{\#1}$ ↦ $\Delta_{0^+}^{\#1\,\dagger}$: 0

$\Delta_{0^+}^{\#2}$ ↦ $\Delta_{0^+}^{\#2\,\dagger}$: $\frac{4\,\sqrt{6}}{16\,a_0+3\,a_0\,k^2}$

$\Delta_{0^+}^{\#3}$ ↦ $\Delta_{0^+}^{\#3\,\dagger}$: $-\frac{144}{a_0\,(16+3\,k^2)^2}$

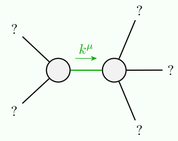
$\Delta_{0^+}^{\#4}$ ↦ $\Delta_{0^+}^{\#4\,\dagger}$: $\frac{16\,(19+3\,k^2)}{a_0\,(16+3\,k^2)^2}$

$\mathcal{T}_{0^+}^{\#1}$ ↦ $\mathcal{T}_{0^+}^{\#1\,\dagger}$: $-\frac{16\,(35+6\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$

$\mathcal{T}_{0^+}^{\#2}$ ↦ $\mathcal{T}_{0^+}^{\#2\,\dagger}$: $-\frac{8\,\sqrt{2}\,(22+3\,k^2)}{3\,a_0\,(16+3\,k^2)^2}$

$\Delta_{0^-}^{\#1}$ ↦ $\Delta_{0^-}^{\#1\,\dagger}$: $-\frac{2}{a_0}$

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

$a_0 < 0$