

Particle spectrograph

Wave operator and propagator

	$\sigma_{2^{+}\alpha\beta}^{\#1}$	$\tau_{2^{+}\alpha\beta}^{\#1}$	$\sigma_{2^{-1}\alpha\beta\chi}^{\#1}$		$\omega_{0^{+}}^{\#1}$	$f_{0^{+}}^{\#1}$	$f_{0^{+}}^{\#2}$	$\omega_{0^{-1}}^{\#1}$	
$\sigma_{2^{+}}^{\#1} \dagger^{\alpha\beta}$	$\frac{2}{(1+2k^2)^2 t_1}$	$-\frac{2i\sqrt{2}k}{(1+2k^2)^2 t_1}$	0		t_3	$-i\sqrt{2}kt_3$	0	0	
$\tau_{2^{+}}^{\#1} \dagger^{\alpha\beta}$	$\frac{2i\sqrt{2}k}{(1+2k^2)^2 t_1}$	$\frac{4k^2}{(1+2k^2)^2 t_1}$	0		$i\sqrt{2}kt_3$	$2k^2t_3$	0	0	
$\sigma_{2^{-1}}^{\#1} \dagger^{\alpha\beta\chi}$	0	0	$\frac{2}{t_1}$		0	0	0	$k^2r_2+t_2$	
				$\omega_{2^{+}\alpha\beta}^{\#1}$	$f_{2^{+}\alpha\beta}^{\#1}$	$\omega_{2^{-1}\alpha\beta\chi}^{\#1}$			
				$\omega_{2^{+}}^{\#1} \dagger^{\alpha\beta}$	$f_{2^{+}}^{\#1} \dagger^{\alpha\beta}$	$\omega_{2^{-1}}^{\#1} \dagger^{\alpha\beta\chi}$			
				$\frac{t_1}{2}$	$-\frac{ik t_1}{\sqrt{2}}$	$\frac{t_1}{2}$			
				$\frac{ikt_1}{\sqrt{2}}$	k^2t_1	0			
				0	0	0			

Quadratic (free) action

$$S = \int \int \int \left(\frac{1}{6} (2t_1 \omega_{\alpha}^{\alpha i} \omega_{\theta}^{\theta} - 4t_3 \omega_{\alpha}^{\alpha i} \omega_{\kappa}^{\kappa} + 6f^{\alpha\beta} \tau_{\alpha\beta} + 6\omega^{\alpha\beta\chi} \sigma_{\alpha\beta\chi} - 4t_1 \omega_{\alpha}^{\theta} \omega_{\alpha}^{\theta} \partial_{,f}^{\alpha i} + 8t_3 \omega_{\alpha}^{\kappa} \omega_{\kappa}^{\kappa} \partial_{,f}^{\alpha i} + 4t_1 \omega_{\theta}^{\theta} \omega_{\theta}^{\theta} \partial_{,f}^{\alpha} - 8t_3 \omega_{\kappa}^{\kappa} \omega_{\kappa}^{\kappa} \partial_{,f}^{\alpha} - 2t_1 \partial_{,f}^{\theta} \partial_{,f}^{\alpha} + 4t_3 \partial_{,f}^{\kappa} \partial_{,f}^{\alpha} - 2t_1 \partial_{,f}^{\alpha i} \partial_{\theta f}^{\theta} + 4t_1 \partial_{,f}^{\alpha} \partial_{\theta f}^{\theta} - 4t_1 \omega_{\theta\alpha} \partial^{\theta} f^{\alpha i} + 4t_2 \omega_{\theta\alpha} \partial^{\theta} f^{\alpha i} - 4t_1 \partial_{\alpha f} \partial^{\theta} f^{\alpha i} - t_2 \partial_{\alpha f} \partial^{\theta} f^{\alpha i} + 4t_1 \partial_{\theta f} \partial^{\theta} f^{\alpha i} + t_2 \partial_{\theta f} \partial^{\theta} f^{\alpha i} + 2t_1 \partial_{,f} \partial_{\theta f} \partial^{\theta} f^{\alpha i} - t_2 \partial_{,f} \partial_{\theta f} \partial^{\theta} f^{\alpha i} + 2(t_1 + t_2) \omega_{\alpha i \theta} (\omega^{\alpha i \theta} + 2 \partial^{\theta} f^{\alpha i}) + 2 \omega_{\alpha \theta i} ((t_1 - 2t_2) \omega^{\alpha i \theta} + 2 (2t_1 - t_2) \partial^{\theta} f^{\alpha i}) + 8r_2 \partial_{\beta} \omega_{\alpha i \theta} \partial^{\theta} \omega^{\alpha \beta i} - 4r_2 \partial_{\beta} \omega_{\alpha \theta i} \partial^{\theta} \omega^{\alpha \beta i} + 4r_2 \partial_{\beta} \omega_{i \theta \alpha} \partial^{\theta} \omega^{\alpha \beta i} - 2r_2 \partial_{,i} \omega_{\alpha \beta \theta} \partial^{\theta} \omega^{\alpha \beta i} + 2r_2 \partial_{\theta} \omega_{\alpha \beta i} \partial^{\theta} \omega^{\alpha \beta i} - 4r_2 \partial_{\theta} \omega_{\alpha i \beta} \partial^{\theta} \omega^{\alpha \beta i} + 4t_3 \partial_{,f}^{\alpha i} \partial_{\kappa f}^{\kappa} - 8t_3 \partial_{,f}^{\alpha} \partial_{\kappa f}^{\kappa}) [t, x, y, z] dz dy dx dt \right)$$

