

Particle spectrograph

Wave operator and propagator

	$\omega_{2^{+}\alpha\beta}^{\#1}$	$f_{2^{+}\alpha\beta}^{\#1}$	$\omega_{2^{-}\alpha\beta\chi}^{\#1}$
$\omega_{2^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{t_1}{2}$	$-\frac{ik t_1}{\sqrt{2}}$	0
$f_{2^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{ik t_1}{\sqrt{2}}$	$k^2 t_1$	0
$\omega_{2^{-}}^{\#1}\dagger^{\alpha\beta\chi}$	0	0	$k^2 r_1 + \frac{t_1}{2}$

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\tau_{0^{+}}^{\#2} == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == 0$	1
$\tau_{0^{+}}^{\#1} == 0$	$\partial_\beta \partial_\alpha \tau^{\alpha\beta} == \partial_\beta \partial^\beta \tau^\alpha_\alpha$	1
$\tau_1^{\#2\alpha} + 2\,i\,k\,\sigma_1^{\#2\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^X \partial_\beta \tau^{\alpha\beta} + 2\,\partial_\delta \partial^\delta \partial_\chi \partial_\beta \sigma^{\alpha\beta\chi}$	3
$\tau_1^{\#1\alpha} == 0$	$\partial_\chi \partial_\beta \partial^\alpha \tau^{\beta\chi} == \partial_\chi \partial^X \partial_\beta \tau^{\beta\alpha}$	3
$\tau_{1^{+}}^{\#1\alpha\beta} + i\,k\,\sigma_{1^{+}}^{\#2\alpha\beta} == 0$	$\partial_\chi \partial^\alpha \tau^{\beta\chi} + \partial_\chi \partial^\beta \tau^{\chi\alpha} + \partial_\chi \partial^X \tau^{\alpha\beta} +$ $2\,\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 2\,\partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} ==$ $\partial_\chi \partial^\alpha \tau^{\chi\beta} + \partial_\chi \partial^\beta \tau^{\alpha\chi} +$ $\partial_\chi \partial^X \tau^{\beta\alpha} + 2\,\partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\tau_{2^{+}}^{\#1\alpha\beta} - 2\,i\,k\,\sigma_{2^{+}}^{\#1\alpha\beta} == 0$	$-i\,(4\,\partial_\delta \partial_\chi \partial^\beta \partial^\alpha \tau^{\chi\delta} + 2\,\partial_\delta \partial^\delta \partial^\beta \partial^\alpha \tau^\chi_\chi -$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\beta\chi} - 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\alpha \tau^{\chi\beta} -$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\alpha\chi} - 3\,\partial_\delta \partial^\delta \partial_\chi \partial^\beta \tau^{\chi\alpha} +$ $3\,\partial_\delta \partial^\delta \partial_\chi \partial^X \tau^{\alpha\beta} + 3\,\partial_\delta \partial^\delta \partial_\chi \partial^X \tau^{\beta\alpha} +$ $4\,i\,k^X\,\partial_\epsilon \partial_\chi \partial^\beta \partial^\alpha \sigma^{\delta\epsilon}_\delta -$ $6\,i\,k^X\,\partial_\epsilon \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\delta\epsilon} -$ $6\,i\,k^X\,\partial_\epsilon \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\delta\epsilon} +$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \tau^{\chi\delta} +$ $6\,i\,k^X\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\alpha\delta\beta} +$ $6\,i\,k^X\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial_\chi \sigma^{\beta\delta\alpha} -$ $2\,\eta^{\alpha\beta}\,\partial_\epsilon \partial^\epsilon \partial_\delta \partial^\delta \tau^\chi_\chi -$ $4\,i\,\eta^{\alpha\beta}\,k^X\,\partial_\phi \partial^\phi \partial_\epsilon \partial_\chi \sigma^{\delta\epsilon}_\delta) == 0$	5
Total constraints/gauge generators:		16

