

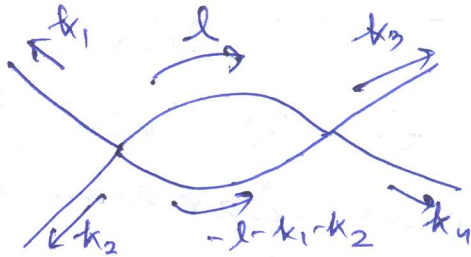
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① Regularization

② Renormalization

(Instead of treating the original parameters as the input parameters, we take the renormalized parameters)

In  $\phi^4$  th., we have 2 parameters  $\rightarrow \lambda$  &  $m$ .  
By adjusting finite no. of parameters we have to make infinite no. of quantities finite - remove a no. of div. - But we need to make a limited class of div. diag. conv.



$$\int \frac{d^4 l}{(2\pi)^4} \frac{1}{\{-l^2 - m^2 + i\epsilon\} \{-(k_1+k_2+l)^2 - m^2 + i\epsilon\}}$$

we get

$$\frac{(k_1+k_2+l)_\mu}{\{-(k_1+k_2+l)^2 - m^2 + i\epsilon\}^2}$$

$\frac{\partial}{\partial k_{1\mu}}$  act on this

this expression has the property that only the first term in the Taylor series expansion is finite; all other terms are divergent

6 powers of  $l$  in denominator & 5 powers of  $l$  in num - so it isn't div.

Regularization

Make infinite integrals finite with the help of a cut-off  $\epsilon$ .

As  $\epsilon \rightarrow 0$ , initially divergent integrals become divergent.

Consistency condition: - Initially finite integrals must approach their original values.

(otherwise you are changing the theory)

It's not that for every new  $k$  we have a new const. - you make it finite for one choice of ext. num., it will be finite for any other choice - so div. are not unrelated - so adjustment of a finite quantities is needed, though apparently naively we would have thought there were infinite no. of const. to be satisfied

Adding more loops don't increase the div. prop. of renormalizable th. -



But non-renormalizable th. - adds of more loops  $\uparrow$  div.