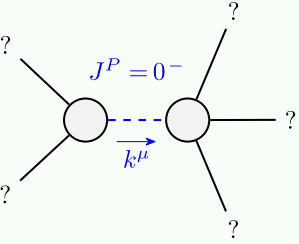
	$\sigma_{0^{+}}^{\#1}$	$\tau_{0^{+}}^{\#1}$	$\tau_{0^{+}}^{\#2}$	$\sigma_{0^{-1}}^{\#1}$
$\sigma_{0^{+}}^{\#1} \dagger$	$\frac{1}{(1+2k^2)^2 t_3}$	$-\frac{i\sqrt{2}k}{(1+2k^2)^2 t_3}$	0	0
$\tau_{0^{+}}^{\#1} \dagger$	$\frac{i\sqrt{2}k}{(1+2k^2)^2 t_3}$	$\frac{2k^2}{(1+2k^2)^2 t_3}$	0	0
$\tau_{0^{+}}^{\#2}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

	$\omega_{1^{+}\alpha\beta}^{\#1}$	$\omega_{1^{+}\alpha\beta}^{\#2}$	$f_{1^{+}\alpha\beta}^{\#1}$	$\omega_{1^{-1}\alpha}^{\#1}$	$\omega_{1^{-2}\alpha}^{\#2}$	$f_{1^{-1}\alpha}^{\#1}$	$f_{1^{-2}\alpha}^{\#2}$
$\omega_{1^{+}}^{\#1} \dagger^{\alpha\beta}$	$\frac{1}{6} (t_1 + 4t_2)$	$-\frac{t_1 - 2t_2}{3\sqrt{2}}$	$-\frac{ik(t_1 - 2t_2)}{3\sqrt{2}}$	0	0	0	0
$\omega_{1^{+}}^{\#2} \dagger^{\alpha\beta}$	$-\frac{t_1 - 2t_2}{3\sqrt{2}}$	$\frac{t_1 + t_2}{3}$	$\frac{1}{3} ik(t_1 + t_2)$	0	0	0	0
$f_{1^{+}}^{\#1} \dagger^{\alpha\beta}$	$\frac{ik(t_1 - 2t_2)}{3\sqrt{2}}$	$-\frac{1}{3} ik(t_1 + t_2)$	$\frac{1}{3} k^2(t_1 + t_2)$	0	0	0	0
$\omega_{1^{-1}}^{\#1} \dagger^{\alpha}$	0	0	0	$\frac{1}{6} (t_1 + 4t_3)$	$\frac{t_1 - 2t_3}{3\sqrt{2}}$	0	$\frac{1}{3} ik(t_1 - 2t_3)$
$\omega_{1^{-2}}^{\#2} \dagger^{\alpha}$	0	0	0	$\frac{t_1 - 2t_3}{3\sqrt{2}}$	$\frac{t_1 + t_3}{3}$	0	$\frac{1}{3} i\sqrt{2}k(t_1 + t_3)$
$f_{1^{-1}}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0	0
$f_{1^{-2}}^{\#2} \dagger^{\alpha}$	0	0	0	$-\frac{1}{3} ik(t_1 - 2t_3)$	$-\frac{1}{3} i\sqrt{2}k(t_1 + t_3)$	0	$\frac{2}{3} k^2(t_1 + t_3)$

