

Particle spectrograph

Wave operator and propagator

Quadratic (free) action

S_F==

∫∫∫((1/6(4t3ω^α{}_iω^κ{}_καω^κ{}_i+2t2ω^κλ{}_iω^κλ{}_i+6f^α{}_βτ_αβ+6ω^αβχσ_αβχ+9r3∂_iω^κλ{}_κ∂'ω^α{}_λ{}_α+4r2∂^βω^α{}_κ∂_θω^κ{}_αβ-2r2∂_θω^κ{}_αβ∂_κω^αβθ-4r2∂_θω^κ{}_αβ∂_κω^θαβ+15r3∂_αω^α{}_λ{}_θ∂_κω^κλ{}_α-15r3∂_θω^α{}_λ{}_α∂_κω^θκλ{}_α+9r3∂_αω^α{}_λ{}_θ∂_κω^κλ{}_α-18r3∂_θω^α{}_λ{}_α∂_κω^κλ{}_θ+t2∂^αf_θκ∂^αf_α-2t2∂^αf_κ∂^κf_α+t2∂^αf_λ∂^κf_αλ-4t3ω^α{}_κα∂^κf'_i-4t3ω^κλ{}_κλ∂^κf'_i-8t3∂^αf_κ∂^κf'_i+4t3∂_κf_λ∂^κf'_i+2t2ω_θκ∂^κf'^θ-4t2ω_ικ∂^κf'^θ-2t2ω_θικ∂^κf'^θ+4t2ω_θκi∂^κf'^θ+4t3ω_ια∂^α∂^κf'_κ+4t3ω_ιλ∂^λ∂^κf'_κ-t2∂^αf_κ∂^κf_λα-t2∂_κf_θ^λ∂^κf_λ^θ+t2∂_κf_θ^λ∂^κf_λ^θ+4t3∂_θf_λ^λ∂^κf_λ^θ+4t3∂^αf_α∂^κf_λκ+2r2∂_κω^αβθ∂^κω_αβθ+4r2∂_κω^θαβ∂^κω_αβθ-4r2∂^βω_ι^αλ∂_λω_αβ^ι+4r2∂^βω_ι^λ∂_λω_αβ^ι-24r3∂^βω_ι^λ∂_λω_αβ^ι-15r3∂_αω_λ^α∂^λω_κ^κ+15r3∂_θω_λ^α∂^λω_κ^κ))[t,x,y,z]dzdydxdt

$\sigma_1^{#1} \dagger \alpha \beta$	$\sigma_1^{#2} \dagger \alpha \beta$	$\tau_1^{#1} \dagger \alpha \beta$	$\sigma_1^{#1} \dagger \alpha$	$\sigma_1^{#2} \dagger \alpha$	$\tau_1^{#1} \dagger \alpha$	$\tau_1^{#2} \dagger \alpha$
$\sigma_1^{#1} \dagger \alpha \beta \frac{6}{(3+k^2)^2 t_2}$	$\frac{3 \sqrt{2}}{(3+k^2)^2 t_2} t_2$	$\frac{3 i \sqrt{2} k}{(3+k^2)^2 t_2} t_2$	0	0	0	0
$\sigma_1^{#2} \dagger \alpha \beta \frac{3 \sqrt{2}}{(3+k^2)^2 t_2} t_2$	$\frac{3}{(3+k^2)^2 t_2} t_2$	$\frac{3 i k}{(3+k^2)^2 t_2} t_2$	0	0	0	0
$\tau_1^{#1} \dagger \alpha \beta -\frac{3 i \sqrt{2} k}{(3+k^2)^2 t_2} t_2$	$-\frac{3 i k}{(3+k^2)^2 t_2} t_2$	$\frac{3 k^2}{(3+k^2)^2 t_2} t_2$	0	0	0	0
$\sigma_1^{#1} \dagger \alpha$	0	0	$-\frac{2}{3 k^2} r_3$	$-\frac{2 \sqrt{2}}{3 k^2 r_3+6 k^4} r_3$	0	$-\frac{4 i}{3 k r_3+6 k^3} r_3$
$\sigma_1^{#2} \dagger \alpha$	0	0	$-\frac{2 \sqrt{2}}{3 k^2 r_3+6 k^4} r_3$	$-\frac{9 k^2 r_3-4 t_3}{3(k+2 k^2)^2 r_3 t_3}$	0	$\frac{i \sqrt{2}(9 k^2 r_3-4 t_3)}{3 k(1+2 k^2)^2 r_3 t_3}$
$\tau_1^{#1} \dagger \alpha$	0	0	0	0	0	0
$\tau_1^{#2} \dagger \alpha$	0	0	$\frac{4 i}{3 k r_3+6 k^3} r_3$	$-\frac{i \sqrt{2}(9 k^2 r_3-4 t_3)}{3 k(1+2 k^2)^2 r_3 t_3}$	0	$\frac{2(9 k^2 r_3-4 t_3)}{3(1+2 k^2)^2 r_3 t_3}$

