Particle spectrograph

Wave operator and propagator

	$\sigma_{1^+\,\alpha\beta}^{\#2}$	$\sigma_{1^+\,\alpha\beta}^{\#1}$	$\tau_{1^+\,\alpha\beta}^{\#1}$	$\sigma_{1^-\,\alpha}^{\#1}$	$\sigma_{1^-\,\alpha}^{\#2}$	$\tau_{1^-\,\alpha}^{\#1}$	$\tau_{1^-\,\alpha}^{\#2}$
$\sigma_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$\frac{2\,i\,\sqrt{2}}{(\alpha_0-4\,\beta_1)\,(1+k^2)}$	0	$\frac{2\,i\,\sqrt{2}\,k}{(\alpha_0-4\,\beta_1)\,(1+k^2)}$	$-\frac{4\,i\,k}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)}$	$-\frac{2\,\sqrt{2}}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)}$	0	0
$\sigma_{1^+}^{\#2\,\dagger\,\alpha\beta}$	$\frac{2\,\sqrt{2}}{(\alpha_0-4\,\beta_1)\,(1+k^2)}$	$\frac{2\,\sqrt{2}}{(\alpha_0-4\,\beta_1)\,(1+k^2)}$	$-\frac{2\,i\,k}{(\alpha_0-4\,\beta_1)\,(1+k^2)^2}$	$-\frac{2\,i\,\sqrt{2}\,k}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	$-\frac{2}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	0	0
$\tau_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$\frac{2\,i\,\sqrt{2}\,k}{(\alpha_0-4\,\beta_1)\,(1+k^2)}$	$\frac{2\,i\,k}{(\alpha_0-4\,\beta_1)\,(1+k^2)^2}$	$\frac{2\,k^2}{(\alpha_0-4\,\beta_1)\,(1+k^2)^2}$	$-\frac{4\,i\,k}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	$-\frac{2\,i\,\sqrt{2}\,k}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	0	$-\frac{4\,k^2}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$
$\sigma_{1^+}^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$\sigma_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	0	$-\frac{2\,\sqrt{2}}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)}$	0	0
$\sigma_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	0	$-\frac{2}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	0	0
$\tau_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$\tau_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	0	$-\frac{2\,i\,\sqrt{2}\,k}{(\alpha_0-4\,\beta_1)\,(1+2\,k^2)^2}$	0	0

	$\omega_{1^+\,\alpha\beta}^{\#1}$	$\omega_{1^+\,\alpha\beta}^{\#2}$	$f_{1^+\,\alpha\beta}^{\#1}$	$\omega_{1^-\,\alpha}^{\#1}$	$\omega_{1^-\,\alpha}^{\#2}$	$f_{1^-\,\alpha}^{\#1}$	$f_{1^-\,\alpha}^{\#2}$
$\omega_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$\frac{1}{4}\,(\alpha_0-4\,\beta_1)$	$\frac{\alpha_0-4\,\beta_1}{2\,\sqrt{2}}$	$-\frac{i\,(\alpha_0-4\,\beta_1)\,k}{2\,\sqrt{2}}$	0	0	0	0
$\omega_{1^+}^{\#2\,\dagger\,\alpha\beta}$	$\frac{\alpha_0-4\,\beta_1}{2\,\sqrt{2}}$	0	0	0	0	0	0
$f_{1^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{i\,(\alpha_0-4\,\beta_1)\,k}{2\,\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	$-\frac{1}{2}\,i\,(\alpha_0-4\,\beta_1)\,k$	0	0	0
$\omega_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	$-\frac{\alpha_0-4\,\beta_1}{2\,\sqrt{2}}$	0	0	0
$f_{1^-}^{\#1\,\dagger\,\alpha}$	0	0	0	0	0	0	0
$f_{1^-}^{\#2\,\dagger\,\alpha}$	0	0	0	0	0	0	$\frac{1}{2}\,i\,(\alpha_0-4\,\beta_1)\,k$

