BROOKHAVEN NATIONAL LABORATORY
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August 8, 1960

Dear Feza,

we have now completed the calculation of S^R with the discouraging result that after all the theory is <u>not</u> renormalizable in the usual sense. This conclusion probably agrees with what Salam states in a recent preprint though the proof he gives in a simplified case is rather obscure. Anyhow I will give you some of the relevant steps of the calculation so that you can check them + see how the argument goes. The self energy after subtraction of the self mass is

$$\Sigma_{ab} = \delta_{ab} F^R(A^2) + A_a A_b G^R(A^2)$$

F^R + G^R are obtained from the 2 first two terms of the original expression for Σ (the one

you have) by means of the table of integrals calculated by Lee . Their expression is

$$F^R(A^2) = \frac{ie}{(4\pi)^2} \int \frac{(A^2+m^2)A^2}{(A^2+M^2)M^2} \left[-5 + f + \frac{5}{6} f^2 + \frac{M^2}{m^2}\left(1 - \frac{f^2}{6}\right)\right] dM^2$$

$$G^R(A^2) = -\frac{ie}{(4\pi)^2} \int \frac{A^2+m^2}{(A^2+M^2)M^2} \left[2 + 5f - \frac{10}{3} f^2 + \frac{A^2}{m^2}\left(1 - \frac{f^2}{6}\right)\right] dM^2$$

$$f = 1 - \frac{m^2}{M^2}$$

$F^R + G^R$ differ from $F + G$ by a polynomial in A

With these expressions for $F^R + G^R$ you calculate S^R by means of the relation

$$S^R = S + iS\Sigma S$$

with $$S_{ab} = \frac{1}{A^2+m^2}\left(\delta_{ab} + \frac{A_a A_b}{m^2}\right)$$

After some calculations you get

$$S^R_{ab} = \frac{1}{A^2+m^2}\left(\delta_{ab} + \frac{A_a A_b}{m^2}\right)\left(1 + i\frac{F^R}{A^2+m^2}\right)$$

$$+ i\frac{A_a A_b}{m^4(A^2+m^2)}\left(F^R + (m^2+A^2)G^R\right)$$

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The asymptotic behaviour of S^R, retaining only the part proportional to δ_{ab} is then:

$$S^R, \rightarrow -\frac{e^2}{(4\pi)^2}\,\frac{5}{6}\,\frac{1}{m^2}\,\ln\frac{A^2}{m^2}$$

As you can see the conclusion is pretty discouraging: indeed the case $g=2$ does not even seem to be fundamentaly different from other cases although the symmetry of the interaction allows one to go one step further. We may go into some more details when we shall meet in Rochester + possibly go back to our earlier discussions about the interaction with fermions: in the light of these latest results, even that case seems however to require a great deal of care.

I hope you had a nice trip + you are enjoying your stay in Rochester. Best regard to Sua (I am trying to guess the spelling!). Au revoir

Yours Luigi Radicati
Luigi

L. A. Radicati
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