Northwestern University Department of Physics and Astronomy

PHYSICS 428-2 QUANTUM FIELD THEORY II

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Course Webpage: `http://www.hep.anl.gov/ian/teaching/QFTII/QFT_Winter09.html`

ASSIGNMENT #6

Due at 3 PM, February 16th

(One page and four problems.)

Reading Assignments:
Sections 10.4, 10.5, 12.2, and 12.3 of Peskin and Schroeder.

Problem 1
Explain why the renormalization of the two vertices in Problem 3 of last week's homework is different.
(Hint: you should go back to the reading assignments in last week's homework!)

Problem 2
Do Problem 10.2 in Peskin and Schroeder.

Problem 3
Do Problem 10.3 in Peskin and Schroeder.

Problem 4
In Dimensional Regularization we define the relation between the bare field ϕ_0 and the renormalized field as $\phi_0 = \mu^{-2\epsilon}\sqrt{Z_2}\phi_r(\mu)$, where we have made explicit the renormalization scale dependence in ϕ_r. Notice that in momentum-independent subtraction scheme such as the MS and $\overline{MS}$ the scaling factor is independent of μ. Suppose we now choose a different renormalization scale μ' in such a way that $\phi_0 = (\mu')^{-2\epsilon}\sqrt{Z_2}\phi_r(\mu')$, then it is clear that $\phi_r(\mu)$ and $\phi_r(\mu')$ differs by a finite renormalization: $\phi_r(\mu) = Z_f\phi_r(\mu')$, where Z_f is a finite scaling factor. Consider scalar fields only, use the LSZ reduction formula to prove that the S-matrix element is invariant under the change in the renormalization scale $\mu \to \mu'$.