	$\tau_{1^{-}\alpha}^{\#2}$	$\tau_{1^{-}\alpha}^{\#1}$	$\sigma_{1^{-}\alpha}^{\#2}$	$\sigma_{1^{-}\alpha}^{\#1}$	$\tau_{1^{+}\alpha\beta}^{\#1}$	$\sigma_{1^{+}\alpha\beta}^{\#2}$	$\sigma_{1^{+}\alpha\beta}^{\#1}$
$\sigma_{1^{+}}^{\#1}\dagger^{\alpha\beta}$	0	0	0	0	$-\frac{i\sqrt{2}\,k}{t_1+k^2\,t_1}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$	0
$\sigma_{1^{+}}^{\#2}\dagger^{\alpha\beta}$	0	0	0	0	$\frac{-2\,ik^3\,(2\,r_3+r_5)+ik\,t_1}{(1+k^2)^2\,t_1^2}$	$\frac{-2\,k^2\,(2\,r_3+r_5)+t_1}{(1+k^2)^2\,t_1^2}$	$-\frac{\sqrt{2}}{t_1+k^2\,t_1}$
$\tau_{1^{+}}^{\#1}\dagger^{\alpha\beta}$	0	0	0	0	$\frac{-2\,k^4\,(2\,r_3+r_5)+k^2\,t_1}{(1+k^2)^2\,t_1^2}$	$\frac{i\,(2\,k^3\,(2\,r_3+r_5)+k\,t_1)}{(1+k^2)^2\,t_1^2}$	$\frac{i\sqrt{2}\,k}{t_1+k^2\,t_1}$
$\sigma_{1^{+}}^{\#1}\dagger^\alpha$	$\frac{i}{k\,(1+2\,k^2)\,(r_1-2\,r_3\cdot r_5)}$	0	$\frac{1}{\sqrt{2}\,(k^2+2\,k^4)\,(r_1-2\,r_3\cdot r_5)}$	$\frac{1}{k^2\,(-r_1+2\,r_3+r_5)}$	0	0	0
$\sigma_{1^{+}}^{\#2}\dagger^\alpha$	$\frac{i\,(6\,k^2\,(r_1-2\,r_3\cdot r_5)+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,(r_1-2\,r_3\cdot r_5)\,t_1}$	0	$\frac{1}{-r_1+2\,r_3+r_5}+\frac{6\,k^2}{2\,(k+2\,k^3)^2}$	$\frac{1}{\sqrt{2}\,(k^2+2\,k^4)\,(r_1-2\,r_3\cdot r_5)}$	0	0	0
$\tau_{1^{+}}^{\#1}\dagger^\alpha$	0	0	0	0	0	0	0
$\tau_{1^{+}}^{\#2}\dagger^\alpha$	$\frac{1}{-r_1+2\,r_3+r_5}+\frac{6\,k^2}{(1+2\,k^2)^2}$	0	$-\frac{i\,(6\,k^2\,(r_1-2\,r_3\cdot r_5)+t_1)}{\sqrt{2}\,k\,(1+2\,k^2)^2\,(r_1-2\,r_3\cdot r_5)\,t_1}$	$\frac{i}{k\,(1+2\,k^2)\,(-r_1+2\,r_3+r_5)}$	0	0	0

	$\omega_{1^{+}\alpha\beta}^{\#1}$	$\omega_{1^{+}\alpha\beta}^{\#2}$	$f_{1^{+}\alpha\beta}^{\#1}$	$\omega_{1^{-}\alpha}^{\#1}$	$\omega_{1^{-}\alpha}^{\#2}$	$f_{1^{-}\alpha}^{\#1}$	$f_{1^{-}\alpha}^{\#2}$
$\omega_{1^{+}}^{\#1}\dagger^{\alpha\beta}$	$k^2\,(2\,r_3+r_5)-\frac{t_1}{2}$	$-\frac{t_1}{\sqrt{2}}$	$-\frac{ik\,t_1}{\sqrt{2}}$	0	0	0	0
$\omega_{1^{+}}^{\#2}\dagger^{\alpha\beta}$	$-\frac{t_1}{\sqrt{2}}$	0	0	0	0	0	0
$f_{1^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{ik\,t_1}{\sqrt{2}}$	0	0	0	0	0	0
$\omega_{1^{-}}^{\#1}\dagger^\alpha$	0	0	0	$k^2\,(-r_1+2\,r_3+r_5)+\frac{t_1}{6}$	$\frac{t_1}{3\sqrt{2}}$	0	$\frac{ik\,t_1}{3}$
$\omega_{1^{-}}^{\#2}\dagger^\alpha$	0	0	0	$\frac{t_1}{3\sqrt{2}}$	$\frac{t_1}{3}$	0	$\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$
$f_{1^{-}}^{\#1}\dagger^\alpha$	0	0	0	0	0	0	0
$f_{1^{-}}^{\#2}\dagger^\alpha$	0	0	0	$-\frac{1}{3}\,i\,k\,t_1$	$-\frac{1}{3}\,i\,\sqrt{2}\,k\,t_1$	0	$\frac{2\,k^2\,t_1}{3}$