Source constraints/gauge generators	
SO(3) irreps	Multiplicities
$\tau_{0^{+}}^{\#2} == 0$	1
$\tau_{0^{+}}^{\#1} - 2ik\sigma_{0^{+}}^{\#1} == 0$	1
$\tau_{1^{-}}^{\#2\alpha} + 2ik\sigma_{1^{-}}^{\#2\alpha} == 0$	3
$\tau_{1^{-}}^{\#1\alpha} == 0$	3
$\tau_{1^{+}}^{\#1\alpha\beta} + ik\sigma_{1^{+}}^{\#2\alpha\beta} == 0$	3
$\tau_{2^{+}}^{\#1\alpha\beta} - 2ik\sigma_{2^{+}}^{\#1\alpha\beta} == 0$	5
Total constraints:	16

	$\sigma_{1^{+}\alpha\beta}^{\#1}$	$\sigma_{1^{+}\alpha\beta}^{\#2}$	$\tau_{1^{+}\alpha\beta}^{\#1}$	$\sigma_{1^{-}\alpha}^{\#1}$	$\sigma_{1^{-}\alpha}^{\#2}$	$\tau_{1^{-}\alpha}^{\#1}$	$\tau_{1^{-}\alpha}^{\#2}$
$\sigma_{1^{+}}^{\#1} \dagger^{\alpha\beta}$	$\frac{2(t_1 + t_2)}{3t_1 t_2}$	$\frac{\sqrt{2}(t_1 - 2t_2)}{3(1 + k^2)t_1 t_2}$	$\frac{i\sqrt{2}k(t_1 - 2t_2)}{3(1 + k^2)t_1 t_2}$	0	0	0	0
$\sigma_{1^{+}}^{\#2} \dagger^{\alpha\beta}$	$\frac{\sqrt{2}(t_1 - 2t_2)}{3(1 + k^2)t_1 t_2}$	$\frac{t_1 + 4t_2}{3(1 + k^2)^2 t_1 t_2}$	$\frac{ik(t_1 + 4t_2)}{3(1 + k^2)^2 t_1 t_2}$	0	0	0	0
$\tau_{1^{+}}^{\#1} \dagger^{\alpha\beta}$	$-\frac{i\sqrt{2}k(t_1 - 2t_2)}{3(1 + k^2)t_1 t_2}$	$-\frac{ik(t_1 + 4t_2)}{3(1 + k^2)^2 t_1 t_2}$	$-\frac{k^2(t_1 + 4t_2)}{3(1 + k^2)^2 t_1 t_2}$	0	0	0	0
$\sigma_{1^{-}}^{\#1} \dagger^{\alpha}$	0	0	0	$\frac{2(t_1 + t_3)}{3t_1 t_3}$	$-\frac{\sqrt{2}(t_1 - 2t_3)}{3(1 + 2k^2)t_1 t_3}$	0	$-\frac{2ikt_1 - 4ikt_3}{3t_1 t_3 + 6k^2 t_1 t_3}$
$\sigma_{1^{-}}^{\#2} \dagger^{\alpha}$	0	0	0	0	0	0	$\frac{i\sqrt{2}k(t_1 + 4t_3)}{3(1 + 2k^2)^2 t_1 t_3}$
$\tau_{1^{-}}^{\#1} \dagger^{\alpha}$	0	0	0	0	0	0	0
$\tau_{1^{-}}^{\#2} \dagger^{\alpha}$	0	0	0	$\frac{2ikt_1 - 4ikt_3}{3t_1 t_3 + 6k^2 t_1 t_3}$	$-\frac{i\sqrt{2}k(t_1 + 4t_3)}{3(1 + 2k^2)^2 t_1 t_3}$	0	$\frac{2k^2(t_1 + 4t_3)}{3(1 + 2k^2)^2 t_1 t_3}$

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

(No massless particles)

Unitarity conditions

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