

1. First, a reading assignment: §6.1 and §6.4 of the *Peskin & Schroeder* textbook. Also, skim through §6.5 about multiple soft photons, real or virtual; never mind the techniques discussed in this section, but the results are important.
2. Second, consider “scalar QED”, the theory of EM field $A^\mu(x)$ coupled to a charged scalar field $\Phi(x)$,

$$\mathcal{L}_{\text{phys}} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + D^\mu\Phi^*D_\mu\Phi - M^2\Phi^*\Phi - \frac{\lambda}{4}\Phi^{*2}\Phi^2. \quad (1)$$

- (a) Spell out the Ward–Takahashi identities for this theory and prove them in terms of the Feynman diagrams.

Note: the hard part is to prove that the WT identities for the S_N amplitudes work at the tree level. After that, you can follow my arguments in class (for the ordinary QED) almost verbatim; to refresh your memory, see [my notes](#).

- (b) **Postponed to the next homework.**

Spell out the counterterms for the Scalar QED, then use the WT identities to relate the coefficients of *three* counterterms.