Quadratic (free) action

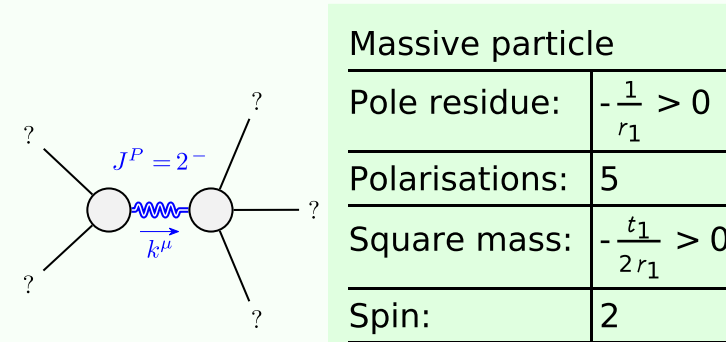
$$S = \iiint \big( f^{\alpha\beta} \tau_{\alpha\beta} + \omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} +$$
$$\frac{1}{6} t_1 (2 \omega^{\alpha\iota}_\alpha \omega^\theta_{\iota\theta} - 4 \omega^\theta_\alpha \partial_\iota f^{\alpha\iota} + 4 \omega^\theta_{\iota\theta} \partial_\iota f^\alpha_\alpha - 2 \partial_\iota f^\theta_\theta$$
$$\partial^\iota f^\alpha_\alpha - 2 \partial_\iota f^{\alpha\iota} \partial_\theta f^\theta_\theta + 4 \partial^\iota f^\alpha_\alpha \partial_\theta f^\theta_{\iota\theta} - 6 \partial_\theta f_{\alpha\iota} \partial^\theta f^{\alpha\iota} -$$
$$3 \partial_\theta f_{\theta\iota} \partial^\theta f^{\alpha\iota} + 3 \partial_\iota f_{\alpha\theta} \partial^\theta f^{\alpha\iota} + 3 \partial_\theta f_{\alpha\iota} \partial^\theta f^{\alpha\iota} +$$
$$3 \partial_\theta f_{\iota\alpha} \partial^\theta f^{\alpha\iota} + 6 \omega_{\alpha\theta\iota} (\omega^{\alpha\iota\theta} + 2 \partial^\theta f^{\alpha\iota})) -$$
$$2 r_3 (\partial_\beta \omega_{\iota\theta} \partial^\iota \omega^{\alpha\beta}_\alpha + \partial_\iota \omega_{\beta\theta} \partial^\iota \omega^{\alpha\beta}_\theta + \partial_\alpha \omega^{\alpha\beta\iota}_\alpha + \partial_\alpha \omega^{\alpha\beta\iota}_{\beta\theta} -$$
$$2 \partial^\iota \omega^{\alpha\beta}_\alpha \partial_\theta \omega_{\beta\iota} + \partial_\alpha \omega^{\alpha\beta\iota}_{\beta\theta} \partial_\theta \omega_{\iota\beta} -$$
$$2 \partial^\iota \omega^{\alpha\beta}_{\alpha\theta} \partial_\theta \omega_{\iota\beta} + 2 \partial_\beta \omega_{\iota\theta} \partial^\theta \omega^{\alpha\beta\iota}_\alpha) +$$
$$\frac{2}{3} r_1 (3 \partial_\beta \omega_{\iota\theta} \partial^\iota \omega^{\alpha\beta}_\alpha + 3 \partial_\iota \omega_{\beta\theta} \partial^\iota \omega^{\alpha\beta}_\theta + 3 \partial_\alpha \omega^{\alpha\beta\iota}_\alpha \partial_\theta \omega_{\beta\iota} -$$
$$6 \partial^\iota \omega^{\alpha\beta}_{\alpha\theta} \partial_\theta \omega_{\beta\iota} + 3 \partial_\alpha \omega^{\alpha\beta\iota}_{\beta\theta} \partial_\theta \omega_{\iota\beta} - 6 \partial^\iota \omega^{\alpha\beta}_{\alpha\theta} \partial_\theta \omega_{\iota\beta} -$$
$$2 \partial_\beta \omega_{\alpha\theta} \partial^\theta \omega^{\alpha\beta\iota}_\alpha + \partial_\beta \omega_{\alpha\theta\iota} \partial^\theta \omega^{\alpha\beta\iota}_\alpha + 2 \partial_\beta \omega_{\iota\theta\alpha} \partial^\theta \omega^{\alpha\beta\iota}_\alpha -$$
$$\partial_\iota \omega_{\alpha\theta\beta} \partial^\theta \omega^{\alpha\beta\iota}_\alpha + \partial_\theta \omega_{\alpha\beta\iota} \partial^\theta \omega^{\alpha\beta\iota}_\alpha + \partial_\theta \omega_{\alpha\beta} \partial^\theta \omega^{\alpha\beta\iota}_\alpha) +$$
$$r_5 (\partial_\iota \omega_{\theta\kappa} \partial^\theta \omega^{\alpha\iota}_\alpha - \partial_\theta \omega_{\iota\kappa} \partial^\theta \omega^{\alpha\iota}_\alpha - (\partial_\alpha \omega^{\alpha\iota\theta} - 2 \partial^\theta \omega^{\alpha\iota}_\alpha)$$
$$(\partial_\chi \omega_{\iota\theta} - \partial_\chi \omega_{\theta\iota})) [t, x, y, z] dz dy dx dt$$