	$\omega_{0^+}^{\#1}$	$f_{0^+}^{\#1}$	$f_{0^+}^{\#2}$	$\omega_{0^-}^{\#1}$
$\omega_{0^+}^{\#1\,\dagger}$	$\frac{1}{2}\,(\alpha_0-4\,\beta_1)$	$-\frac{i\,(\alpha_0-4\,\beta_1)\,k}{\sqrt{2}}$	0	0
$f_{0^+}^{\#1\,\dagger}$	$\frac{i\,(\alpha_0-4\,\beta_1)\,k}{\sqrt{2}}$	$-4\,\beta_1\,k^2$	0	0
$f_{0^+}^{\#2\,\dagger}$	0	0	0	0
$\omega_{0^-}^{\#1\,\dagger}$	0	0	0	$\frac{\alpha_0}{2}-2\,\beta_1+\alpha_3\,k^2$

	$\sigma_{2^+\,\alpha\beta}^{\#1}$	$\tau_{2^+\,\alpha\beta}^{\#1}$	$\sigma_{2^-\,\alpha\beta\chi}^{\#1}$
$\sigma_{2^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{16\,\beta_1}{\alpha_0^2-4\,\alpha_0\,\beta_1}$	$-\frac{2\,i\,\sqrt{2}}{\alpha_0\,k}$	0
$\tau_{2^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{2\,i\,\sqrt{2}}{\alpha_0\,k}$	$\frac{2}{\alpha_0\,k^2}$	0
$\sigma_{2^-}^{\#1\,\dagger\,\alpha\beta\chi}$	0	0	$\frac{1}{-\frac{\alpha_0}{4}+\beta_1}$

	$\omega_{2^+\,\alpha\beta}^{\#1}$	$f_{2^+\,\alpha\beta}^{\#1}$	$\omega_{2^-\,\alpha\beta\chi}^{\#1}$
$\omega_{2^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{\alpha_0}{4}+\beta_1$	$\frac{i\,(\alpha_0-4\,\beta_1)\,k}{2\,\sqrt{2}}$	0
$f_{2^+}^{\#1\,\dagger\,\alpha\beta}$	$-\frac{i\,(\alpha_0-4\,\beta_1)\,k}{2\,\sqrt{2}}$	$2\,\beta_1\,k^2$	0
$\omega_{2^-}^{\#1\,\dagger\,\alpha\beta\chi}$	0	0	$-\frac{\alpha_0}{4}+\beta_1$

	$\sigma_{0^+}^{\#1}$	$\tau_{0^+}^{\#1}$	$\tau_{0^+}^{\#2}$	$\sigma_{0^-}^{\#1}$
$\sigma_{0^+}^{\#1\,\dagger}$	$\frac{8\,\beta_1}{\alpha_0^2-4\,\alpha_0\,\beta_1}$	$-\frac{i\,\sqrt{2}}{\alpha_0\,k}$	0	0
$\tau_{0^+}^{\#1\,\dagger}$	$\frac{i\,\sqrt{2}}{\alpha_0\,k}$	$-\frac{1}{\alpha_0\,k^2}$	0	0
$\tau_{0^+}^{\#2\,\dagger}$	0	0	0	0
$\sigma_{0^-}^{\#1\,\dagger}$	0	0	0	$\frac{2}{\alpha_0-4\,\beta_1+2\,\alpha_3\,k^2}$

Source constraints/gauge generators

SO(3) irreps	Multiplicities
$\tau_{0^+}^{\#2}==0$	1
$\tau_{1^-}^{\#2\,\alpha}+2\,i\,k\,\sigma_{1^-}^{\#2\,\alpha}==0$	3
$\tau_{1^-}^{\#1\,\alpha}==0$	3
$\tau_{1^+}^{\#1\,\alpha\beta}+i\,k\,\sigma_{1^+}^{\#2\,\alpha\beta}==0$	3
Total constraints:	10

