Particle spectrograph

Wave operator and propagator

	$\Delta_{1^-}^{\#1}{}_{\alpha}$	$\Delta_{1^-}^{\#2}{}_{\alpha}$	$\Delta_{1^-}^{\#3}{}_{\alpha}$	$\Delta_{1^-}^{\#4}{}_{\alpha}$	$\Delta_{1^-}^{\#5}{}_{\alpha}$	$\Delta_{1^-}^{\#6}{}_{\alpha}$	$\mathcal{T}_{1^-}^{\#1}{}_{\alpha}$
$\Delta_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0	0	0
$\Delta_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0	0	0
$\Delta_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	0	0	0	0	0
$\Delta_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$-\frac{2k^2}{\sqrt{3}\,a_0\,(2+k^2)}$	0	$-\frac{2k^2}{\sqrt{3}\,a_0\,(2+k^2)}$	0	$\frac{\sqrt{\frac{2}{3}}\,k^2}{a_0\,(2+k^2)}$	0	$-\frac{2i\sqrt{2}\,k}{a_0\,(2+k^2)}$
$\Delta_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	$\frac{k^2\,(2+k^2)}{2\sqrt{6}\,a_0\,(2+k^2)^2}$	$\frac{\sqrt{\frac{5}{6}}\,k^2}{4a_0+2a_0k^2}$	$-\frac{\sqrt{\frac{5}{6}}\,k^2}{4a_0+2a_0k^2}$	$\frac{k^2}{\sqrt{6}\,a_0\,(2+k^2)}$	$\frac{k^2\,(5+2k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$	$-\frac{k^2}{\sqrt{6}\,a_0\,(2+k^2)}$	$-\frac{ik\,(4+k^2)}{a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	$-\frac{76+52k^2+3k^4}{12a_0\,(2+k^2)^2}$	$\frac{\sqrt{5}\,(10+3k^2)}{12a_0\,(2+k^2)}$	$\frac{1}{12a_0}$	$\frac{\sqrt{5}\,(10+3k^2)}{12a_0\,(2+k^2)}$	$\frac{-2+k^2}{3\sqrt{2}\,a_0\,(2+k^2)^2}$	$\frac{1}{-2a_0-\frac{8a_0}{2+3k^2}}$	$\frac{ik\,(6+5k^2)}{\sqrt{6}\,a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	$-\frac{2k^2}{3a_0\,(2+k^2)^2}$	$\frac{\sqrt{5}\,k^2}{12a_0\,(2+k^2)}$	$-\frac{\sqrt{5}}{6a_0+3a_0k^2}$	$-\frac{\sqrt{5}}{6a_0}$	$\frac{2\,(17+14k^2+3k^4)}{3a_0\,(2+k^2)^2}$	$-\frac{\sqrt{5}}{6a_0}$	$\frac{i\sqrt{5}\,k}{a_0\,(2+k^2)}$
$\Delta_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	$\frac{-2+k^2}{3\sqrt{2}\,a_0\,(2+k^2)^2}$	$-\frac{\sqrt{2}}{6a_0+3a_0k^2}$	$\frac{1}{-2a_0-\frac{8a_0}{2+3k^2}}$	$-\frac{\sqrt{\frac{2}{3}}\,k^2}{6a_0+3a_0k^2}$	$\frac{k^2\,(5+2k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$	$-\frac{\sqrt{2}\,(7+3k^2)}{3a_0\,(2+k^2)}$	$-\frac{2ik\,(3+k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	$-\frac{ik\,(6+5k^2)}{\sqrt{6}\,a_0\,(2+k^2)^2}$	$\frac{i\sqrt{5}\,k}{2a_0+a_0k^2}$	$-\frac{ik\,(6+5k^2)}{\sqrt{6}\,a_0\,(2+k^2)^2}$	$\frac{i\sqrt{\frac{5}{6}}\,k}{2a_0+a_0k^2}$	$-\frac{ik\,(3+k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$	$\frac{i\sqrt{\frac{2}{3}}\,k}{a_0\,(2+k^2)}$	$\frac{2k^2}{a_0\,(2+k^2)^2}$
$\mathcal{T}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	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	0	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$
$\Delta_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{\sqrt{2}\,(4+k^2)}{a_0\,(2+k^2)}$	$\frac{(4+k^2)^2}{2a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{2k^2}{\sqrt{3}\,a_0\,(2+k^2)}$	$\frac{k^2\,(-2+k^2)}{2\sqrt{6}\,a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{2k^2}{3a_0\,(2+k^2)}$	$-\frac{\sqrt{\frac{5}{6}}\,k^2}{4a_0+2a_0k^2}$
$\Delta_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{\sqrt{\frac{2}{3}}\,k^2}{2a_0+a_0k^2}$	$\frac{k^2\,(5+2k^2)}{\sqrt{3}\,a_0\,(2+k^2)^2}$
$\Delta_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	0	0	0	0	$-\frac{k^2}{\sqrt{6}\,(2a_0+a_0k^2)}$
$\mathcal{T}_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	$\frac{2i\sqrt{2}\,k}{2a_0+a_0k^2}$	$\frac{ik\,(4+k^2)}{a_0\,(2+k^2)^2}$

