February 9th, 2017

Assignment # 3

(due Thursday February 23rd, 2017)

1. Furry's theorem states that $\langle\Omega|T\left\{A_{\mu_1}(q_1)\cdots A_{\mu_n}(q_n)\right\}|\Omega\rangle = 0$ if n is odd, as a consequence of charge conjugation (C) invariance.

1.a) In scalar QED, charge conjugation exchanges ϕ and ϕ^*. How must A_μ transform so that the Lagrangian is invariant?

1.b) Prove Furry's theorem in scalar QED non-perturbatively using the path integral.

1.c) Does Furry's theorem hold if the photons are off-shell or just on-shell?

1.d) Prove Furry's theorem in QED using the path integral.

1.e) In the Standard Model, charge conjugation is violated by the weak interactions. Does your proof for correlation functions of photons still work in the Standard Model, or do you expect small violations of Furry's theorem?

2. Problem 12.1 of Peskin and Schroeder's book.