

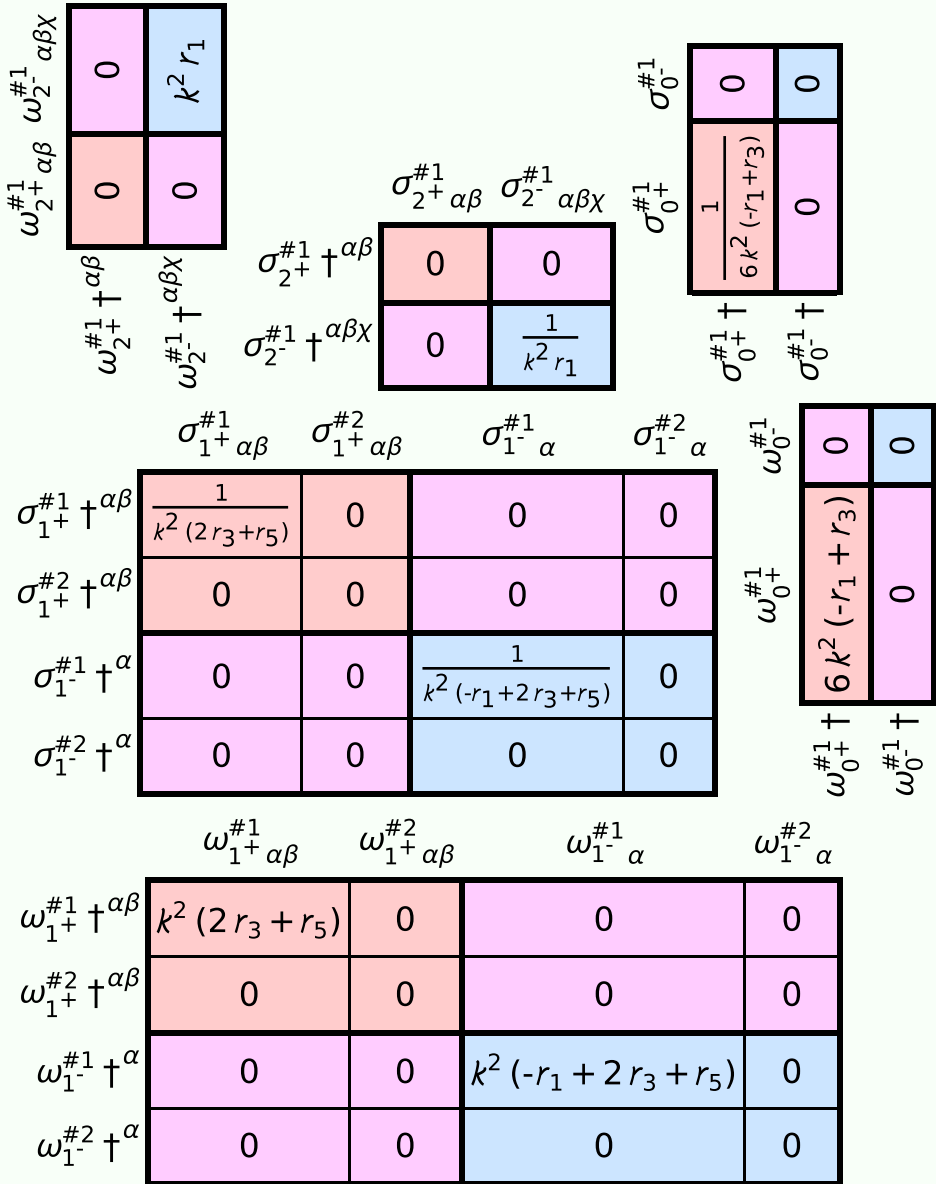
# Particle spectrograph

## Wave operator and propagator

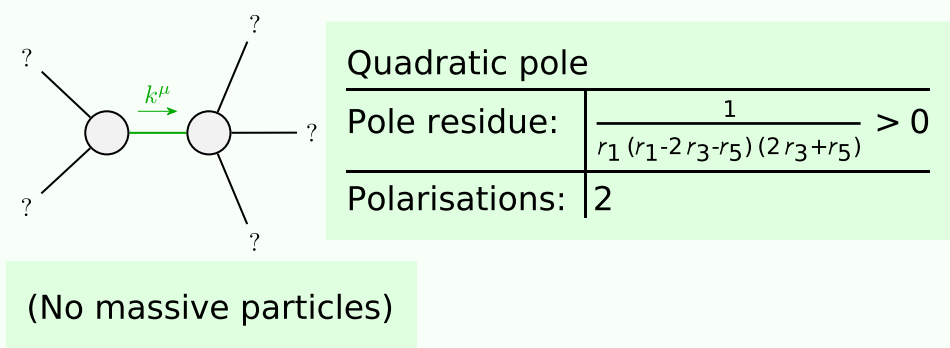
Quadratic (free) action

$$S = \iiint (\omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 2r_3 (\partial_\beta \omega^\theta_{\phantom{\theta}\theta} \partial'_1 \omega^{\alpha\beta}_\alpha + \partial_1 \omega^\theta_{\phantom{\theta}\theta} \partial'_\beta \omega^{\alpha\beta}_\alpha + \partial_\alpha \omega^{\alpha\beta 1}_\beta - 2 \partial'_1 \omega^{\alpha\beta}_\alpha \partial_\theta \omega^\theta_{\phantom{\theta}\theta} + \partial_\alpha \omega^{\alpha\beta 1}_\beta \partial_\theta \omega^\theta_{\phantom{\theta}\theta} + 2 \partial'_1 \omega^{\alpha\beta}_\alpha \partial_\theta \omega^\theta_{\phantom{\theta}\theta} + 2 \partial_\beta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha) + \frac{2}{3} r_1 (3 \partial_\beta \omega^\theta_{\phantom{\theta}\theta} \partial'_1 \omega^{\alpha\beta}_\alpha + 3 \partial_1 \omega^\theta_{\phantom{\theta}\theta} \partial'_\beta \omega^{\alpha\beta}_\alpha + 3 \partial_\alpha \omega^{\alpha\beta 1}_\beta \partial_\theta \omega^\theta_{\phantom{\theta}\theta} - 6 \partial'_1 \omega^{\alpha\beta}_\alpha \partial_\theta \omega^\theta_{\phantom{\theta}\theta} + 3 \partial_\alpha \omega^{\alpha\beta 1}_\beta \partial_\theta \omega^\theta_{\phantom{\theta}\theta} - 6 \partial'_1 \omega^{\alpha\beta}_\alpha \partial_\theta \omega^\theta_{\phantom{\theta}\theta} + 2 \partial_\beta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha + \partial_\beta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha + 2 \partial_\beta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha - \partial_1 \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha + \partial_\theta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha + \partial_\theta \omega_{\phantom{\theta}\theta} \partial^\theta \omega^{\alpha\beta 1}_\alpha) + r_5 (\partial_1 \omega^\kappa_{\phantom{\kappa}\kappa} \partial^\theta \omega^{\alpha 1}_\alpha - \partial_\theta \omega^\kappa_{\phantom{\kappa}\kappa} \partial^\theta \omega^{\alpha 1}_\alpha - (\partial_\alpha \omega^{\alpha 1 \theta}_\alpha - 2 \partial^\theta \omega^{\alpha 1}_\alpha) (\partial_\kappa \omega^\kappa_{\phantom{\kappa}\kappa} - \partial_\kappa \omega^\kappa_{\phantom{\kappa}\kappa})) [t, x, y, z] dz dy dx dt$$

Source constraints		
SO(3) irreps	Fundamental fields	Multiplicities
$\sigma_0^{1-} == 0$	$\epsilon \eta_{\alpha\beta\chi\delta} \partial^\delta \sigma^{\alpha\beta\chi} == 0$	1
$\sigma_1^{2\alpha} == 0$	$\partial_\chi \partial_\beta \sigma^{\alpha\beta\chi} == 0$	3
$\sigma_1^{2\alpha\beta} == 0$	$\partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + \partial_\delta \partial^\delta \partial_\chi \sigma^{\alpha\beta\chi} == \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta}$	3
$\sigma_2^{1\alpha\beta} == 0$	$3 \partial_\delta \partial_\chi \partial^\alpha \sigma^{\beta\chi\delta} + 3 \partial_\delta \partial_\chi \partial^\beta \sigma^{\alpha\chi\delta} + 2 \eta^{\alpha\beta} \partial_\epsilon \partial^\epsilon \partial_\delta \sigma^{\chi\delta} == \partial_\chi \partial^\epsilon \partial_\delta \sigma^{\beta\chi\alpha}$	5
Total constraints/gauge generators:		12



## Massive and massless spectra



## Unitarity conditions

$r_1 < 0 \&\& (r_5 < r_1 - 2r_3 \parallel r_5 > -2r_3) \parallel r_1 > 0 \&\& -2r_3 < r_5 < r_1 - 2r_3$