	$\Delta_{0^+}^{\#1}$	$\Delta_{0^+}^{\#2}$	$\Delta_{0^+}^{\#3}$	$\Delta_{0^+}^{\#4}$	$\mathcal{T}_{0^+}^{\#1}$	$\mathcal{T}_{0^+}^{\#2}$	$\Delta_{0^-}^{\#1}$
$\Delta_{0^+}^{\#1}{}^{\dagger}$	0	$\frac{4\sqrt{6}}{16a_0+3a_0k^2}$	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0k^2}$	$-\frac{8}{\sqrt{3}\,(16a_0+3a_0k^2)}$	$-\frac{2i\sqrt{2}}{a_0\,k}$	$-\frac{2i\sqrt{6}\,k}{16a_0+3a_0k^2}$	0
$\Delta_{0^+}^{\#2}{}^{\dagger}$	$\frac{4\sqrt{6}}{16a_0+3a_0k^2}$	$-\frac{144}{a_0\,(16+3k^2)^2}$	$\frac{16\,(19+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{8\sqrt{2}\,(10+3k^2)}{a_0\,(16+3k^2)^2}$	$\frac{8i\sqrt{3}}{16a_0\,k+3a_0\,k^3}$	$\frac{72ik}{a_0\,(16+3k^2)^2}$	0
$\Delta_{0^+}^{\#3}{}^{\dagger}$	$-\frac{4\sqrt{\frac{2}{3}}}{16a_0+3a_0k^2}$	$\frac{16\,(19+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{16\,(35+6k^2)}{3a_0\,(16+3k^2)^2}$	$\frac{8\sqrt{2}\,(22+3k^2)}{3a_0\,(16+3k^2)^2}$	$\frac{8i}{\sqrt{3}\,(16a_0\,k+3a_0\,k^3)}$	$\frac{8ik\,(19+3k^2)}{a_0\,(16+3k^2)^2}$	0
$\Delta_{0^+}^{\#4}{}^{\dagger}$	$-\frac{8}{\sqrt{3}\,(16a_0+3a_0k^2)}$	$\frac{8\sqrt{2}\,(10+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{8\sqrt{2}\,(22+3k^2)}{3a_0\,(16+3k^2)^2}$	$\frac{32\,(13+3k^2)}{3a_0\,(16+3k^2)^2}$	$\frac{4i\sqrt{2}\,k\,(10+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{4i\sqrt{2}\,k\,(10+3k^2)}{a_0\,(16+3k^2)^2}$	0
$\mathcal{T}_{0^+}^{\#1}{}^{\dagger}$	$\frac{2i\sqrt{2}}{a_0\,k}$	$-\frac{72ik}{a_0\,(16+3k^2)^2}$	$\frac{8ik\,(19+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{8i}{\sqrt{3}\,(16a_0\,k+3a_0\,k^3)}$	$\frac{4\sqrt{3}}{16a_0+3a_0k^2}$	$-\frac{36k^2}{a_0\,(16+3k^2)^2}$	$\frac{4}{a_0\,k^2}$
$\mathcal{T}_{0^+}^{\#2}{}^{\dagger}$	$\frac{2i\sqrt{6}\,k}{16a_0+3a_0k^2}$	$-\frac{72ik}{a_0\,(16+3k^2)^2}$	$\frac{8ik\,(19+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{4i\sqrt{2}\,k\,(10+3k^2)}{a_0\,(16+3k^2)^2}$	$-\frac{36k^2}{a_0\,(16+3k^2)^2}$	$\frac{4\sqrt{3}}{16a_0+3a_0k^2}$	0
$\Delta_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{2}{a_0}$