	$\sigma_{0^{+}}^{\#1}$	$\tau_{0^{+}}^{\#1}$	$\tau_{0^{+}}^{\#2}$	$\sigma_0^{\#1}$
$\sigma_{0^{+}}^{\#1}\dagger$	$\frac{1}{6\,k^2\,(-r_1+r_3)}$	0	0	0
$\tau_{0^{+}}^{\#1}\dagger$	0	0	0	0
$\tau_{0^{+}}^{\#2}\dagger$	0	0	0	0
$\sigma_0^{\#1}\dagger$	0	0	0	$-\frac{1}{t_1}$

	$\sigma_{2^{+}\alpha\beta}^{\#1}$	$\tau_{2^{+}\alpha\beta}^{\#1}$	$\sigma_{2^{-}\alpha\beta\chi}^{\#1}$
$\sigma_{2^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{2}{(1+2\,k^2)^2\,t_1}$	$-\frac{2\,i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	0
$\tau_{2^{+}}^{\#1}\dagger^{\alpha\beta}$	$\frac{2\,i\,\sqrt{2}\,k}{(1+2\,k^2)^2\,t_1}$	$\frac{4\,k^2}{(1+2\,k^2)^2\,t_1}$	0
$\sigma_{2^{+}}^{\#1}\dagger^{\alpha\beta\chi}$	0	0	$\frac{2}{2\,k^2\,r_1+t_1}$

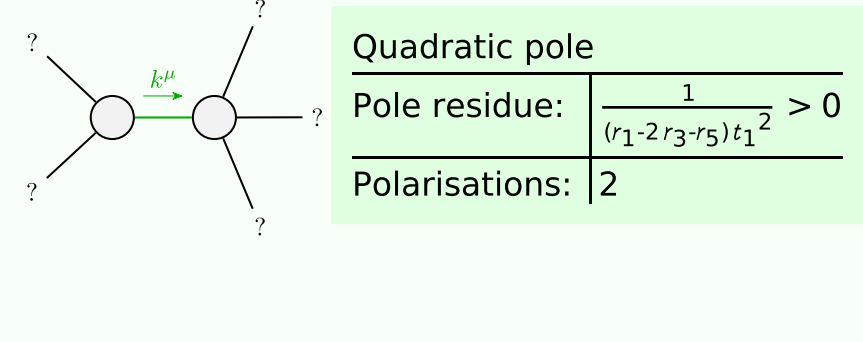
	$f_{0^{+}}^{\#1}$	$f_{0^{+}}^{\#2}$	$\omega_0^{\#1}$
$\omega_0^{\#1}\dagger$	0	0	0
$f_{0^{+}}^{\#1}\dagger$	0	0	0
$f_{0^{+}}^{\#2}\dagger$	0	0	0
$\omega_0^{\#1}\dagger$	$6\,k^2\,(-r_1+r_3)$	0	$-t_1$

Massive and massless spectra



Massive particle

Pole residue:	$-\frac{1}{r_1} > 0$
Polarisations:	5
Square mass:	$-\frac{t_1}{2r_1} > 0$
Spin:	2
Parity:	Odd



Quadratic pole

Pole residue:	$\frac{1}{(r_1-2\,r_3\cdot r_5)\,t_1^2} > 0$
Polarisations:	2

Unitarity conditions

$r_1 < 0 \ \&\& \ r_5 < r_1 - 2\,r_3 \ \&\& \ t_1 > 0$