Quadratic (free) action

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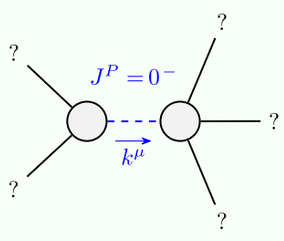
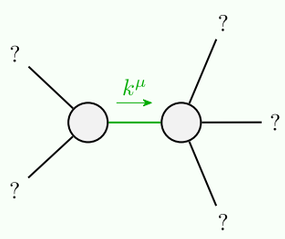
$$\int\int\int\int(f^{\alpha\beta}\,\tau_{\alpha\beta}+\omega^{\alpha\beta\chi}\,\sigma_{\alpha\beta\chi}-\frac{1}{2}\,\alpha_0\,(\omega_{\alpha\chi\beta}\,\omega^{\alpha\beta\chi}+\omega^{\alpha\beta}{}_{\alpha}\,\omega_{\beta}{}^{\chi}{}_{\chi}+2\,f^{\alpha\beta}\,\partial_\beta\omega_{\alpha}{}^{\chi}{}_{\chi}-2\,\partial_\beta\omega^{\alpha\beta}{}_{\alpha}-2\,f^{\alpha\beta}\,\partial_\chi\omega_{\alpha}{}^{\chi}{}_{\beta}+2\,f^{\alpha}{}_{\alpha}\,\partial_\chi\omega^{\beta\chi}{}_{\beta})+\beta_1\,(2\,\omega^{\alpha\beta}{}_{\alpha}\,\omega_{\beta}{}^{\chi}{}_{\chi}-4\,\omega_{\alpha}{}^{\chi}{}_{\chi}\,\partial_\beta f^{\alpha\beta}+4\,\omega_{\beta}{}^{\chi}{}_{\chi}\,\partial^\beta f^{\alpha}{}_{\alpha}-2\,\partial_\beta f^{\chi}{}_{\chi}\,\partial^\beta f^{\alpha}{}_{\alpha}-2\,\partial_\beta f^{\alpha\beta}\,\partial_\chi f_{\alpha}{}^{\chi}+4\,\partial^\beta f^{\alpha}{}_{\alpha}\,\partial_\chi f_{\beta}{}^{\chi}-2\,\partial_\alpha f_{\beta\chi}\,\partial^\chi f^{\alpha\beta}-\partial_\alpha f_{\chi\beta}\,\partial^\chi f^{\alpha\beta}+\partial_\beta f_{\alpha\chi}\,\partial^\chi f^{\alpha\beta}+\partial_\chi f_{\alpha\beta}\,\partial^\chi f^{\alpha\beta}+\partial_\chi f_{\beta\alpha}\,\partial^\chi f^{\alpha\beta}+2\,\omega_{\alpha\chi\beta}\,(\omega^{\alpha\beta\chi}+2\,\partial^\chi f^{\alpha\beta}))+\frac{1}{3}\,\alpha_3\,(4\,\partial_\beta\omega_{\alpha\chi\delta}-2\,\partial_\beta\omega_{\alpha\delta\chi}+2\,\partial_\beta\omega_{\chi\delta\alpha}-\partial_\chi\omega_{\alpha\beta\delta}+\partial_\delta\omega_{\alpha\beta\chi}-2\,\partial_\delta\omega_{\alpha\chi\beta})\,\partial^\delta\omega^{\alpha\beta\chi})[t,x,y,z]\,dz\,dy\,dx\,dt$$

Massive and massless spectra



Massive particle

Pole residue:	$-\frac{1}{\alpha_3}>0$
Polarisations:	1
Square mass:	$-\frac{\alpha_0-4\,\beta_1}{2\,\alpha_3}>0$
Spin:	0
Parity:	Odd



Quadratic pole

Pole residue:	$\frac{1}{\alpha_0}>0$
Polarisations:	2

Unitarity conditions

$\alpha_0>0$ && $\alpha_3<0$ && $\beta_1<\frac{\alpha_0}{4}$