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

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

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

$\Gamma_{3^-}^{\#1}{}^{\dagger}{}^{\alpha\beta\chi}$

	$\Gamma_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{2^+}^{\#3}{}_{\alpha\beta}$	$h_{2^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{2^-}^{\#1}{}_{\alpha\beta\chi}$	$\Gamma_{2^-}^{\#2}{}_{\alpha\beta\chi}$
$\Gamma_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{a_0}{4}$	0	0	$\frac{ia_0k}{4\sqrt{2}}$	0	0
$\Gamma_{2^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	$-\frac{a_0}{2}$	0	$\frac{ia_0k}{4\sqrt{3}}$	0	0
$\Gamma_{2^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{a_0}{4}$	$-\frac{ia_0k}{4\sqrt{6}}$	0	0
$h_{2^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{ia_0k}{4\sqrt{2}}$	$-\frac{ia_0k}{4\sqrt{3}}$	$\frac{ia_0k}{4\sqrt{6}}$	0	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	$\frac{a_0}{4}$

Source constraints/gauge generators

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

	$\Gamma_{1^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{1^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{1^+}^{\#3}{}_{\alpha\beta}$	$\Gamma_{1^-}^{\#1}{}_{\alpha}$	$\Gamma_{1^-}^{\#2}{}_{\alpha}$	$\Gamma_{1^-}^{\#3}{}_{\alpha}$	$\Gamma_{1^-}^{\#4}{}_{\alpha}$	$\Gamma_{1^-}^{\#5}{}_{\alpha}$	$\Gamma_{1^-}^{\#6}{}_{\alpha}$	$h_{1^-}^{\#1}{}_{\alpha}$
$\Gamma_{1^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{a_0}{4}$	$-\frac{a_0}{2\sqrt{2}}$	0	$-\frac{a_0}{4}$	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	$-\frac{ia_0k}{4\sqrt{2}}$
$\Gamma_{1^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{a_0}{2\sqrt{2}}$	0	0	$\frac{a_0}{2\sqrt{2}}$	0	0	0	0	0	0
$\Gamma_{1^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{a_0}{4}$	0	0	0	0	0	0	$\frac{ia_0k}{4\sqrt{6}}$
$\Gamma_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0	0	0	0	0	$-\frac{ia_0k}{4\sqrt{2}}$
$\Gamma_{1^-}^{\#2}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0	0	$\frac{\sqrt{5}\,a_0}{6}$	0	0	0
$\Gamma_{1^-}^{\#3}{}^{\dagger}{}^{\alpha}$	0	0	0	$-\frac{a_0}{4}$	$\frac{a_0}{2\sqrt{2}}$	0	$-\frac{a_0}{3}$	$\frac{\sqrt{5}\,a_0}{6}$	$\frac{a_0}{3}$	$-\frac{1}{4}\,i\,\sqrt{5}\,a_0\,k$
$\Gamma_{1^-}^{\#4}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0	0	$\frac{a_0}{3}$	$-\frac{1}{6}\,\sqrt{\frac{5}{2}}\,a_0$	$\frac{a_0}{6\sqrt{2}}$	$\frac{ia_0k}{4\sqrt{3}}$
$\Gamma_{1^-}^{\#5}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0	0	$\frac{\sqrt{5}\,a_0}{6}$	$-\frac{1}{6}\,\sqrt{\frac{5}{2}}\,a_0$	$-\frac{\sqrt{5}\,a_0}{6}$	$\frac{1}{4}\,i\,\sqrt{\frac{5}{6}}\,a_0\,k$
$\Gamma_{1^-}^{\#6}{}^{\dagger}{}^{\alpha}$	0	0	0	0	0	0	$\frac{a_0}{3}$	$-\frac{a_0}{6\sqrt{2}}$	$-\frac{a_0}{6}$	$-\frac{ia_0k}{4\sqrt{6}}$
$h_{1^-}^{\#1}{}^{\dagger}{}^{\alpha}$	$\frac{ia_0k}{4\sqrt{2}}$	0	$\frac{ia_0k}{4\sqrt{6}}$	0	$\frac{ia_0k}{4\sqrt{3}}$	$\frac{ia_0k}{4\sqrt{6}}$	0	$-\frac{1}{4}\,i\,\sqrt{\frac{5}{6}}\,a_0\,k$	$\frac{ia_0k}{4\sqrt{6}}$	0