$\omega_1^{#1} \dagger \alpha \beta$	$\omega_1^{#2} \dagger \alpha \beta$	$f_1^{#1} \dagger \alpha \beta$	$\omega_1^{#1} \dagger \alpha$	$\omega_1^{#2} \dagger \alpha$	$f_1^{#1} \dagger \alpha$	$f_1^{#2} \dagger \alpha$
$\omega_1^{#1} \dagger \alpha \beta \frac{2 t_2}{3}$	$\frac{\sqrt{2} t_2}{3} t_2$	$\frac{1}{3} i \sqrt{2} k t_2$	0	0	0	0
$\omega_1^{#2} \dagger \alpha \beta \frac{\sqrt{2} t_2}{3} t_2$	$\frac{t_2}{3} t_2$	$\frac{i k t_2}{3} t_2$	0	0	0	0
$f_1^{#1} \dagger \alpha \beta -\frac{1}{3} i \sqrt{2} k t_2$	$-\frac{1}{3} i k t_2$	$\frac{k^2 t_2}{3} t_2$	0	0	0	0
$\omega_1^{#1} \dagger \alpha$	0	0	$\frac{1}{6}(-9 k^2 r_3+4 t_3)$	$-\frac{\sqrt{2} t_3}{3}$	0	$-\frac{2}{3} i k t_3$
$\omega_1^{#2} \dagger \alpha$	0	0	$-\frac{\sqrt{2} t_3}{3}$	$\frac{t_3}{3}$	0	$\frac{1}{3} i \sqrt{2} k t_3$
$f_1^{#1} \dagger \alpha$	0	0	0	0	0	0
$f_1^{#2} \dagger \alpha$	0	0	$\frac{2 i k t_3}{3}$	$-\frac{1}{3} i \sqrt{2} k t_3$	0	$\frac{2 k^2 t_3}{3}$

Source constraints/gauge generators

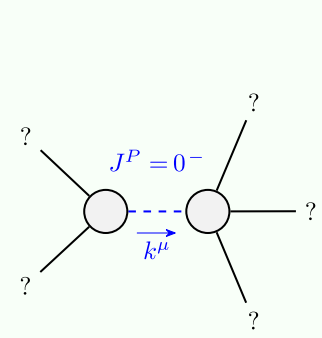
SO(3) irreps	Multiplicities
$\tau_0^{#2} == 0$	1
$\tau_0^{#1} - 2 i k \sigma_0^{#1} == 0$	1
$\tau_1^{#2 \alpha} + 2 i k \sigma_1^{#2 \alpha} == 0$	3
$\tau_1^{#1 \alpha} == 0$	3
$\tau_1^{#1 \alpha \beta} + i k \sigma_1^{#1 \alpha \beta} == 0$	3
$\sigma_1^{#1 \alpha \beta} == \sigma_1^{#2 \alpha \beta}$	3
$\sigma_2^{#1 \alpha \beta \chi} == 0$	5
$\tau_2^{#1 \alpha \beta} == 0$	5
Total constraints:	24

$\sigma_0^{#1}$	$\tau_0^{#1}$	$\tau_0^{#2}$	$\sigma_0^{#1}$
$\sigma_0^{#1} \dagger \frac{1}{(1+2 k^2)^2 t_3} t_3$	$-\frac{i \sqrt{2} k}{(1+2 k^2)^2 t_3} t_3$	0	0
$\tau_0^{#1} \dagger \frac{i \sqrt{2} k}{(1+2 k^2)^2 t_3} t_3$	$\frac{2 k^2}{(1+2 k^2)^2 t_3} t_3$	0	0
$\tau_0^{#2} \dagger$	0	0	0
$\sigma_0^{#1} \dagger$	0	0	$\frac{1}{k^2 r_2+t_2}$

$\sigma_{2+}^{#1} \dagger \alpha \beta$	$\tau_{2+}^{#1} \dagger \alpha \beta$	$\sigma_{2-}^{#1} \dagger \alpha \beta \chi$
$\sigma_{2+}^{#1} \dagger \alpha \beta -\frac{2}{3 k^2} r_3$	0	0
$\tau_{2+}^{#1} \dagger \alpha \beta$	0	0
$\sigma_{2-}^{#1} \dagger \alpha \beta \chi$	0	0

$\omega_{2+}^{#1} \dagger \alpha \beta$	$f_{2+}^{#1} \dagger \alpha \beta$	$\omega_{2-}^{#1} \dagger \alpha \beta \chi$
$\omega_{2+}^{#1} \dagger \alpha \beta -\frac{3 k^2 r_3}{2}$	0	0
$f_{2+}^{#1} \dagger \alpha \beta$	0	0
$\omega_{2-}^{#1} \dagger \alpha \beta \chi$	0	0

Massive and massless spectra



Massive particle	
Pole residue:	$-\frac{1}{r_2} > 0$
Polarisations:	1
Square mass:	$-\frac{t_2}{r_2} > 0$
Spin:	0
Parity:	Odd

(seipitred ssælsæw on)

Unitarity conditions

$r_2 < 0 \&\& t_2 > 0$