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ICISE



Massive boson

Class equation for free massive vector

$$(\square + M^2) B^\mu - \partial_\mu \partial^\nu B^\nu = 0.$$

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \frac{1}{2} M^2 B_\mu B^\mu$$

no gauge freedom $B^\mu \rightarrow B^\mu + \partial^\mu \chi$

but. $\partial_\mu B^\mu = 0.$

\rightarrow 4 components of B^μ - 1 condition $(\partial_\mu B^\mu) = 0$
 \parallel 3 components.

3 polariz. vectors for massive vector boson E_μ^i

Propagator

non span $(-k^2 + M^2) B^\mu - k^\mu k^\nu B_\nu$

inverse:

$$\frac{-g^{\mu\nu} + k^\mu k^\nu / M^2}{\cdot k^2 - M^2}$$

Propagator can only depend on $g^{\mu\nu}$ and $k^\mu k^\nu$
must be $A g^{\mu\nu} + B k^\mu k^\nu$
Verify

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} - \frac{1}{2\lambda} (\partial_\mu A^\mu)^2$$

gauge

$$\square A^\mu - \partial^\mu \partial_\nu A^\nu + \frac{1}{\lambda} \partial^\mu \partial_\nu A^\nu = 0$$

in momentum space

$$(-k^2 g^{\mu\nu} + (1 - \frac{1}{\lambda}) k^\mu k^\nu) A_\nu = 0$$

inverse:

$$\left(-g^{\mu\nu} + (1 - \frac{1}{\lambda}) \frac{k^\mu k^\nu}{k^2} \right) \frac{1}{k^2}$$

$G^{\mu\nu}$: propagator, $G^{\mu\nu} = \frac{-g^{\mu\nu}}{k^2}$

Any part
must be
m²







THANK YOU !