Quadratic (free) action

$S == \iiiint (\frac{1}{4}$

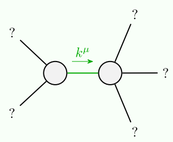
$(2\,a_0\,\Gamma^{\alpha}{}_{\alpha}{}^{\beta}\,\Gamma^{\chi}{}_{\beta\chi} + 4\,h^{\alpha\beta}\,\mathcal{T}_{\alpha\beta} + \Gamma^{\alpha\beta\chi}\,(-2\,a_0\,\Gamma_{\beta\chi\alpha} + 4\,\Delta_{\alpha\beta\chi}) - a_0\,h^{\chi}{}_{\chi}\,\partial_{\beta}\Gamma^{\alpha}{}_{\alpha}{}^{\beta} +$

$a_0\,h^{\chi}{}_{\chi}\,\partial_{\beta}\Gamma^{\alpha\beta}{}_{\alpha} - 2\,a_0\,h_{\alpha\chi}\,\partial_{\beta}\Gamma^{\alpha\beta\chi} + 2\,a_0\,h_{\beta\chi}\,\partial^{\chi}\Gamma^{\alpha}{}_{\alpha}{}^{\beta}))[t,\,x,\,y,\,z]\,dz\,dy\,dx\,dt$

	$\Gamma_{0^+}^{\#1}{}_{\alpha\beta}$	$\Gamma_{0^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{0^+}^{\#3}{}_{\alpha\beta}$	$\Gamma_{0^+}^{\#4}{}_{\alpha\beta}$	$h_{0^+}^{\#1}{}_{\alpha\beta}$	$h_{0^+}^{\#2}{}_{\alpha\beta}$	$\Gamma_{0^-}^{\#1}$
$\Gamma_{0^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$-\frac{a_0}{2}$	0	0	0	$-\frac{ia_0k}{2\sqrt{2}}$	0	0
$\Gamma_{0^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{a_0}{2}$	$-\frac{a_0}{2\sqrt{2}}$	0	$-\frac{1}{4}\,i\,a_0\,k$	0
$\Gamma_{0^+}^{\#3}{}^{\dagger}{}^{\alpha\beta}$	0	$\frac{a_0}{2}$	0	$-\frac{a_0}{2\sqrt{2}}$	$\frac{ia_0k}{4\sqrt{3}}$	0	0
$\Gamma_{0^+}^{\#4}{}^{\dagger}{}^{\alpha\beta}$	0	$-\frac{a_0}{2\sqrt{2}}$	$-\frac{a_0}{2\sqrt{2}}$	$\frac{a_0}{2}$	$-\frac{ia_0k}{4\sqrt{6}}$	0	0
$h_{0^+}^{\#1}{}^{\dagger}{}^{\alpha\beta}$	$\frac{ia_0k}{2\sqrt{2}}$	0	$-\frac{ia_0k}{4\sqrt{3}}$	$\frac{ia_0k}{4\sqrt{6}}$	0	0	0
$h_{0^+}^{\#2}{}^{\dagger}{}^{\alpha\beta}$	0	0	$\frac{ia_0k}{4}$	$-\frac{ia_0k}{4\sqrt{2}}$	0	0	0
$\Gamma_{0^-}^{\#1}{}^{\dagger}$	0	0	0	0	0	0	$-\frac{a_0}{2}$

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

Massive and massless spectra



Quadratic pole

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

(No massive particles)

Unitarity conditions

$a_0 < 0$