

10/11/06

$$S_{tot} = S + S_{g.f} + S_{ghost}$$

↓
gauge fixing term

Example :- Take the gauge fixing fr.

$$\mathcal{H}_A \rightarrow \partial_\mu A_\nu^a(x)$$

$$S_{tot} = -\frac{1}{4} \int d^4x F_{\mu\nu}^a(x) F^{\mu\nu a}(x) - \frac{1}{2\alpha} \int d^4x \partial^\mu A_\mu^a(x) \partial^\nu A_\nu^a(x) + \int d^4x b_a(x) \square x c_a(x) + g f^{abc} \int d^4x \partial^\mu b_a(x) A_\mu^b(x) c_c(x) + S_{fermion} + S_{scalar} + \text{coupling between fermions \& scalars}$$

$$F_{\mu\nu}^a = \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + g f^{abc} A_\mu^b A_\nu^c$$

Step 4 :- Count dimension of each term.

$$S_{free} = -\frac{1}{4} \int d^4x (\partial_\mu A_\nu^a - \partial_\nu A_\mu^a)^2$$

dimension 4

$\Rightarrow A_\nu^a$ has dimension 1.

Identify the term with no coupling constant then we can read out the dim. of the field

(The term $\int d^4x b_a(x) \square x c_a(x)$ tells us)

b_a has dimension $1 + \lambda$
 c_a has dimension $1 - \lambda$ } we'll choose $\lambda = 0$ (for convenience)

look at free fermion & free scalar action \rightarrow det. dim. of ϕ & ψ

this is allowed bcos everywhere we have the comb. of b_a & c_a together

α has dimension zero
 g has dimension zero

$$F_{\mu\nu}^c = \partial_\mu A_\nu^c - \partial_\nu A_\mu^c$$

+ $gf^{abc} A_\mu^a A_\nu^b$

$$F_{\mu\nu}^a F_{\mu\nu}^a = (\partial_\mu A_\nu^a - \partial_\nu A_\mu^a) (\partial^\mu A^{\nu a} - \partial^\nu A^{\mu a})$$

$$+ 2g f^{abc} (\partial_\mu A_\nu^c - \partial_\nu A_\mu^c) A^{\mu a} A^{\nu b}$$

$$+ g^2 f^{abc} f^{a'b'c'} A_\mu^a A_\nu^b A^{\mu a'} A^{\nu b'}$$

So g must have dim. zero
 \rightarrow every term should have same dim.

dim. of every op. ≤ 4

(Each term has dimension 4)

All terms have dimension 4 operators.

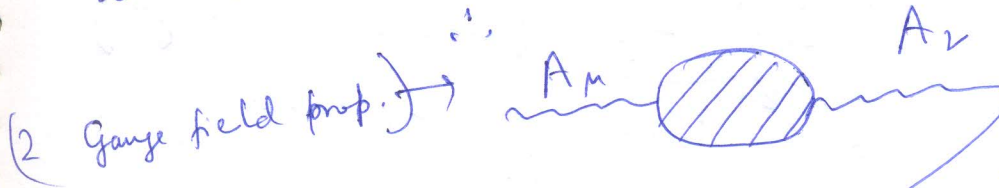
(Here all coupling constants have dim. ≥ 0
 \Rightarrow so all op. have dim. ≤ 4)

\rightarrow First condition of power counting renormalizability is satisfied.

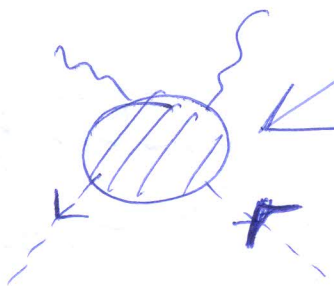
But terms like $\int d^4x A_\mu^a A^{\mu a}$

$\int d^4x b^{abcd} A_\mu^a A_\nu^b A^{\mu c} A^{\nu d}$
 x contraction of a, b, c, d
 (Kronecker delta or f^{abc})

are not there.



could have uncancelled divergence



could have uncancelled divergence

this has an intrinsic div. & not subdivergences which could be cancelled by other counter terms

